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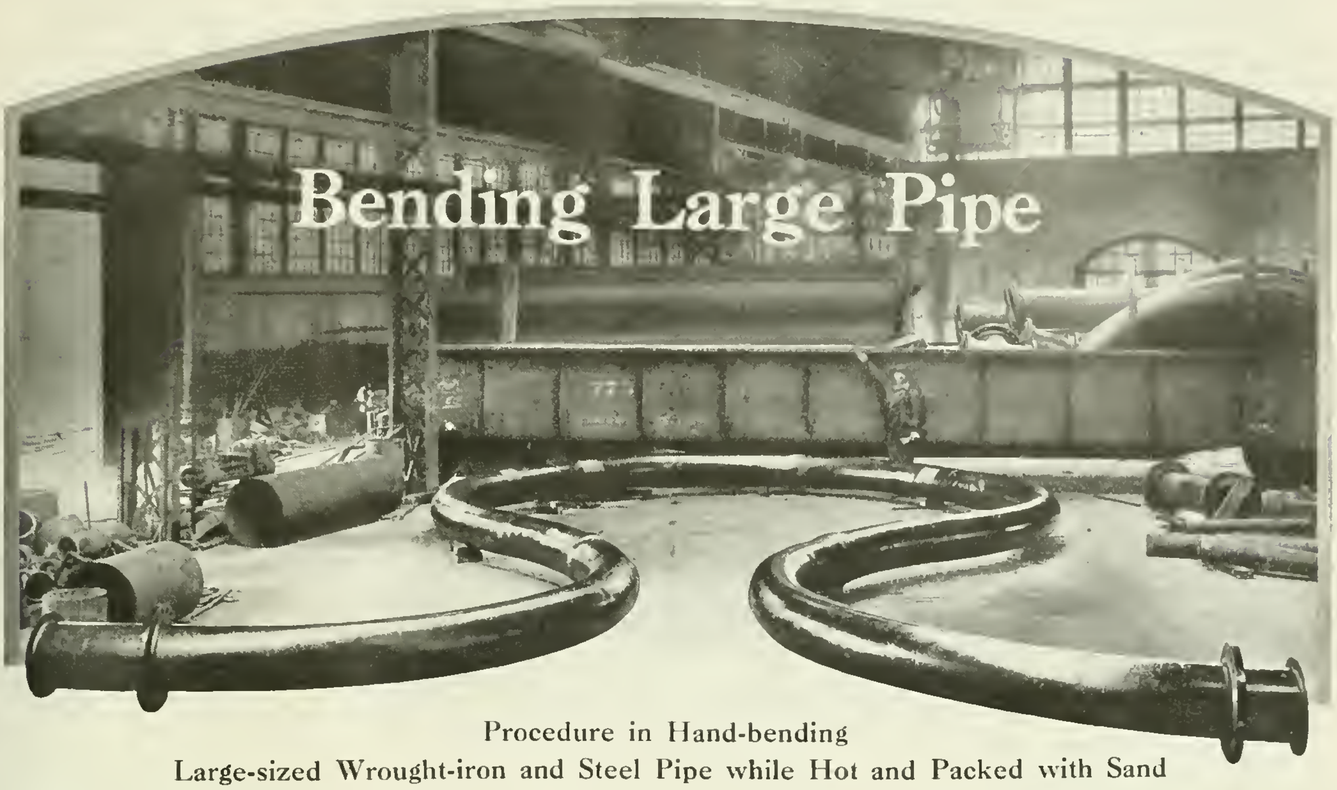


Bending Large Pipe

Procedure in Hand-bending Large-sized Wrought-iron and Steel Pipe while Hot and Packed with Sand

By CHARLES O. HERB

BENDING large wrought-iron and steel pipe is an art in which the success of the operation depends almost entirely upon the man in charge. The pipe is bent while hot, and therefore close attention and quick action are required to prevent flattening or bulging on the inside of the bend, fracture on the outside, the opening up of seams on butt-welded pipe, and other difficulties likely to arise while the work is in progress. Considerable experience is also necessary to properly supervise the steps preceding the actual bending. The present article mentions briefly the advantages of pipe bends over steel and cast-iron fittings when the direction of the pipe line must be altered, and describes the tools used and methods followed in bending large pipe by hand. Tables give the minimum and advisable radii for pipe bends and other information of value to the plant engineer. The illustrations, with the exception of Fig. 7, were obtained at the plant of the M. J. Dougherty Co., Philadelphia, Pa., and represent the practice of this company in bending pipe from 6 to 30 inches in nominal size.

In modern industrial plants, pipe bends are greatly preferred to steel or cast-iron fittings for a number of reasons. In the first place, the use of bands reduces the number of joints and eliminates much of the leakage common to fittings. U-bends also serve conveniently in long steam lines as a means of compensating for expansion and contraction of the pipe which result from changes in its temperature. Again, in conveying steam or fluids through piping, the velocity is reduced because of the friction between the fluid and the pipe. In the case of steam lines a high friction causes a greater percentage of condensation in the line and a drop in steam pressure. This is especially a vital factor about coal mines where steam is frequently conveyed 3000 feet from the boiler house to its place of application. Fittings contribute considerably to this reduction in velocity and pressure because of the friction caused by their necessarily small radii. It has been proved that the resistance met with in a 12-inch 90-degree elbow fitting is equivalent to the resistance offered by 40 feet of straight-length pipe of the same size. With pipe bends, however, the radii may be much larger than with fittings, and friction may be reduced to the minimum. Finally, pipe bends permit a cheaper and safer installation than fittings and are much neater.

Design of Bending Table, Blocks, Shoes, and Pins

The common practice is to bend heated pipe to shape around either shoes or pins located on a large table to suit the radius to which the pipe is to be bent. The two bending tables of the M. J. Dougherty Co. are 20 feet square, being constructed of two semi-steel castings, 9 inches thick. Each table weighs approximately 70 tons. The two sections are held together by fifteen 2-inch bolts and five steel forged keys which are dovetailed at both ends. In assembling the sections, the keys were heated and shrunk into dovetailed slots cored in the sections, thus insuring a rigid connection. The keys extend the full depth of the table and their

Pipe up to about 4 inches in nominal size can be bent while cold by employing machines designed for the purpose, but larger sizes must be heated for the operation. The general practice is to bend such pipe on a large table, employing a winch to pull the sand-packed, heated pipe to the required shape around blocks or pins. A great deal of skill is required to bend large pipe without obtaining any of the undesirable results common to this work.

cross-section is 12 inches long and 4 inches wide between the dovetails. The location of these keys may be observed in Fig. 2 which shows plan and end views of the table. The top and adjoining surfaces of the two sections are finished. The table is supported by three long concrete piers, one at each end and one at the center, to which it is anchored by two-inch foundation bolts. The working surface of the table is about 3½ feet above the floor level.

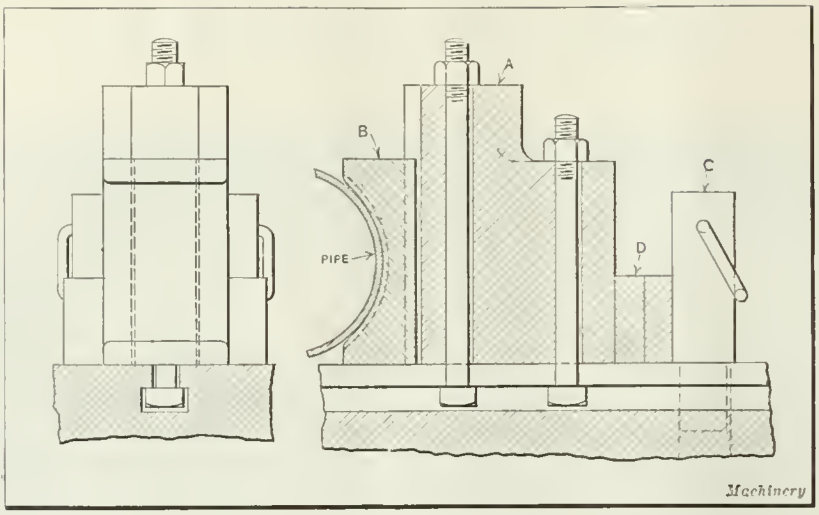


Fig. 1. A Bending Shoe and Method of attaching it to the Table shown in Fig. 2

The table has a hole at *A* from which a series of T-slots radiate to three sides of the table. These T-slots are 22½ degrees apart and serve as a means of attaching to the table, blocks against which the shoes previously mentioned are abutted. In back of hole *A* several parallel T-slots extend across the table. Spaced between all T-slots are a series of 3½-inch holes which receive the table pins. In addition to using these pins as an upright against which the pipe may be bent, they are also employed to prevent one end of the pipe from moving during an operation and to provide additional support to the blocks and shoes. The portion of these pins which extends above the table surface is about 4 inches in diameter.

The method of arranging a block and shoe for a job is illustrated in Fig. 1. Block *A* is clamped to the table the necessary distance from the center of hole *A*, Fig. 2, so that after shoe *B* is slid into place, the distance from the center of the hole to the bending surface of the shoe will equal the radius to which the pipe is to be bent minus one-half the outside diameter of the pipe, when the radius is given to the center line of the pipe. The shoe is merely butted against the block, and is prevented from moving sidewise by a tongue which engages the walls of a recess on the block. Two table pins *C* relieve the block clamping bolts from overstrain

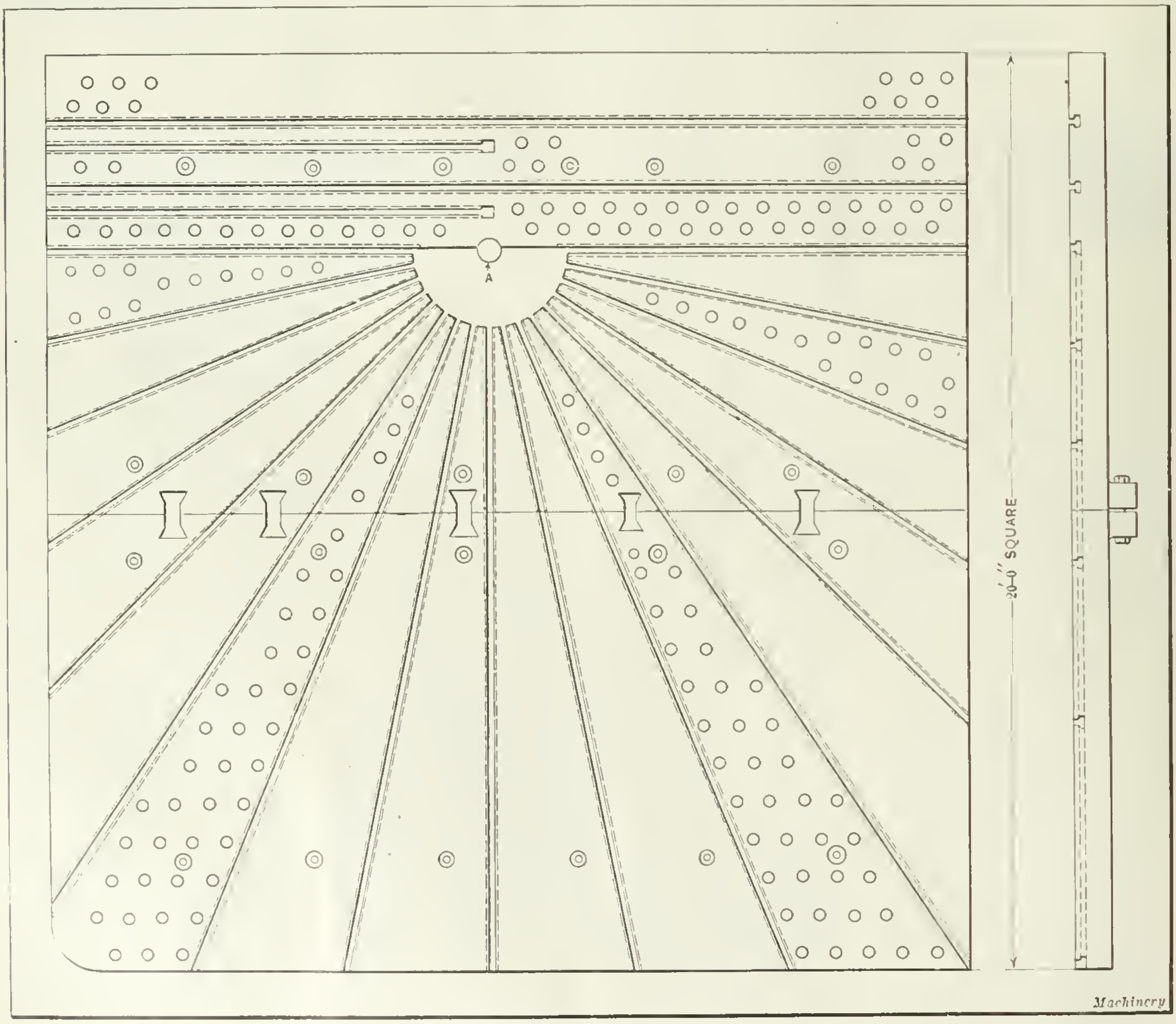


Fig. 2. Plan and End Views of a 20-foot Square Bending Table, showing the Lay-out of T-slots, Pin-holes, and Assembly Keys

Because of the table pin-holes being at the side of the T-slots, it is generally necessary to place spacers between the pins and block *A*, as shown at *D*. A forged handle on the table pins facilitates their use.

The shoes are made in various sizes from 4¾ to 23 inches in height to accommodate the bending of pipe of any size up to 30-inch. The curved bending surface of the smallest sized shoe has a radius of 2¾ inches and that of the largest, a radius of 12¼ inches. Only one size of block is used with the entire equipment of shoes, the block being 18 inches in overall height. Both blocks and shoes are iron castings. When large quantities of pipe, 6 inches or less in nominal size, are to be bent to the same radius, it is more economical to provide forms cast to the shape of the desired bend, instead of utilizing the shoes. Such forms may be quickly set up for a bending operation.

The chief tendencies of a pipe while being bent are to flatten or buckle along the inside of the curve. These tendencies are guarded against by filling the pipe with kiln-dried sand and packing the sand so thoroughly that the pipe wall cannot readily flatten or buckle because of the resistance offered by the sand. Preparatory to filling the pipe with sand, a cap or plug is inserted in one end and secured in place by means of radially disposed set-screws. The pipes are filled at one end of the shop where the roof is 60 feet above the floor level and where a pit extends 46 feet below the floor. The pipe is raised into a vertical position and lowered into the pit a sufficient amount to permit the pipe to be filled through using a rubber hose connected to the under side of a 25-ton sand bin erected along the wall.

When the pipe has been filled it is raised until the bottom end is almost level with the floor, after which the sand is packed by hammering on the pipe. An automatic air-operated mechanism which is adjustable to suit various sizes of pipe, has recenty been developed in this plant for hammering; it was formerly done by hand, however, as shown in Fig. 3 in which a 12-inch pipe 20 feet long is being packed by four men. This practice is still followed in many plants. After one section of the pipe has been hammered a sufficient amount, the pipe is lowered 2 or 3 feet. This procedure is followed until the pipe has been hammered its entire length. The amount of hammering, of course, depends upon the diameter of the pipe, that illustrated being hammered for about one hour. It is obviously a slow, tedious job, and the value of the automatic device mentioned may

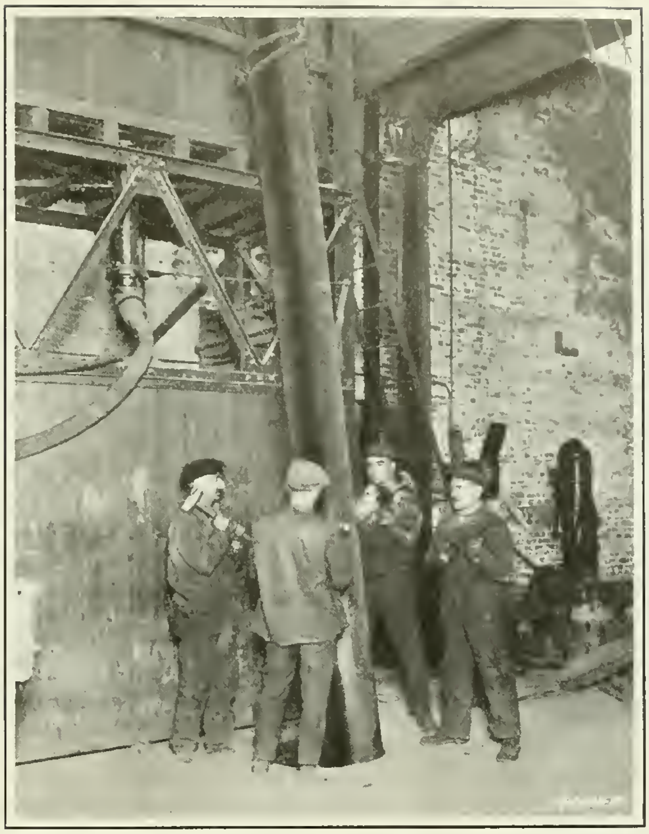


Fig. 3. Packing Sand in a Pipe by hammering on the Outside while the Pipe is held in a Vertical Position

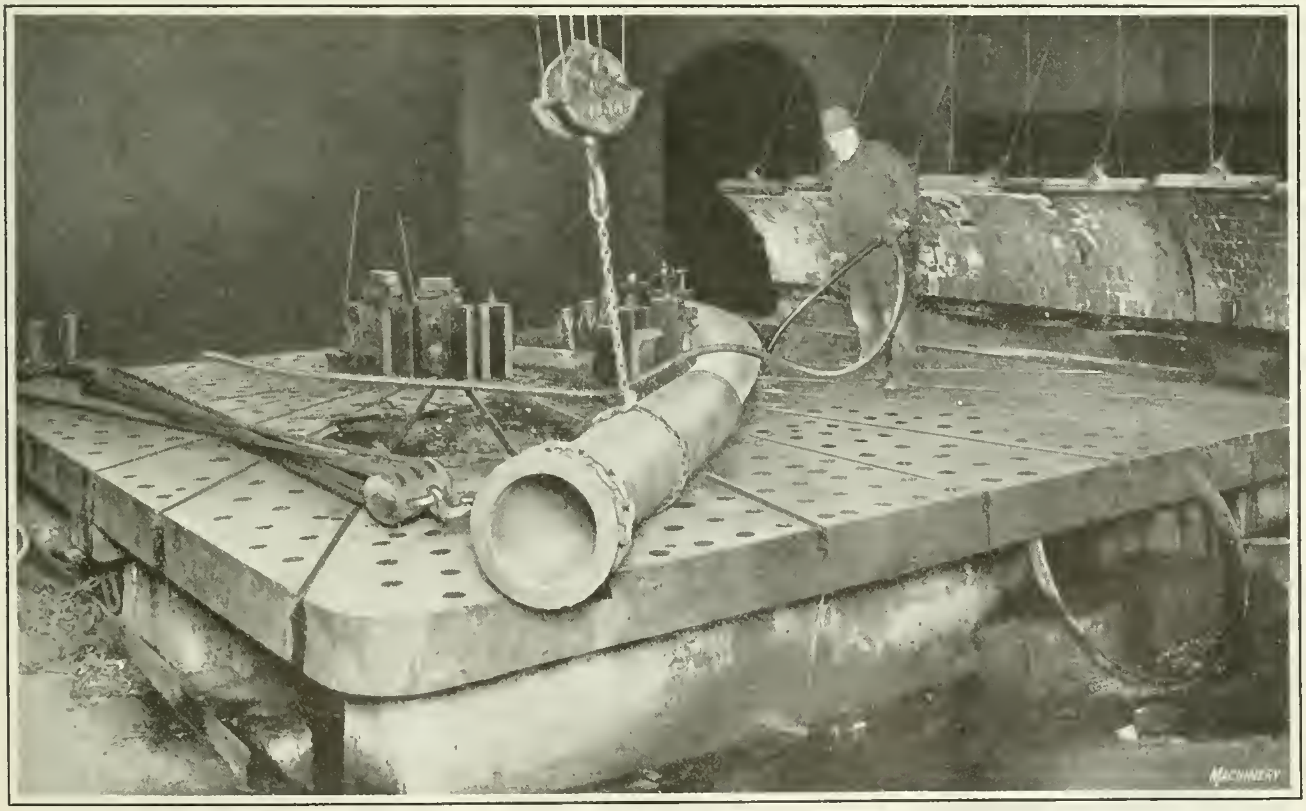


Fig. 4. Bending a 12-inch Pipe 20 Feet Long by employing a Winch to pull the Pipe against Shoes set to the Required Radius of the Bend

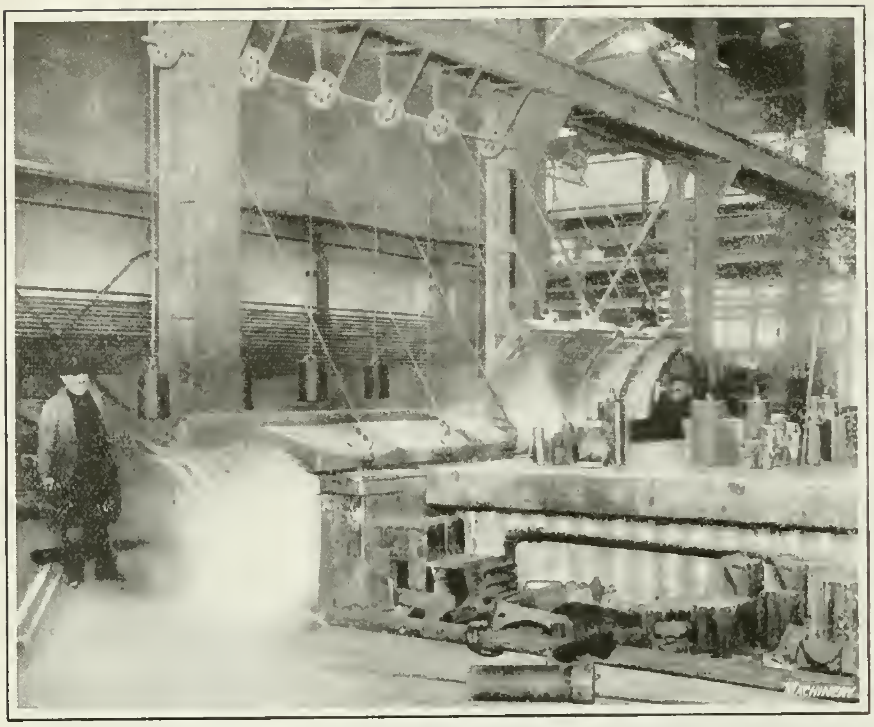


Fig. 5. Heating Pipes to a Cherry-red Color in an Oil Furnace constructed along One Side of the Bending Table

easily be appreciated. After the packing of the pipe has been completed, about a 2-inch covering of clay is made over the sand at the exposed end of the pipe and a cap fitted over the clay in the same manner as at the opposite end. Either a five- or a ten-ton hoist is used for handling the pipe during its filling and packing, the hoist employed for a given job depending on the weight of the pipe.

Heating to the Necessary Temperature

After the pipe end has been sealed, the distance from one end to the point where the bend is to commence is measured and a yellow band painted around the pipe at that location. A similar band is also painted at the point where the bend is to end. These bands later aid in placing the pipe correctly on the table relative to the bending shoes and in the bending step. The pipe is next lifted by an overhead traveling crane and transferred to the oil furnace constructed along one side of the table as illustrated in Fig. 5 which shows two pipes being heated. The furnace has eight burners which project flames transversely beneath the pipe. Only those burners are lighted whose flames will play on the section of the pipe to be bent. Eight counterweighted doors lined with firebrick provide for closing the top of the furnace over the section of the pipe to be heated. When closed, these doors cause the flame to circle around the pipe. The doors over the section of the pipe not to be bent are left raised to permit the flames to escape. The pipe remains in the furnace until it has been brought to a cherry-red color. The fuel oil is atomized by compressed air delivered from a tank extending along the rear wall of the furnace.

The Bending Operation

When the pipe has reached the proper temperature, the burners are shut off, the furnace doors raised and the pipe lifted to the bending table by means of the overhead crane. That end of the pipe which has not been heated is next secured between table pins and blocks. Bending shoes had been previously arranged for bending the pipe shown in the furnace in Fig. 5 to a radius of 5 feet 10 inches. A larger diameter pipe of short length and having an integral flanged end was slipped over the free end of this pipe as shown in Fig. 4 and, by means of a short length of chain, tackle blocks and rope, connected to a 19-horsepower motor-driven winch or "niggerhead." The bending is accomplished by hauling up on the rope connected to the winch. The operation was about half completed at the time the photograph reproduced in Fig. 4 was taken. This portion of the operation must be conducted with extreme care because if the pipe is bent too quickly, flattening or buckling will result in spite of the sand filling, or the wall of the pipe will be excessively strained along the outside of the bend, causing cracks. During the operation, one end of the pipe is lifted slightly above the surface of the table by means of the crane to lessen the load on the winch.

Before commencing the operation, water from a hose is squirted on the side of the pipe which later forms the outside of the bend, until it becomes blue. This insures that the pipe will compress along the inside of the curve rather than stretch along the outside. This cooling also insures a better support of the pipe wall by the sand filling, because it causes the internal diameter of the pipe to be slightly reduced. If the wall at the outside of the curve is permitted to stretch, the diameter will be slightly increased. However, if the pipe is cooled too much, buckles will result when

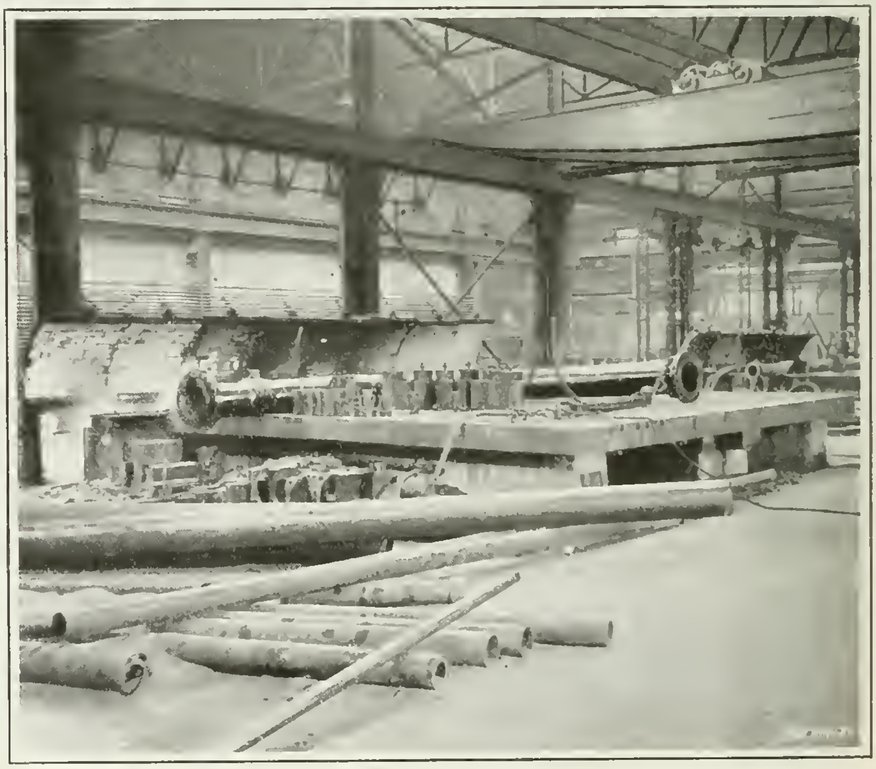


Fig. 6. View of Furnace and Table, with Completed 90-degree Bend lying on the Table

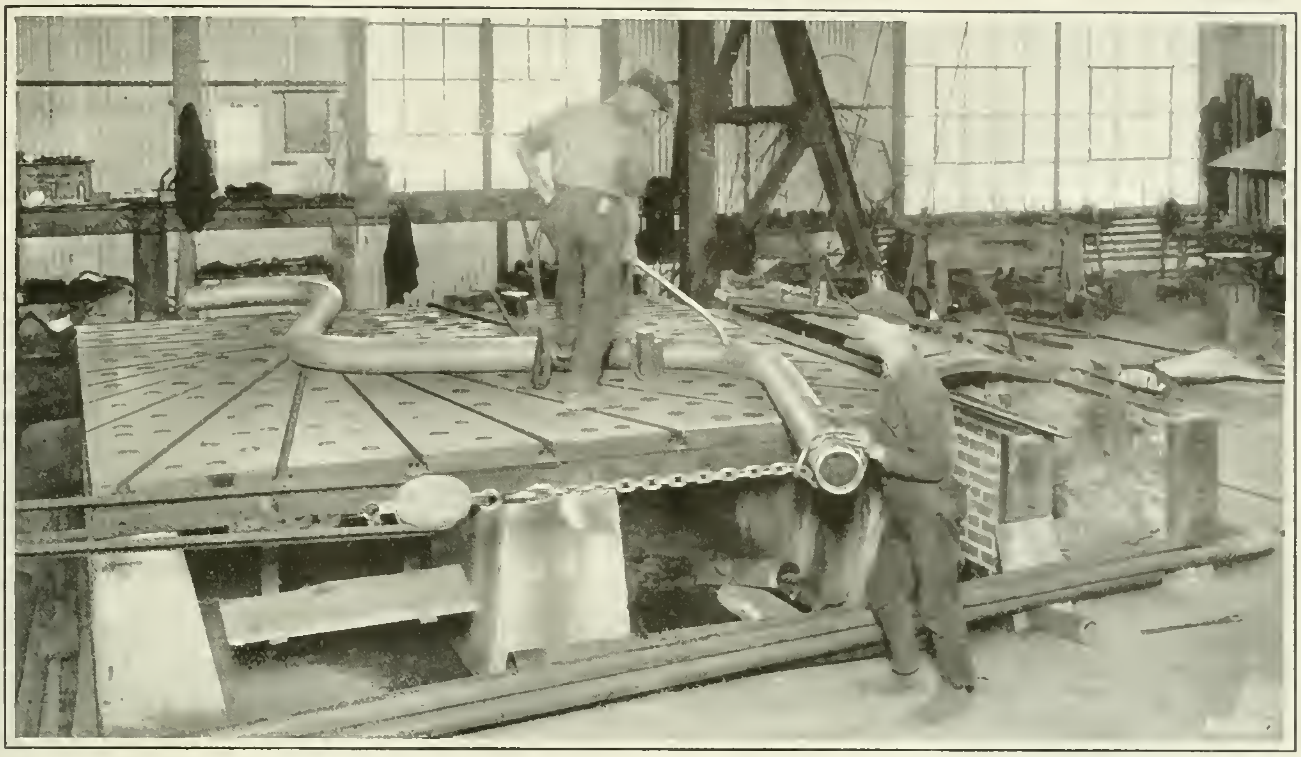


Fig. 7. Three 90-degree Bends being made in a 6-inch Pipe heated locally and bent by holding the Pipe between Two Pins

the attempt is made to bend the pipe. The cooled section is, of course, quickly reheated by the sand and the adjoining uncooled pipe wall.

While the bending is in progress the man in charge of the job remains on the table and holds the hose of running water in readiness. If the pipe bends too quickly at any point he signals the operator of the winch to stop hauling the rope and applies water at the threatened point to cool it momentarily. This work must be done quickly, otherwise the pipe will become too cold for the bending to be accomplished satisfactorily. The pipe in the illustration Fig. 4 was bent to an angle of 90 degrees. In Fig. 6 a finished 90-degree elbow is shown on the bending table.

Making Complicated Bends

In view of the methods followed in bending pipe, it would seem difficult to perform an operation with any degree of accuracy; yet an experienced man can bend large pipe to within 1/4 and even 1/8 inch of the required dimensions. Bends of 90 and 180 degrees are, of course, simpler to produce to specifications than double bends. For bends of the latter class, a templet is usually made from about 3/4-inch round stock to follow the outline that the axis of the pipe will assume when bent. Then, during the bending operation, this templet is used to determine when the pipe has been brought to the desired shape. On double bends care is

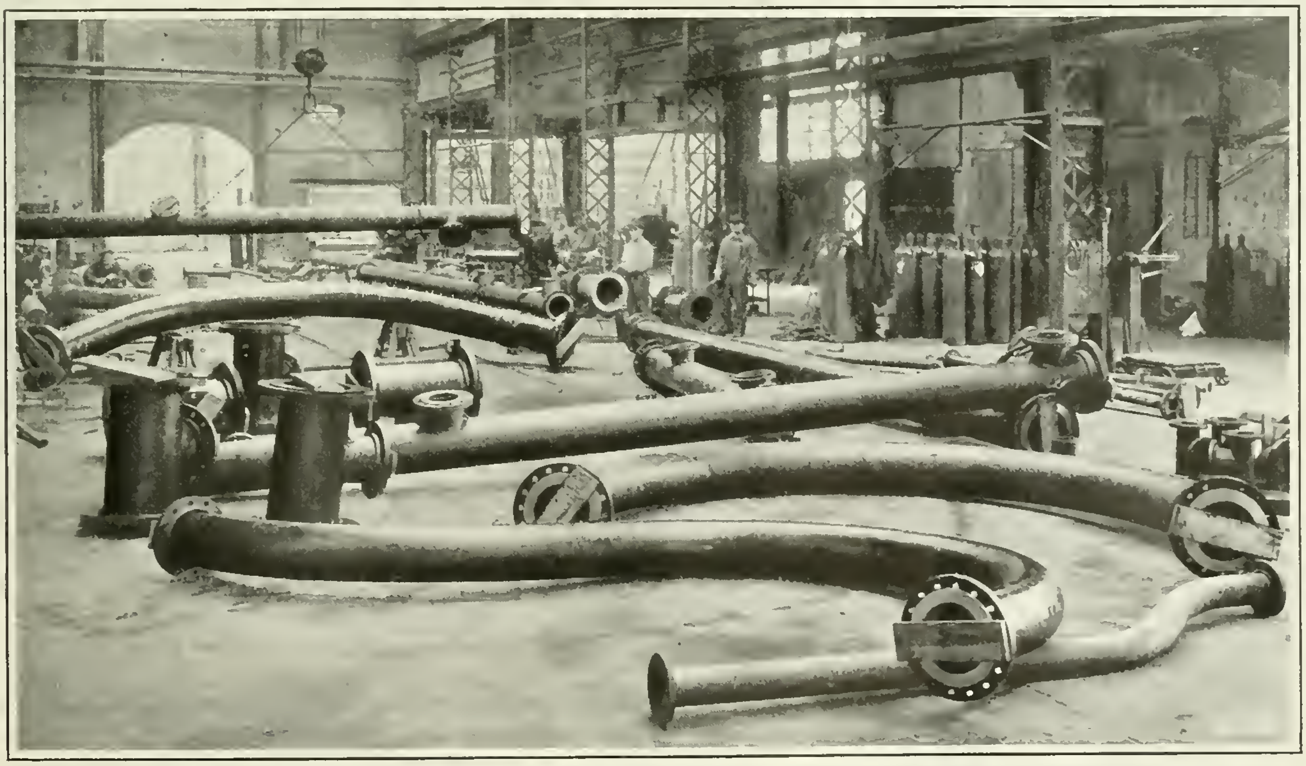


Fig. 8. Examples of Bends having Square-lap Van Stone Flanges and Straight Pipes having Welded Side Outlets

taken to bend the curves to the proper radii, even though the distance between the radii centers is only approximate. Such discrepancies are later rectified by heating the straight section of pipe between the two curves by means of a portable oil-burning equipment and then again bending the pipe slightly as required. The yellow bands painted around the pipe prior to heating facilitates the making of double bends.

TABLE 1. MINIMUM AND ADVISABLE RADII FOR PIPE BENDS; LENGTH NECESSARY FOR 90-DEGREE BENDS; AND DESIRABLE STRAIGHT LENGTH AT ENDS

Nominal Size of Pipe, Inches	Standard or Full Weight Pipe								Extra Strong Pipe				Expansion Bends				Length of Straight Section for Fitting	
	Min. Radius		Length for 90-deg. Bend		Advisable Radius		Length for 90-deg. Bend		Min. Radius		Length for 90-deg. Bend		Advisable Radius		Length for 90-deg. Bend			
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
1		4		6¼		5		7⅞		2½		3 15/16		8	1	0½		2½
1¼		5		7⅞		6		9 7/16		3		4¾		10	1	3¾		2¾
1½		6		9 7/16		8	1	0½		4		6¼	1	0	1	6⅞		3
2		7		11		10	1	3¾		5		7⅞	1	3	1	11½		3½
2½		8	1	0½	1	0	1	6⅞		6		9 7/16	1	6	2	4¼		4
3		10	1	3¾	1	3	1	11½		8	1	0½	1	9	2	9		4½
3½	1	0	1	6⅞	1	6	2	4¼		10	1	3¾	2	0	3	1¾		5
4	1	3	1	11½	1	9	2	9	1	0	1	6⅞	2	3	3	6⅜		5½
4½	1	6	2	4¼	2	0	3	1¾	1	2	1	10	2	6	3	11⅛		6
5	1	9	2	9	2	3	3	6⅜	1	3	1	11½	2	9	4	3⅞		6½
6	2	0	3	1¾	2	6	3	11⅛	1	9	2	9	3	3	5	1¼		7
7	2	3	3	6⅜	2	9	4	3⅞	2	0	3	1¾	3	9	5	10¾		8
8	2	9	4	3⅞	3	3	5	1¼	2	3	3	6⅜	4	3	6	8⅛		9
9	3	3	5	1¼	3	9	5	10¾	2	9	4	3⅞	4	9	7	5½		10
10	3	9	5	10¾	4	3	6	8⅛	3	3	5	1¼	5	6	8	7⅝	1	0
11	4	3	6	8⅛	4	9	7	5½	3	9	5	10¾	6	0	9	5⅛	1	1
12	4	9	7	5½	5	3	8	3	4	3	6	8⅛	6	6	10	2½	1	2
14	6	0	9	5⅛	6	6	10	2½	5	6	8	7⅝	7	6	11	9⅜	1	4
15	6	6	10	2½	7	0	11	0	6	0	9	5⅛	8	6	13	4¼	1	5
16	7	0	11	0	7	6	11	9⅜	6	6	10	2½	9	0	14	1⅝	1	6
18	7	9	12	2⅛	8	3	12	11½	7	3	11	4⅝	......		......		1	6
20	9	0	14	1⅝	9	6	14	11	8	3	12	11½	......		......		1	6
22	....		......		......		......		9	3	14	6⅜	......		......		1	6
24	....		......		......		......		10	0	15	8½	......		......		1	6

Machinery

An interesting operation consisting of putting three 90-degree bends in a 6-inch pipe to radii of 30 inches, is illustrated in Fig. 7. This photograph was taken at the plant of the Standard Piping and Fitting Co., 30th and Race Sts., Philadelphia, Pa. The pipe was held between two table pins with suitable shoes placed between the pins and the pipe. The work was heated locally after being packed with sand and bent by employing a winch as explained in connection with the previous example. The pipe in this case was bent to specifications by reference to a templet. If it were necessary to make an offset in a plane other than that in which the bends are made, it could be accomplished by clamping the pipe to the table, and by means of a hoist, pulling up the section of the pipe to be raised. A pneumatic hoist attached to an I-beam trolley is used in some plants for this purpose.

The heading illustration shows an expansion bend produced at the plant of the M. J. Dougherty Co. This example consists of five sections of 16-inch extra strong pipe welded together after having been bent to shape. The over-all height is 38 feet and the distance from face to face of the flanges, 24 feet. Other interesting examples of pipe work at the same plant are illustrated in Fig. 8. Holes have been cut into the walls of some of these examples and outlets welded into place. All these examples have a square-lapped Van Stone joint. In producing this joint the steel flange is slipped over the pipe end, after which the end is heated and forced back by special machines.

TABLE 2. THICKNESS OR WEIGHT OF PIPE FOR EXPANSION BENDS FOR VARIOUS PRESSURES

Working Pressure, Pounds per Square Inch		Nominal Pipe Diameter, Inches	Radius of Bend	Thickness or Weight of Pipe
	Up to 125 Pounds	7 and under	4 to 5 times dia.	Extra strong
		8 and over	4 to 5 times dia.	½ inch
		7 and under	Over 5 times dia.	Standard weight
		8	Over 5 times dia.	28.55 pounds per foot
		10	Over 5 times dia.	40.48 pounds per foot
		12	Over 5 times dia.	49.56 pounds per foot
		14 to 16	Over 5 times dia.	5/16 inch
		18 to 22	Over 5 times dia.	⅜ inch
		24 to 30	Over 5 times dia.	7/16 inch
	125 to 250 Pounds	7 and under	4 to 6 times dia.	Extra strong
		8 and over	4 to 6 times dia.	½ inch
		7 and under	Over 6 times dia.	Standard weight
		8	Over 6 times dia.	28.55 pounds per foot
		10	Over 6 times dia.	40.48 pounds per foot
		12	Over 6 times dia.	49.56 pounds per foot
		14 to 16	Over 6 times dia.	⅜ inch
		18 to 22	Over 6 times dia.	7/16 inch
		24 to 30	Over 6 times dia.	½ inch
	250 to 350 Lbs.	7 and under	4 times dia. and over	Extra strong
		8 and over	4 times dia. and over	½ inch

Machinery

Bending Limitations

Pipe of large sizes should be bent to as long radii as conditions will permit in order to reduce the possibility of buckling or flattening to the minimum. A suitable radius for all pipe from 4 to 20 inches in diameter inclusive, is six times the diameter of the pipe. This is known as the "standard radius," and bends made to a radius of this proportion are very satisfactory. Pipe from 4 to 12 inches, however, can be bent successfully to a radius equal to three times the diameter, and sizes above 12 inches to a radius equal to four times the diameter. The radii may be even smaller than the ratios that are mentioned, but it is not advisable to make small bends.

The length of pipe allowed for a curve should equal the length of the arc which will be formed by the center line of the pipe. Thus, if the radius to the center of a 90-degree bend is to be 48 inches, the length of pipe that should be allowed for the curve would equal 0.7854 × 2 × 48 or 6 feet 3⅜ inches. To this length, of course, would need to be added the length of straight section or tangent at each end of the bend. This straight section should at least equal the diameter of the pipe, and with pipe 10 inches or larger in size it is advisable to make the straight section one and one-half times the diameter. If the straight section at the end of the pipe is less than specified, the pipe is liable to flatten at the end, a condition that will prevent the tight fitting of a screwed-on flange and cause leakage.

Table 1 presents the minimum and advisable radii to which standard or full-weight wrought-iron and steel pipe should be bent; the minimum radii for extra strong pipe; the advisable radii for bends to be used to take up expansion and contraction of steam lines; the length of pipe necessary for 90-degree bends of the radii given; the minimum straight section length that should be furnished at each end of a pipe. The length of pipe necessary for forming a 180-degree bend to any of the radii given, may be determined by doubling the length required for a 90-degree bend of the same radius. Each radius is given to the center of the pipe. This table has been compiled from the data of large concerns making a specialty of pipe bending and may thus be considered as safe to work to.

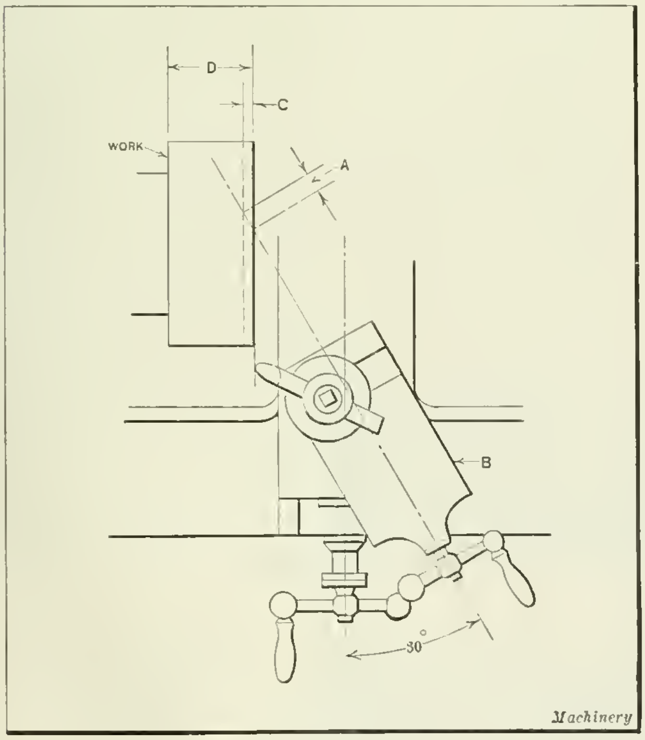
The advisable radii for expansion bends are somewhat greater than the advisable radii for full-weight or standard pipe. Bends made to these dimensions will have the desired expansive value. If they are much less, the bends will have practically no expansive value. Bends in expansion should have the largest radii possible under prevailing conditions. Tests conducted by the Crane Co., Chicago, Ill., showed that expansion U-bends made from extra-strong pipe have practically the same expansive value as U-bends made from standard or full-weight pipe. An important factor to be considered in designing pipe bends for expansion lines is the weight per foot of the pipe to be used. This depends upon the working pressure to which the line will be subjected. Table 2 gives either the desirable weight of pipe, or its wall thickness, for working pressures up to 350 pounds per square inch. This table is based on experiments made by the Crane Co.

* * *

SETTING TOOL FOR FACING CUT

By H. P. FOOTE

If the compound rest of a lathe is set at an angle of 30 degrees, as indicated in the accompanying illustration, the distance *A* through which the slide *B* must be moved to take a facing cut of depth *C* is twice as great as it would be if the compound rest were set parallel with the lathe spindle. It is also obvious that *A* is equal to twice the distance through which the carriage would have to be moved to the left in order to obtain the same result.



Method of setting Tool for Facing Cut

Now assume that a facing cut has been taken, and on measuring with a micrometer, dimension *D* is found to be within 0.0005 inch of the desired thickness. In order to remove 0.0005 inch of metal from the face of the work, it is necessary, theoretically at least, to advance the rest on which the tool is mounted exactly 0.001 inch instead of 0.0005 inch. Thus by having the compound rest set at a 30-degree angle we may use the 0.001-inch graduation of the compound rest feed-screw in setting the tool over for a cut of only 0.0005 inch.

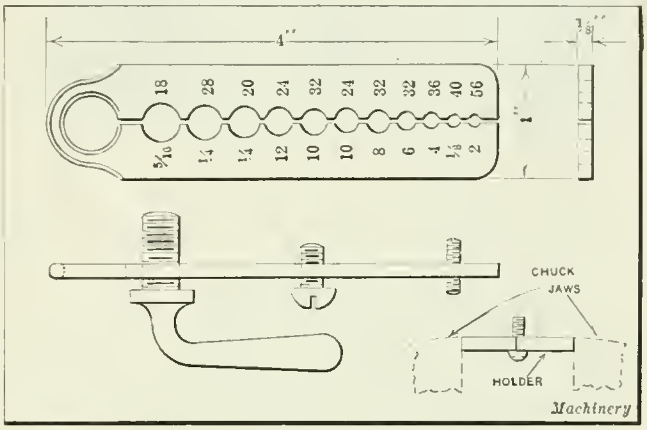
Obviously this method is also an advantage (in so far as the reading of the micrometer graduations is concerned) when the tool is required to be set over for cuts of greater depth. For instance, the tool would be set over for a cut of 0.0075 inch by advancing the compound rest 0.015 inch. The angular setting of the compound rest must, of course, be exact in order to obtain accurate results. If set for cuts of a greater depth than 0.010 inch the tool must be fed across the work twice, that is, in and then out. This is also the most dependable method for fine cuts

* * *

HOLDER FOR SMALL SCREWS

By ALBERT M. SARGENT

The writer read with interest the description of a device for holding small screws, which appeared on page 575 of March MACHINERY. A somewhat different type of holder which has some advantages that are not found in the one referred to is shown in the accompanying illustration. This holder can be used for screws of any length and type without danger of distorting the threads. It is made from a strip of cold-rolled stock 4 inches long, 1 inch wide, and 1/8 inch thick. The strip stock was first drilled and tapped as indicated by the notations opposite the tapped holes, and was then split down the center with a 1/32-inch milling cutter. A hacksaw could, of course, be used instead of a milling cutter. It is quite an advantage to have the sizes of the tapped holes marked on the holder, but this is not necessary.



Holder for Small Screws

Cyanide was used in hardening the holder so that it would be slightly springy at the bow end and have a hard outer surface. In using the holder, the screw is simply screwed into the proper size hole, in the position desired, after which the holder is clamped in the vise, as indicated in the lower right-hand corner of the illustration. Small-sized screws may be released by springing the split ends apart by hand.

* * *

MEETING OF AUTOMOBILE PRODUCTION MEN

A meeting of the Society of Automotive Engineers will be held in Detroit October 26-27 for the purpose of discussing problems of automobile production, the meeting being known as the Automotive Production Meeting. Papers dealing with current production problems in a simple and practical way will be read and fully discussed in the morning meetings on both days. The afternoons will be devoted to factory inspection trips where new and advanced production methods that will particularly interest the tool, inspection, and production men, will be shown. The principal object of this meeting is to promote an interchange of ideas between practical factory men. K. L. Herrmann, production engineer of the Studebaker Co., Detroit, is chairman of the committee.

Rivet Spinning Operations

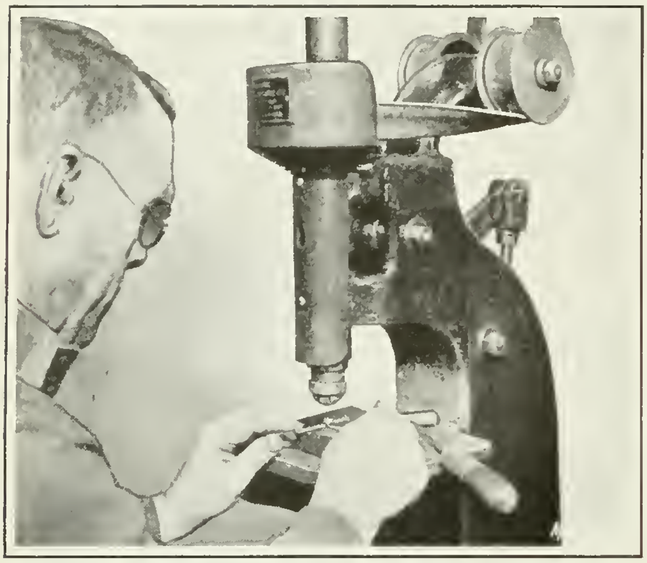


Fig. 1. Spinning the Eccentric Stud by Means of which the Locking Levers are assembled

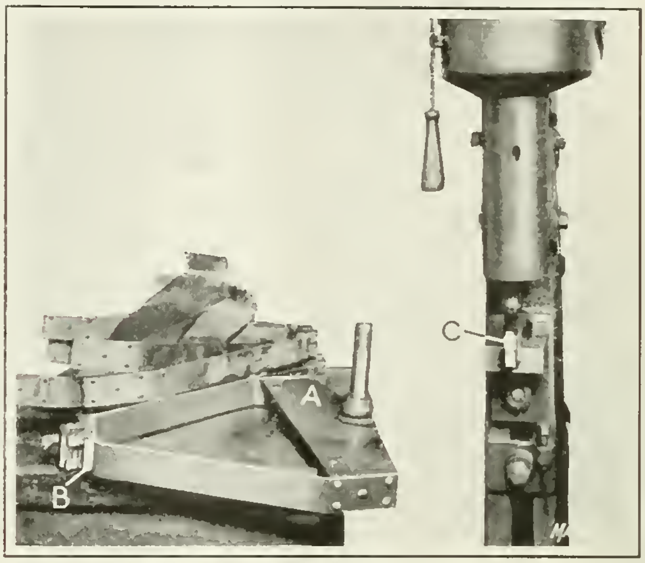


Fig. 2. Riveting Machine set up for spinning Rivets in Wire Reel Cart Frames

RIVET spinning—in the general meaning of the term—includes spinning heads on pins, studs and bushings, as well as rivets. In "setting-down" a rivet, or pin-head by spinning, the action on the metal differs from that which occurs when the work is performed by hammering, inasmuch as when spinning, the metal is pressed with a rotary movement into the shape desired instead of being pounded. Both methods have advantages according to the results desired. A spun rivet is not distorted on the body and does become tight in the hole as a result of the spinning action. This is likely to occur when a rivet is hammered, and for that reason a trip-hammer is often purposely employed to bring about this condition. Where a free-acting joint is required, however, spinning produces the best results, and the applied pressure of the rolls can be so controlled as to obviate bulging or distorting the rivet body. The rolls by which rivets are spun require more working space than a rivet hammer, and hence, a hammer is necessary in cases where lack of room prevents the use of spinning rolls. Obviously, a hammer cannot be used for heading bushings or for flaring pipe, for the performance of both of which operations a spinning machine is well adapted.

Riveting machines that spin rivets, pins, and other fastenings by a pair of rapidly revolving rolls, such as those built by the Grant Mfg. & Machine Co. of Bridgeport, Conn., are provided with rolls carried in a holder in which they are free to revolve while they are pressed against the rivet or pin as the machine spindle rotates at high velocity. A tongue in the holder separates the rolls which are set at a slight angle. The tongue serves to clear the burrs that work up between the rolls during the spinning operation. The revolving rolls cause the metal to spread and assume the proper form of head. The rolls may be made with flat, concave or angular faces to suit the shape of head desired; also special shapes may be employed. The machines are built in either the vertical or horizontal style, in both of which styles the arrangement of rolls and their action is the same. One feature of these machines is the absence of noise which is characteristic of hammer-riveting.

Rivet heads which are spun have a well-finished surface, the metal being spun smoothly and firmly into shape by the action of the rolls. These may be made with flat ends to produce round domes; round ends, cone points, and countersunk ends to produce either oval or flat heads; and chamfered bushings to produce a flat surface that is flush with the work. If the rivet or other fastening is a free sliding fit in the hole, the anvil supporting a round-head rivet is made with a slightly deeper cup, and to a smaller radius than the curvature of the rivet-head, which prevents it from turning. In the case of a flat-head rivet or pin, the anvil is often serrated for the same purpose. The average working speed of these machines is 1750 spindle revolutions per minute. A few examples of the work for which the rivet spinning machine is adaptable, are given in the following.

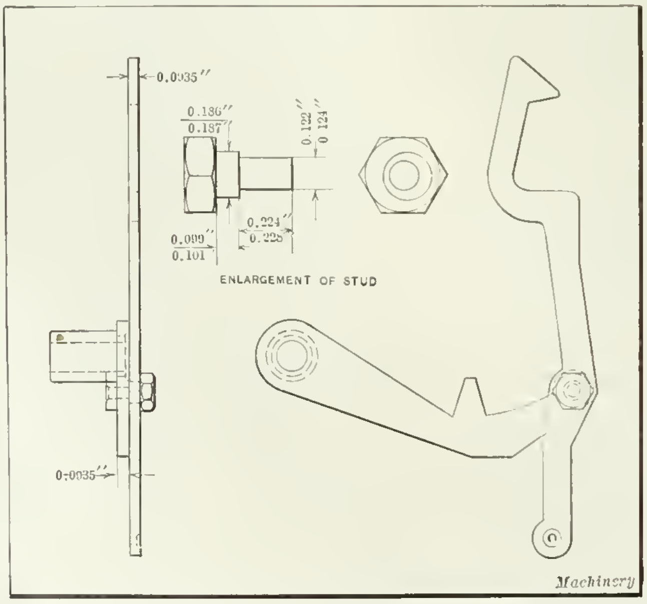


Fig. 3. Locking Unit of a Calculating Machine assembled by riveting

Spinning Steel Stud in Calculating Machine Part

The carriage lock for a Monroe calculating machine, and an enlarged view of the stud used in its assembly, are illustrated in Fig. 3. The shoulder of this stud is eccentric relative to the body diameter and head, the purpose being to provide means for adjustment between the hook-end of one lever and the cam-

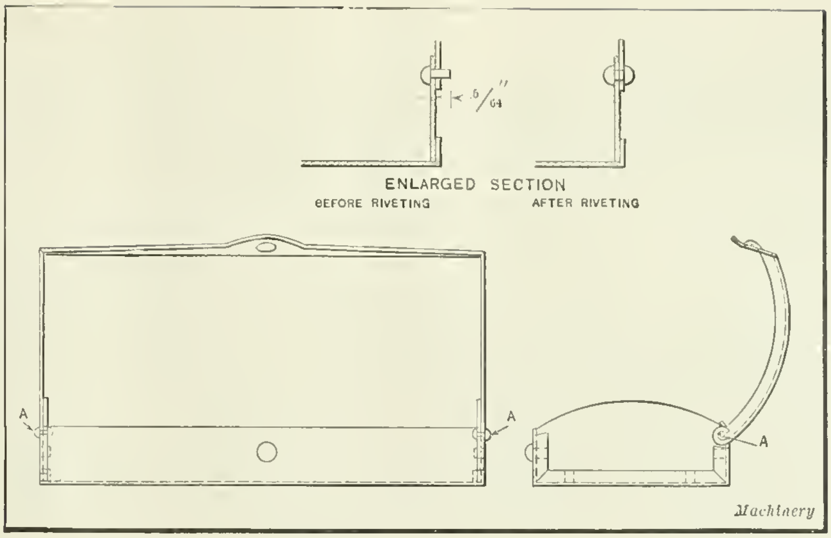


Fig. 4. Safety Razor Case in which Two Rivets are spun to produce the Cover Hinge

lug of the other. This adjustment is accomplished by simply turning the stud and heavy countersunk washer to which it is riveted. The thickness of the two lever members of the lock and the washer is such that 3/64 inch of metal protrudes to be spun flush in the countersunk hole in the washer.

The operation is illustrated in Fig. 1 where it will be seen that a block is used on the regular table of the machine to accommodate the two levers to be assembled. The operator holds the work in position, moving the hook-lever back and forth to determine the freedom of action while the rolls are spinning down the rivet.

The operator then fits the stud into the two parts, assembles the washer, places the parts in position on the block and operates the foot-treadle to apply pressure to the stud. After spinning, the operator frequently uses a brass hammer to free the joint. The end of the stud is lubricated with vaseline. On account of the amount of care and inspection that each unit receives, the production is not high. The output is 184 locks per hour.

Riveting Frames Made of Flat Stock

The Dilwood Mfg. Co. of Newark, N. J., manufactures a wire-reel cart for the U. S. Army, which is used for field work by the Signal Corps. This cart is collapsible and is a good example of "fabricated" work, in the manufacture of which arc-welding and rivet spinning are extensively used.

The two end frames of the cart, one of which is shown in Fig. 2, are locked to a rectangular side frame by clamp levers which engage steel buttons, riveted into the gusset plate *A* of the end frames and thus may be disassembled at will. The side frame is made of flat stock which is first bent to shape and tacked at the joint by welding and then riveted. The frames are reinforced with cross-braces which are held in cast-iron bearings, riveted to the sides of the frame. In all, there are twenty-eight rivets in the main or side frame, all of which are spun. This frame weighs 22 pounds; it is stated that ten frames can be fabricated with the aid of the rivet spinning machine in the time that formerly but one could be made by hand-riveting.

The end frames contain five rivets at each end for the gusset plate and four for the assembly of the cast-iron box *B* in which the shaft that carries the coil of wire has its bearing. The two locking buttons that are riveted in the gusset plates are made of cold rolled steel, ⅜ inch in diameter, and are spun with an oval head. The anvil in which the head of these buttons rests during the riveting operation, is cupped out to contact only on the sides of the button head so that it will not revolve during the operation For the five countersunk-head rivets a special serrated anvil *C* is used, to prevent the rivets from turning. The rivets are assembled from the inside outward, the anvil allowing the frame to hang over it when riveting from the outside. These rivets are 3/16 inch in diameter, ⅝ inch long, and are made of cold-rolled steel. During the spinning the rivets are lubricated with graphite. The sixteen rivets and two buttons are spun at the rate of one hundred frames per nine hours, in spite of the fact that the frames each weigh eight pounds and cannot be handled rapidly.

Spinning Hinge Rivets in Safety Razor Cases

An example of brass rivet spinning using a two-spindle horizontal type of machine is found in the plant of the Auto Strop Safety Razor Co., New York City. The cases, which are made from 0.022-inch sheet metal, are illustrated in Fig. 4, the two rivets being indicated at *A*. A free joint is required for the cover of the case, and the rivet holes must align; otherwise, the hinge will bind. The rivets are 0.048 inch in diameter, 0.120 inch long, with round heads, and they are loosely assembled as a separate operation to the spinning.

As the enlarged sectional views show, the rivet is spun with an oval head, for which 5/64 inch of its length is used. A special fixture is used on the machine, the set-up of which is illustrated in Fig. 5. This fixture is merely a substantial cast-iron block with a steel face, over which the case tightly fits, affording support within the case for the rivet heads to hold them firmly against the spinning action of the rolls. Two ejector pins operate through the fixture by means of the hand-lever *A*.

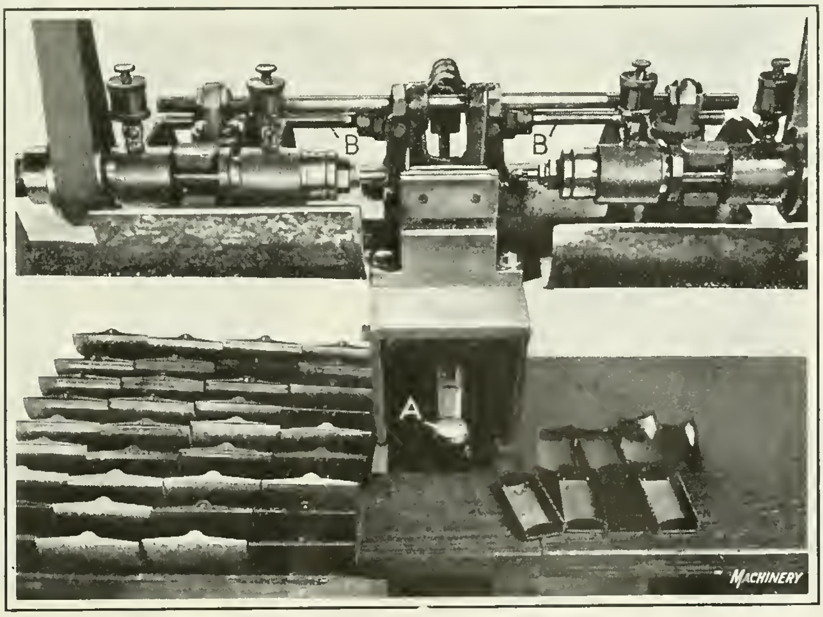


Fig. 5. Two-spindle Horizontal Machine and Fixture for riveting Safety Razor Cases

The design of this machine is a radical departure from the vertical type illustrated in connection with the other applications described. The opposed spindle-heads are separately driven, and the spindles are advanced in

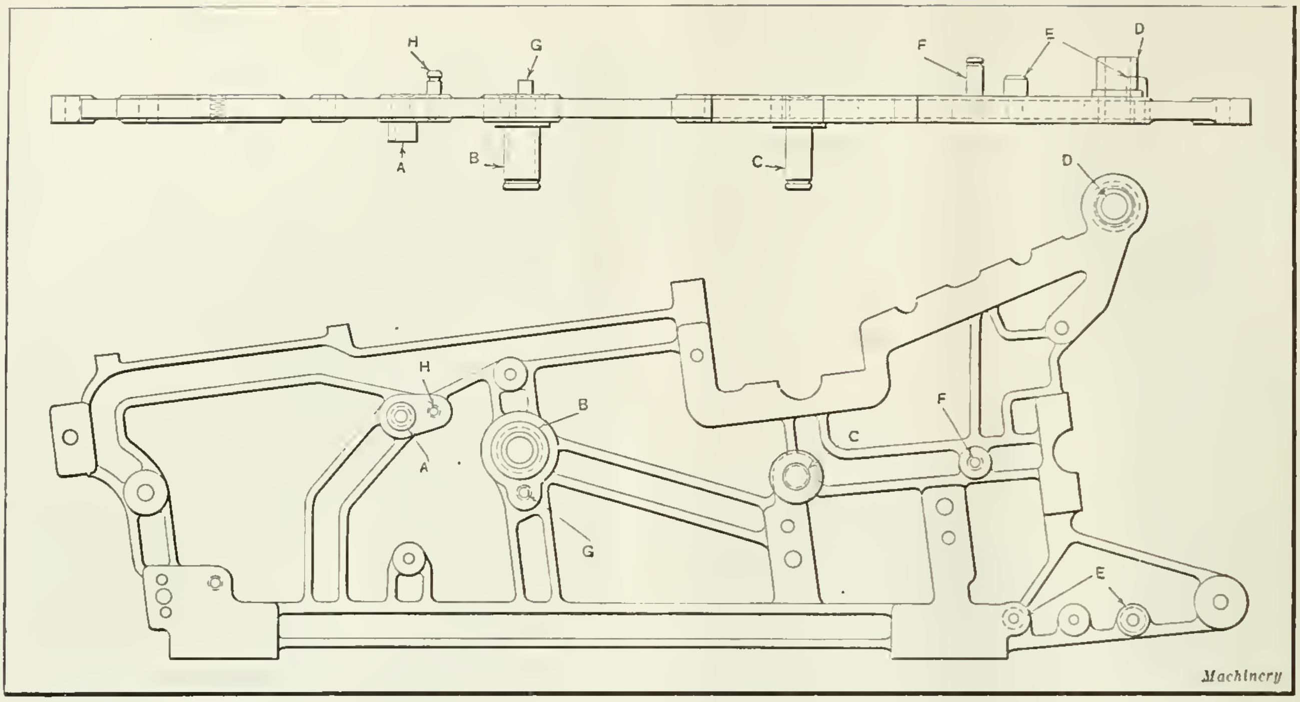


Fig. 6. Side Frame of a Calculating Machine in which Various Riveting Operations are performed

unison by a toggle-lever connection, operated by a foot-lever beneath the bench. The amount of traverse of these spindles determines the freedom of the hinged joint, and this traverse is regulated by adjusting nuts on the threaded rods *B*. Similar adjustment is also provided for setting the position of the heads on the flat side on which they operate, to accommodate work of varying length. Two-spindle riveting machines of this kind also find extensive application in cutlery plants where they are employed for the purpose of spinning the rivets by which the handles of knives and forks are assembled.

No lubricant is used in this operation but the rolls are frequently washed with kerosene. The production for a ten-hour day is 5150 cases, or more than 10,000 spun rivets.

Spinning Steel Studs and Bushings in Cast-iron Calculating Machine Frames

The two side-frames between which the mechanism of the Monroe calculating machine is assembled are made of cast-iron and contain a number of bushings and studs. The design of the frame is shown in Fig. 6, which shows the location of the various studs and bushings that are assembled into it. The riveting work is divided into three operations, the first of which is the spinning of the carriage hinge-rod bushing *D*, which is a casehardened machine steel part. This bushing is placed over a stud in a fixture block to locate it, and the casting which is countersunk to receive the head to be spun is slipped over the end of the bushing.

The bushing is also countersunk a sufficient amount so

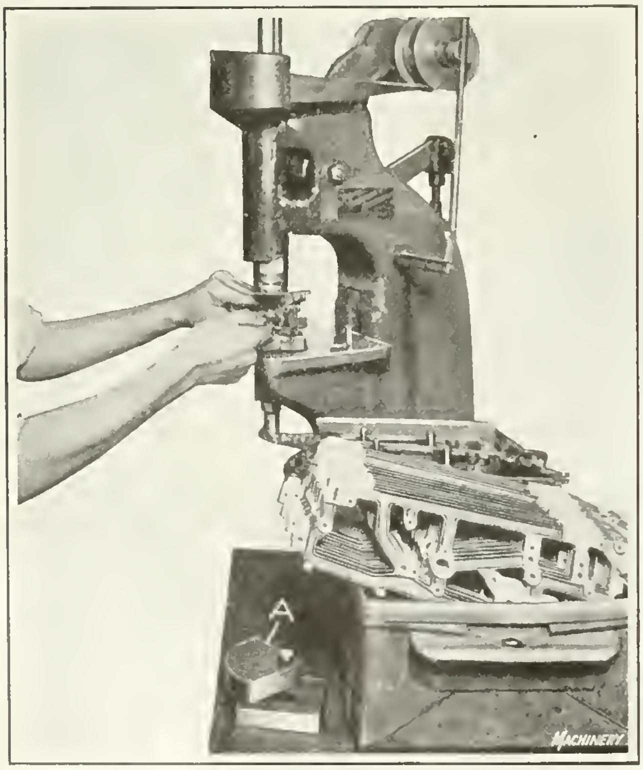


Fig. 7. Using Swivel Block for spinning Rivets of Different Diameters without rehandling the Work

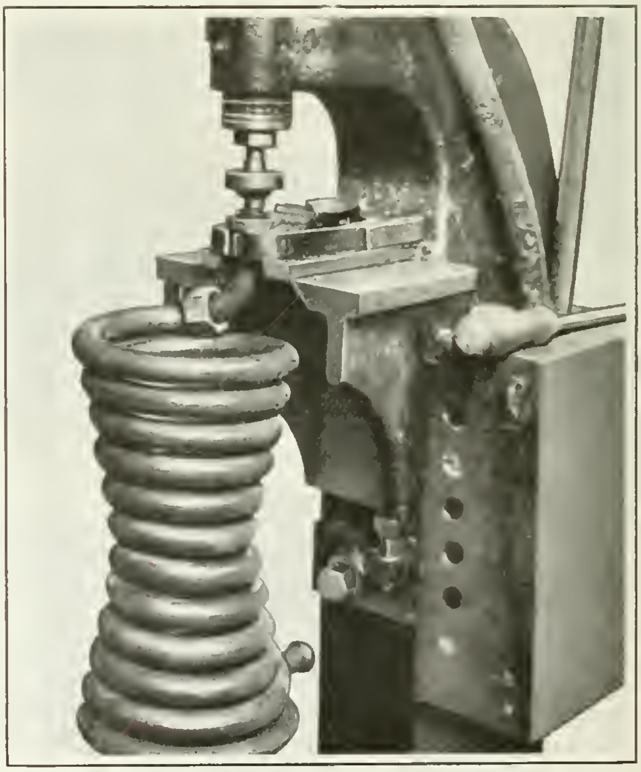


Fig. 8. Application of a Riveting Machine in which a Special Clamping Device and Special Spinning Tool are used

that as the end is spun the metal spreads into the countersunk hole in the casting, and also into the countersunk hole of the bushing. The depth of countersinks is such that the spun metal produces a flat even surface, with no metal projecting into the hole. With this arrangement the operation is completed with the spinning, and no subsequent machine work is required to clean out burrs in the hole. With a hardened steel bushing it would be impossible to ream and difficult otherwise to remove burrs; hence the importance of countersinking. The production is 230 bushings per hour.

The next riveting operation is that of spinning the keyboard clearing lever-stud bushing *A*, the crank-handle stud bushing *B*, and the intermediate driving gear stud *C*, all of which are spun in one operation. These bushings and all the other studs shown are made of cold-rolled steel. The operation of spinning the three parts just mentioned is illustrated in Fig. 7, in which also a number of pieces of work are shown. A swivel block, similar in design to that shown at *A*, and containing three locating bushings to accommodate the diameters of the work to be spun, is used. First, the casting with one bushing hand-pressed in place is located by the proper bushing in the swivel block, which is swung into alignment with the spindle of the machine where it is held by a spring pin. The second bushed hole is then used for the next bushing and so on, thus reducing the amount of handling that would be required if an entirely separate operation were used for each member to be spun.

In this case also, the bushings are countersunk and the stud has a cup point. This permits the projecting stud or bushing to be spun evenly and flush with the finished side of the casting. In the case of the bushings, which in this case are not hardened, it is sometimes necessary to ream out the holes to remove burrs formed by the spinning rolls, although the countersinking of the bushing is designed to obviate this. The bushings and the stud are an easy push fit in the casting, and are assembled by the operator of the riveting machine. The production time is sixty-four frames per hour or 192 riveting operations, which includes pressing the bushings and stud into place, and assembling the washer beneath stud *C*.

The other studs shown at *E*, *F*, *G* and *H*, Fig. 6, are a drive fit and are riveted in from the opposite side of the casting, using the swivel block already referred to. In this case, however, the work is done on a hammer machine.

Bell-mouthing Pipe by Spinning

In the plant of the Lawson Machine Co., Wilkinsburg, Pa., the end of the copper coil used in the construction of a gas heater is flared by means of a riveting machine which carries a special spinning roll-head. The set-up for the operation is illustrated in Fig. 8. It will be seen that one end of the coil is gripped in a suitable clamp after the joint nut has been slipped over, and that it is then bell-mouthed. This coil is an important unit in the gas heater, and the flared end is produced to enable a water-tight joint to be made. The rolls in this special head are placed at a suitable angle to give the radius of the bellmouth, this spinning tool being carried in the machine spindle in place of the regular roll holder. The pipe in this coil is 3/4 inch outside diameter and of No. 20 gage stock. A well-formed opening in the pipe is thus secured and the production time is fifty coils per hour. This operation was formerly done by hand which was found to be slow and inaccurate.

* * *

Chatter marks on work that has been finished by cylindrical grinding are due either to vibrations of the building, unsuitable belt joints, knocking end thrust of revolving shafts, lack of balance in revolving machine parts, incorrect speed of the wheel used, lack of proper steadyrests, or wheels which are not properly balanced.—*Grits and Grinds*

SELLING PRODUCTION SERVICE

By ERNEST F. DuBRUL, General Manager,
National Machine Tool Builders' Association, Cincinnati, Ohio

It costs more to be without good equipment than to buy it. Experienced salesmen have made many sales by demonstrating that fact. It is the only argument on which any kind of machinery can really be sold, because the value of the machine to the user depends on no other quality than the saving in cost of production to be obtained through the use of the machine. The price of the machine is of no particular consequence, its design and other selling points are in themselves of no great moment, unless a saving in production costs can be shown by its use. If the saving by the use of new or improved equipment is not in proportion to the price that has to be paid, even the cheapest machine is expensive.

The great difficulty confronting salesmen of machine tools is that thousands of buyers do not think in terms of production service obtained from the machines that they buy. Too many are judging erroneously the value of a machine tool almost entirely by a comparison of the price with other machines made in large quantities. Machine tool salesmen should emphasize the fact that they are not selling machines —they are selling production service. The purchasing agent who is not a production man generally insists upon buying machines rather than service, and he will naturally insist upon buying the cheapest machine in the market. But the experienced user of machine tools knows that each machine is peculiarly suited for a particular kind of service, and he will buy the type of machine that he knows is best suited to his needs.

There are numerous instances where the cheapest machines are the machines to buy for the service to be performed; there are other instances, however, where machines of a higher grade, which usually means a higher price, are the only machines that can be bought economically. There is a field for every line and type of machine tools made. It is the judgment of the buyer that should determine which kind of machine suits his needs best; and in making a decision he should be guided not by the price of the machine in dollars and cents, but by the service which he expects from the machine. The machine that will save him the most money in proportion to its cost is the machine that he should buy.

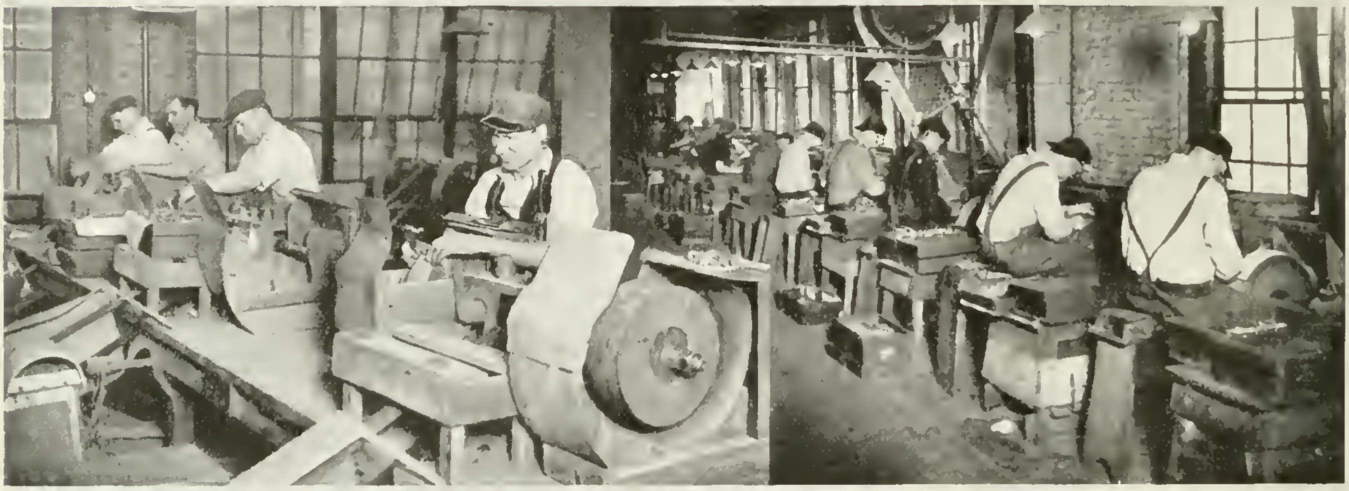
It is false economy for the management to allow purchasing agents to think of price rather than of relative productive capacity. Purchasing agents in large concerns, particularly, are so much in the habit of buying commodities that may be bought by the pound or gallon, and the quality of which is practically uniform and standardized, that they do not seem to discriminate between the buying of goods of this kind and machinery and tools or other equipment which is acquired not to be used up as a raw material, but because of the savings in production obtainable through their use.

* * *

QUALIFICATIONS OF A TIME-STUDY MAN

A successful time-study man must have a friendly and tactful disposition. He must be willing to show fairness to the men in the shop and must be patient, diplomatic, and show no prejudices. He should possess a calm analytical mind, so that he can divide an operation into its logical elements. He should also be able to meet in an intelligent manner any argument relative to rates that is advanced by the men; but at the same time, when in doubt, he should favor the men, because only by so doing will he be able to gain their confidence, and without their confidence he will be unable to carry out successfully, for the best interest of his firm, the work to which he has been assigned.

Principles of Metal Polishing



By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

POLISHING departments need more attention than they generally receive in manufacturing plants. To obtain the best results, the polishing equipment should be installed in a room provided with good lighting and ventilation, and should be given the same attention by the man in charge of production as are the other shop departments. Instead of this, the polishing department is frequently located in the basement or in some dark corner of the shop, where the conditions are not satisfactory for good work; and when no particular attention is given to the department by the production manager, the foreman may initiate his own policy, resulting in lack of standardization, thereby often increasing the cost and lowering the quality of the product.

There is need for standardized practice in the polishing department as well as in the machining departments; but frequently when a matter pertaining to polishing, such as the kind of wheel or abrasive to use, comes to the attention of the management, it is simply referred to the boss polisher, and his judgment prevails. Sometimes his recommendations are correct; often they are not. The boss polisher is usually a graduate from the ranks and frequently looks with suspicion on any new idea that affects his work, or on the introduction of new devices or tools that may result in a change in practice being forced upon him. At any rate, standards are not generally followed except those founded on the experience of that particular foreman. There seems to be a feeling in many organizations that polishing is a phase of manufacturing where efficiency need not be seriously regarded and where engineering has no place. In reality, there are few departments where the installation of improved methods and equipment will reflect more directly on the quality and cost of the work produced than in the polishing room.

The same care should be exercised to bring about polishing efficiency as is generally done to secure better results in other manufacturing departments such as, for example, the milling and planing departments, where improved or automatic machines are frequently coming into use and faster working equipment is being introduced. It probably is true that since the polishing department has been conducted on such a neglected basis for so long, manufacturers fail to appreciate the improvements that are possible by inaugurating a change in policy. To sum up the whole situation, the average polishing department is operated at an expense out of all proportion to other departments; polishing wheels for example, are used long after they are out of true, so their efficiency is decreased sometimes as much as 50 per cent. This would not be tolerated in a modern machine shop.

Terms Used in the Polishing Field

In general, any wheel made from whatever material—leather, canvas, or wood, for example — that has a polishing abrasive glued to its face, is a polishing wheel. In a general sense, any operation performed on a polishing wheel may be termed polishing. It embraces everything from the "flexible-grinding" operations performed on rough forgings such as axes and picks, and the removal of flash from table knives and forks, to the production of the brightest luster, such as is given to surgical instruments, high quality scissors, and other kinds of general hardware. Strictly speaking, the former class of work, which consists of grinding away metal preliminary to the luster producing process, should be known as "flexible grinding," as should all other operations in which a flexible polishing wheel removes metal preparatory to plating, painting or enameling the surface. In contradistinction to flexible grinding is the process by which the surface of

This is the first article of a series on polishing which will cover the general principles of metal polishing, polishing wheels and abrasives, polishing methods and equipment, and the making of polishing wheels. A number of examples of polishing practice in the metal-working industry will be included. The articles will deal with the art of metal polishing in all its phases, and will call attention to details that are not always regarded as important. They will prove of especial value owing to the fact that polishing has received but little attention in the technical press in the past, and they will deal with the subject in a more complete manner than has been done hitherto.

metals is refined by a number of operations until it has been reduced to a degree of smoothness that is known as a mirror finish; that is, a finish such that the light is refracted from the surface as in a mirror. But in general, in the trade, polishing is the term used to cover all this work of refining metal surfaces. Polishing, however, does not include buffing, an operation that is performed with a buffing wheel—that is, any wheel to the face of which the abrasive is loosely applied, rather than glued.

Chisels, hammers, screwdrivers, wrenches, and similar classes of work which are to be highly finished, but not plated, usually require four operations which are: roughing, dry-fining, greasing and coloring. That is, by means of four operations all the finishing work is done on polishing wheels, including the roughing which is frequently regarded as a solid grinding wheel job. Sometimes there are two steps to the greasing operation—rough and fine greasing. For some hardware, typical of which are cheaper screwdrivers and wrenches that do not demand a high finish, two operations are sufficient—roughing and dry-fining.

For knife blades and cutlery the roughing operation is performed with solid grinding wheels and the polishing is known as fine or blue glazing, but these terms are never used when referring to the polishing of hardware parts, plumbers supplies, etc. A term used in finishing German silver, white metal, and similar materials is "sand-buffing," which, in distinction to the ordinary buffing operation that is used only to produce a very high finish, actually removes considerable metal, as in rough polishing or flexible grinding. For saud-buffing, rotten-stone and pumice are loosely applied.

Although this series of articles does not deal with the buffing phase of metal finishing, something should be said regarding the art which will clearly define it and remove the possibility of its being regarded as polishing. Buffing is not so harsh an operation as polishing. The abrasives which are glued to a polishing wheel are intended to grind away roughness that the grinding wheel or other cutting tool leaves—unevennesses that are often discernible only with the aid of a microscope. Buffing, on the other hand, employs such soft cutting materials as tripoli, lime, crocus or rouge prepared in cake form with tallow and other greases as a body, this being applied to the cloth buff by hand from time to time so that the face of the buff is furnished with a coating of this composition. Some metals, like German silver and white metal, are buffed before plating. Pocket-knife blades are polished with emery and then highly finished (colored) by what is known as "crocus polishing," in which a wheel, similar to a leather-faced wood polishing wheel is used for buffing. Steel parts to be plated are usually prepared for plating by polishing, buffing being employed to give a luster to the plated surface.

The Relation of Design to Finish

The best results in polishing may often depend upon the design of the piece. In fact, the proper place to approach the polishing industry with a view to improving results is in the drafting-room, for in the designing of any new article, the manner and quality of finish can be greatly influenced by the contour of the part. It is often possible to eliminate small concave surfaces without affecting the appearance or the usefulness of the part, and by this means make it possible for a polishing wheel to reach all surfaces to produce the desired finish. The contour should, if possible, be such that it can be readily followed by the polishing wheel. Oftentimes a small expenditure in forging or in casting, by making minor changes in dies or patterns, will result in a large saving in finishing the article. It is not unusual, by some simple change in the original design, to obtain a sufficient reduction in the cost of finishing, to create a substantial advantage over a competitor.

The polishing of large surfaces is not difficult—it is the small concave surfaces, corners, and recesses that are expensive to finish, because it is almost impossible for a narrow-faced or small-diameter wheel to work effectively at the desired speed and reach such inaccessible places. The great number of these difficult surfaces found in the design of gun parts makes the finishing of this class of work comparatively expensive and the methods of performing the work of special interest. The exterior surfaces of those parts which make up the attractive appearance of firearms cannot be dispensed with without seriously affecting the market value of the product, but there are a great many articles which are finished by polishing that could easily be changed in design to facilitate the work of polishing without affecting in any way the selling value of the product. These things should receive careful consideration by the management of any manufacturing organization.

The methods of performing various operations prior to polishing also have a direct affect on the cost of finishing as well as on the quality of the finished surface. A good illustration of this phase of the industry may be noted in connection with the production of axe heads and similar forged implements. In forging, scale gathers on the surface of the hot metal and in the forging operations becomes imbedded into the surface to such an extent that in finishing, the pitted surfaces thus produced must be removed, which sometimes requires the grinding away of 1/16 inch of metal in order to reduce the axe head to a condition where it can be finished satisfactorily. To remove this unnecessary metal the practice followed in one shop was first to use a solid grinding wheel, which left a wavy surface so that it became necessary to semi-finish-grind before any polishing could be done. The result was that several operations were required to finish the axe head, whereas, with proper attention to the forging of the heads these operations could have been reduced. The method of manufacture was later changed and the work done without these extra operations. The elimination of grinding on a solid emery wheel was accomplished by simply wire-brushing the scale as it appeared on the hot forging between operations. There are many similar instances where great savings in polishing costs could be made by some such simple means as that mentioned.

Broader Application of Polishing

The advantages which may be obtained by flexible grinding with formed-face polishing wheels have resulted, during recent years, in this means being used largely for certain classes of work to supplant the use of solid grinding wheels. This is made possible by the improvement in polishing wheel design to an extent that the coarser-grain, fast-cutting artificial abrasives commonly used for flexible grinding may be effectively held on the periphery of the wheel. In this connection, of course, the holding power of glue and the resistance to frictional heat produced are of vital importance. Work produced by polishing wheels instead of solid grinding wheels is economical, because with the solid wheel the surfaces left are wavy, so that a number of operations are required to polish the surface. The forgings and castings are often taken directly to the polishing department for roughing without being first ground, and if the polishing wheel is properly designed and applied, it will leave a smooth surface for subsequent operations. This principle of employing a flexible grinding tool rather than a solid wheel results in fewer operations being required to finish a surface.

* * *

A certain type of foreman prides himself on treating all men alike, but he might just as logically take pride in the fact that he applies the same methods to the heat-treatment of all kinds of steels. Men differ in analysis far more widely than do steels.

Making Radio Parts

By FRED R. DANIELS

Molding Radio Insulator Products—Description of Dies and Methods Used

Large quantities of molded products are used in radio equipment. Many of these are molded with brass inserts to provide means for electric circuit connections in radio instruments. Although the main purpose of employing molded materials so extensively in radio instruments is to furnish adequate electrical insulation, numerous molded parts are also used as control knobs and handles. This article contains two examples of molded work having metal inserts, and two examples in which inserts are not used, but which are good examples of molding radio parts. The practice described is that of the Shaw Insulator Co., Newark, N. J.

The materials commonly used for this purpose are condensite, redmanol, bakelite, formica, electrose, etc.—all condensation products of phenol and formaldehyde—and shellac compositions. The first class of materials is prepared both in powdered form and in sheets of about 1/4-inch thickness, but the shellac compositions are made in sheets only. The powder is used in "closed" or "positive" molds; that is, molds into which charges of powder are placed that will exactly produce the desired part without any overflow. The "open" or "negative" mold, on the other hand, is one in which sheet stock is used; here the lower die cavity is surrounded by an overflow channel into which the excess material is forced as the cavity of the die is filled under pressure. This overflow is a total loss, as it cannot be used again. On removing the parts from negative dies, they are usually surrounded by a liberal flash and in some cases, where the filling out of the piece is difficult, this flash will be heavy enough to hold an entire string of parts together.

There is also what might be called a "semi-positive" method of molding in which the molded product used is also in sheet form, but the pieces of material used are carefully weighed to agree with the weight of the finished article. This practice, however, is followed only in cases where the design of the die is such that the amount of overflow must be limited because it is impracticable to provide a large overflow channel in the die.

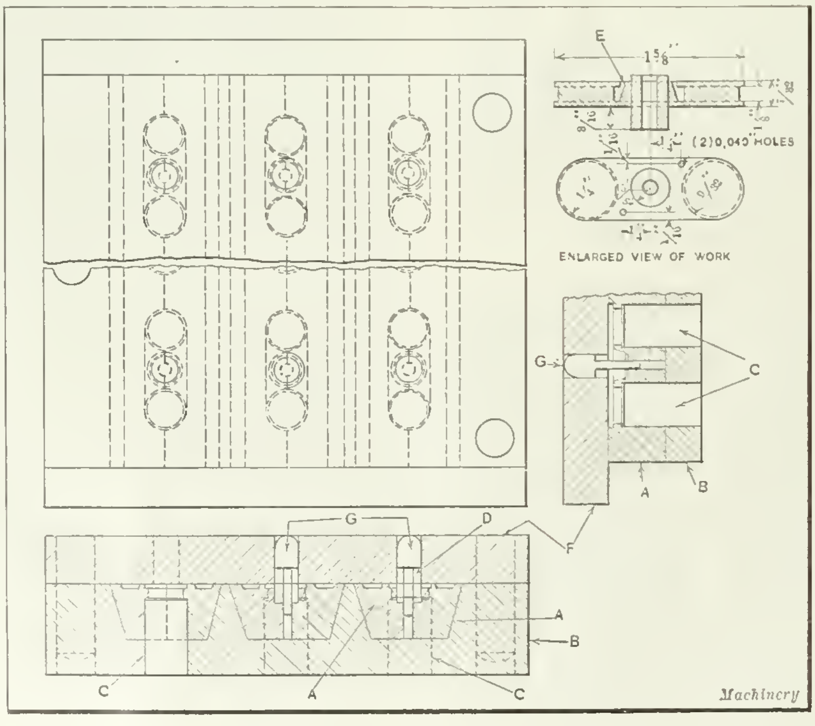


Fig. 1. Enlarged View of Condensite Bobbin and Dies in which this Bobbin is molded

The principle employed in the making of molded insulator parts is that of combined heat and pressure; pressure is supplied by a hydraulic press, through a pump and accumulator, and the heat by live steam. In the practice described, Watson-Stillman hydraulic presses are used which are designed to furnish a pressure of 2000 pounds per square inch. For heating the platens of the press between which the dies are placed, a live steam pressure of 90 pounds is regularly used, which gives a temperature of 320 degrees F. The combined heat and pressure are applied for variable lengths of time, the duration depending on the size and sectional area of the part being molded. The steam is not passed through channels in the dies (as is sometimes done) but is conducted to the dies by contact with the hot platens. The dies are prepared for the press on heated tables or work-benches made of iron, so that they are not cold when placed in the press, but already hotter than the bare hands can stand.

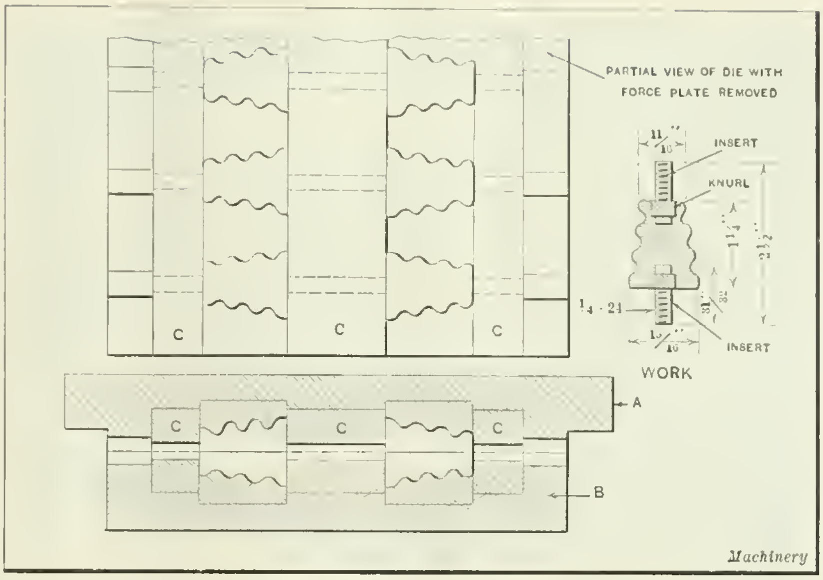


Fig. 2. Dies used in molding Insulators for Radio Variable Condensers

Molding Small Bobbin Having Brass Insert

The first example of molded work to be considered is that of a condensite bobbin made for the American Radio & Research Corporation. The bobbin is used as a vernier adjustment in connection with variometers; an enlarged view of the finished product is shown in the upper right-hand corner of Fig. 1. The main point of interest in connection with this job is the construction of the dies, this being a job known as a "side-draw" job, that is, on account of the flanges which surround the spool portions of the bobbin, it is necessary to draw the sections between the flanges from each side. This calls for the use of pairs of bars *A* which are set into the base plate *B* of the die at each of its three stations.

Each of the three pairs of bars *A* has accommodation for three bobbins and each pair encloses three pairs of plugs *C* which form the bottom surface of the spools. Between each pair of semicircular holes in these bars, there is a countersunk opening leading to a whole which passes through them. Each countersunk hole furnishes a seat for a brass insert *D* and leaves a cavity around the end of the insert so that the material may be built up around it and reinforce it, as indicated in the view of the work at *E*. The bars *A* are furnished with a shallow channel which surrounds the die openings, this being necessary in a negative mold, and is the provision for receiving the overflow material.

The top or force plate *F* carries three dowel-pins by means of which it is aligned with the base plate, and in this force plate there are holes directly over the countersunk holes in which the inserts are seated in the bars *A*. Each of these holes provides accommodations for a protector pin *G* which not only serves to prevent the molded material from entering the central hole in the insert, but also acts as a pilot to position the insert vertically and correctly. The force plate is made of hardened tool steel; the base-plate of unhardened tool steel; the bars of Ketos steel, hardened; the plugs *C* and the protector pins of drill rod.

Preparation of the Mold

After the dies are taken from the press, they are placed on the steam-heated table or work-bench where the removal of the work and the loading of the dies is done. In preparing the mold, the condensite sheets are broken into pieces of approximately correct size, which can be readily determined by the skilled operator, and these are laid on a cloth where they are warmed by the hot plate. The bars *A* are first located in the base plate and the inserts dropped into place in the countersunk holes. The protector pins are then put in place and the cavities jammed full of the now plastic pieces of sheet stock to the extent that they are built up around the protector pins *G*. The operator can usually time his work so that the sheet stock is not allowed to become heated beyond a certain degree. If too much heat is applied to the material it becomes ruined and cannot be reclaimed. The operator, of course, works with heavy leather gloves because the dies are always too hot to be handled with the bare hands.

There are two small holes 0.040 inch in diameter in the work, these being blind holes for the lead wires from the bobbin winding. For the sake of clarity, the two small pins or cores which produce these holes were not shown in the sectional views of the assembled dies, but they are carried in the force plate. As soon as all the inserts have been set in place and the die cavities built up with plastic material, the mold is closed by slipping the force plate over the aligning dowel-pins. The prepared mold is then placed in the press where it is subjected to the required 2000 pounds per square inch pressure for a period of about three minutes.

The hot die is then removed from the steam-heated hydraulic press and placed between the pressure plates of another press in which cold water is used in place of steam. This sufficiently lowers the temperature of the dies so that the hot plastic material, still under pressure, will become completely solidified and shrunk sufficiently to permit ready removal upon opening the dies. The hot dies are left in the cold press for a few minutes, the length of time depending

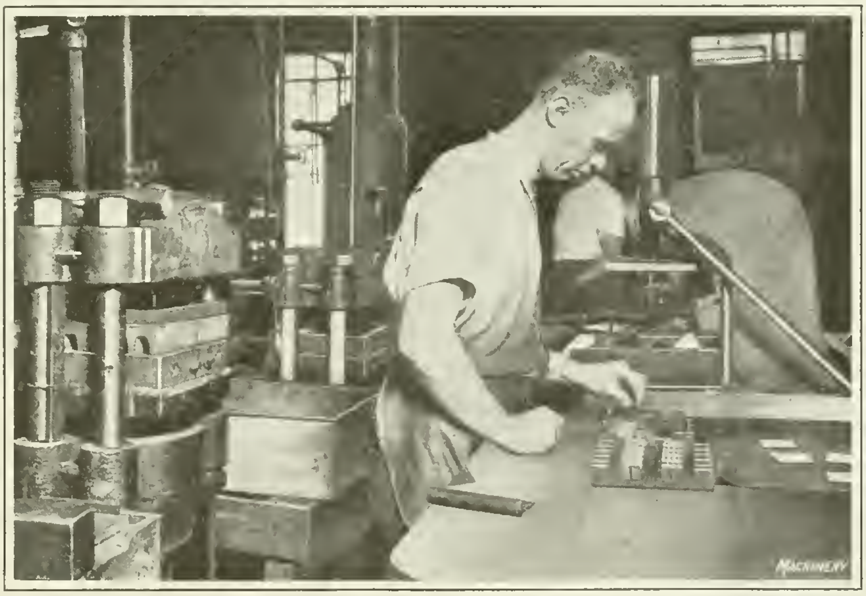


Fig. 3. Preparing the Mold for producing Variable Condenser Insulators

on the judgment of the operator and being regulated in accordance with the size of the work. When the dies are opened they are reversed in position; that is, the force plate is at the bottom, so that the bars *A* are on the force plate instead of in the base plate channels in which they are contained when the die is prepared for molding. This arrangement makes it possible to draw the bars from the side.

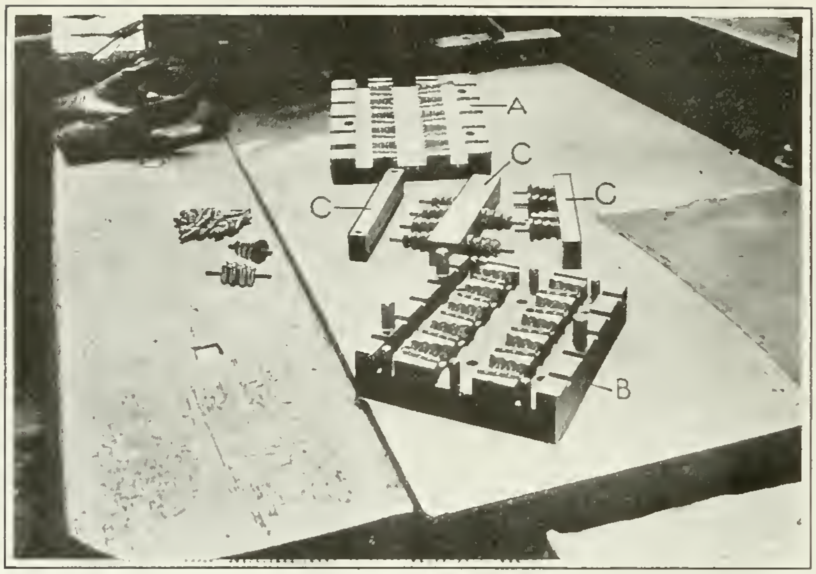


Fig. 4. Parts of the Dies shown in Fig. 2

The next example of molding work is that of a variable condenser insulator, this part being made of sheet redmanol in what might be termed semi-positive dies. A sectional view of this insulator, which is made for the Wireless Specialty Apparatus Co., Boston, Mass., is shown in Fig. 2, also a sectional view of the dies and a partial plan view with the force pate *A* removed.

The baseplate *B* contains three channels in which bars *C* are located by dowel-pins. There are holes spaced in these bars for the accommodation of the inserts which are molded into the insulators. Referring to the view of the work, it will be seen that there are two of these inserts. They are made of brass, have a coarse knurled head and are threaded. The shoulder of the knurled head serves to locate the inserts in the bars and they are slipped into the holes before the bars are put into the die. As soon as the operator has set the inserts into the three bars, pieces of sheet redmanol which previously were weighed to obtain a close approximation of the mass required, and which have been warmed to a plastic state during the preparation of the die, are broken into small pieces which are tucked under the knurled heads of the inserts that project into the cavities in the base plate.

Fig. 3 shows the preparation of this die, after one row of cavities has been filled. The remaining space between the bars is piled high with the plastic material and then the die is closed by means of the force plate in which there are channels to receive the upper part of the insert-carrying bars *C* Fig. 2. This illustration Fig. 3 shows a number of the pieces of redmanol on a cloth, being warmed on the heated plate or work-bench and gives an idea of the size required for the production of this particular insulator. The pieces of sheet stock are about 2½ inches square. The press shown in the foreground is the hot-press and the other is the one in which the dies are cooled by circulating water upon removal from the steam-heated press. The difficulty of providing overflow channels in the dies for this part accounts for the fact that although sheet stock is used, it must be nearly a positive mold. The only escapement for the material that is possible is at the parting, and this

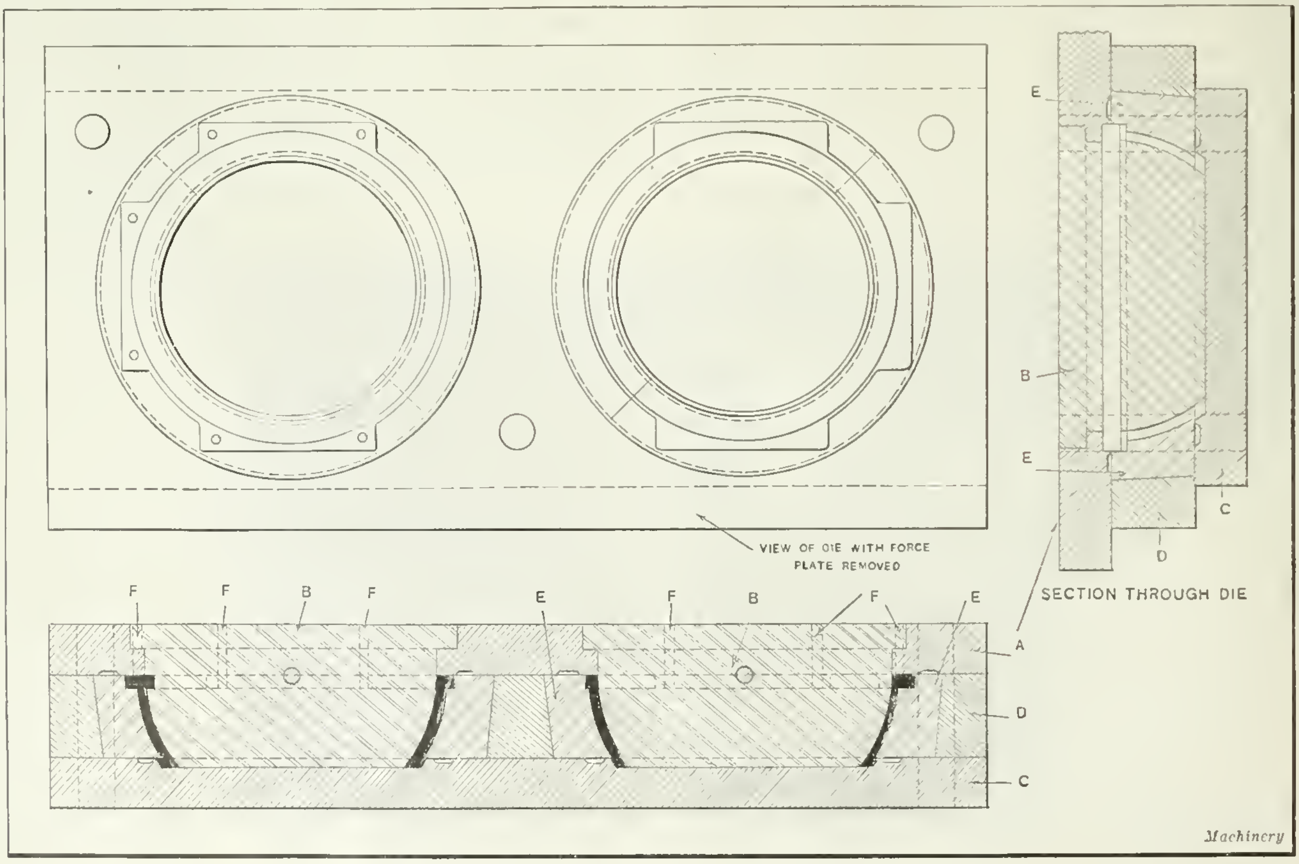


Fig. 5. Dies from which Two Halves of a Variometer Stator are produced

must be kept to such a small amount that the dies will not be prevented from practically coming together. About five minutes is required to mold a set of ten insulators in these dies.

The dies, after they have been opened and the work partly removed, are shown in Fig. 4. The base plate *B* is in the foreground and the three bars *C* are shown with the finished work as it appears when the dies are opened. The force plate *A* is shown in the background. It is necessary to scrape off all particles of plastic material which may have stuck to the matching surfaces of the die-plates, and if this is not done the dies will not be properly closed and will result in an unsatisfactory product. The die-plates, insert bars and pins are made of the same materials as corresponding parts of the dies shown in Fig. 1.

Molding Stators for Variometers

The stator of the variometer used in the Adams-Morgan regenerative circuit receiving set consists of a hollow spherical member which is molded in halves, each part carrying three flanges by means of which the two halves are joined. The rotor member of the variometer revolves within the stator and it has a shaft extending through the stator to which connection to the secondary winding is made. The bearings for this shaft are formed by two semicircular grooves molded into each half of the stator, passing diametrally through two of the flanges mentioned. One of these stator members is shown lying on the die-plate in Fig. 6 and its sectional shape is indicated in Fig. 5, where the work is shown in the dies by solid black sectioning. The stators are made from Shawlac (a shellac composition) which is considerably less expensive than the condensation products, and, for certain uses, just as suitable. This material, in sheet form, is handled in molding much the same as other molding jobs wherein sheet stock is used.

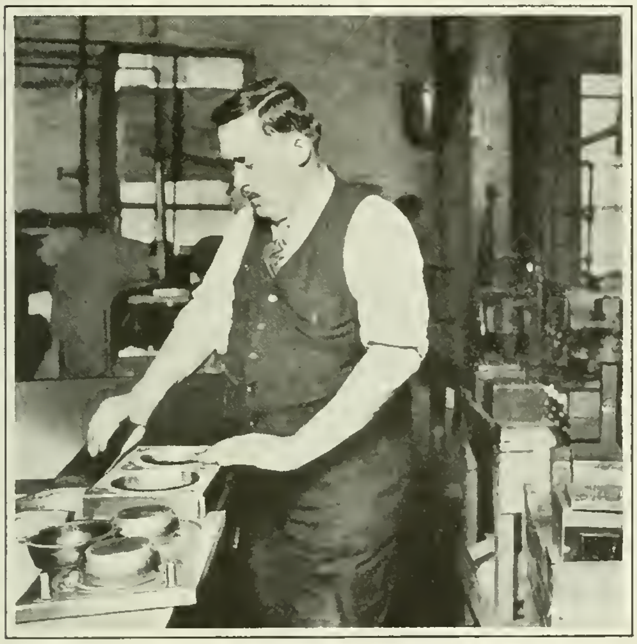


Fig. 6. Preparing the Mold for the Variometer Stator

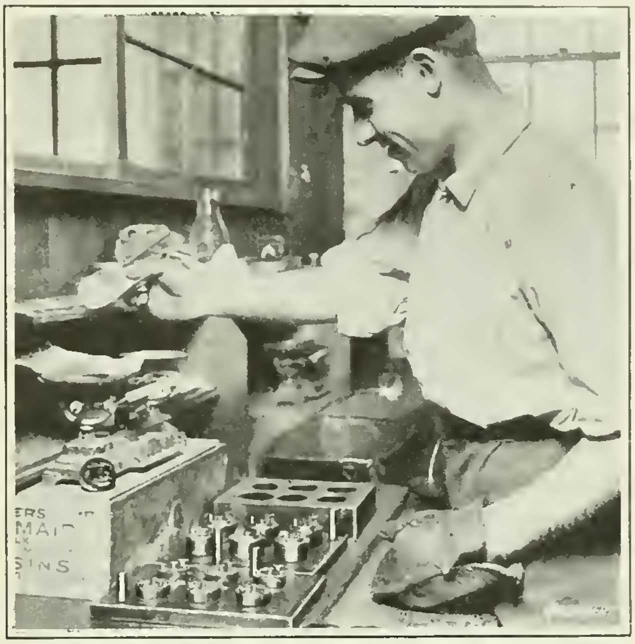


Fig. 7. Weighing out the Molding Material

The construction of the dies is plainly indicated in Fig. 5 where sectional views are shown and a plan view with the force plate removed. The force plate *A* carries two force plugs *B*, through each of which there extends a steel pin, the center line of which coincides with the parting line of the stator halves. These pins extend on both sides of plugs *B* and are the means of forming the half bearings for the rotor shaft in the flanges. The base plate *C* carries an intermediate plate *D* known as a "chase." The chase is machined to receive two split rings *E* for each mold, the rings being located in proper position by pins carried in the base plate. The necessity for this construction will be apparent when the sectional shape of the stator is observed. It would be impossible to remove the work from the dies, on account of the rib at the small end, if the construction did not permit a side draw.

Overflow channels for the excess stock are provided in the force plate and in the base plate, which are shown located close enough to the mold cavity to permit the plastic material to ooze into them when under pressure. Two holes are molded in each of the three flanges for the purpose of assembling the two members together and these holes are formed by pins *F* carried in the force plate. The force plate is made of unhardened tool steel; the base plate, chase, plugs and split rings from pack-hardened machine steel, and the pins and dowels from drill rod. The view shown in Fig. 6 should be self-explanatory after what has already been said regarding the preparation of molds for the production of other articles. The operator is in the act of cutting the sheet stock to fill in around the split die rings, these having been removed for one of the two impressions; they are lying on the heated work-plate just back of the dies.

Bases for Filament Rheostats

All the examples of molded work described up to this time have been made of sheet stock, and have been produced in negative molds. When an article is produced by the positive method, the raw material is used in the form of powder and is carefully weighed so that each charge will contain no excess material. The DeForest filament rheostat is made in this way: It is molded from No. 160 condensite powder and the operation of preparing the mold for this job is illustrated in Fig. 7. Views of the work are shown in the lower right-hand corner of Fig. 8 in which illustration sectional views and a plan view of the dies are also presented. The general die arrangement is not radically different from that already described, except, of course, that there is no overflow channel. When the work is removed from the die impressions of a positive mold, there will be no perceptible fin or burr produced, if the charge has been weighed out accurately.

The force plate *A* carries the force plugs *B* which extend into the chase *C* as shown, when the die is assembled. Similarly, other plugs in the base plate *D* extend up sufficiently to produce the proper die cavities within the chase. The

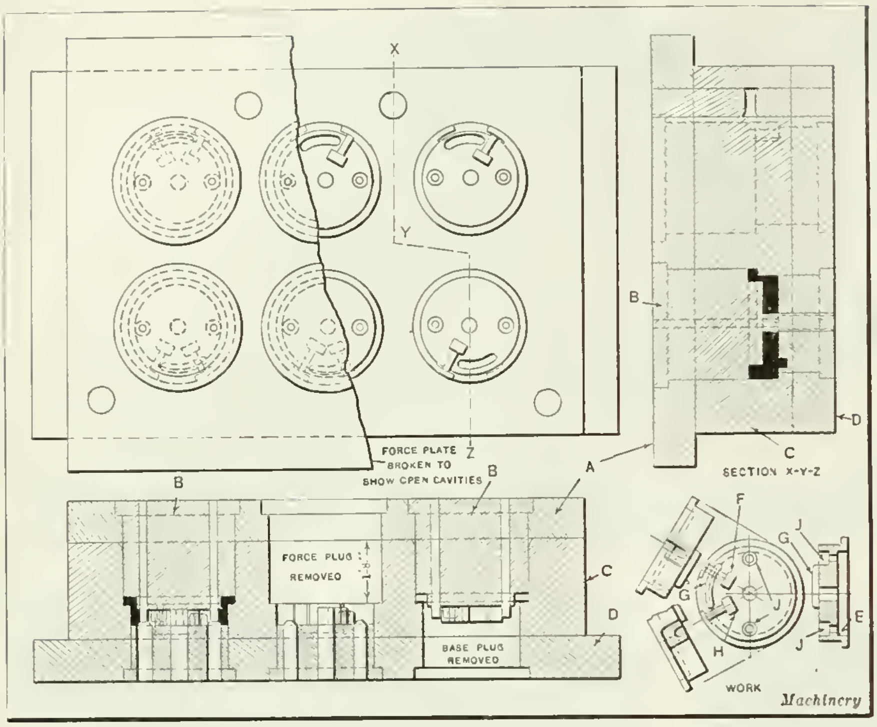


Fig. 8. Rheostat Base and Dies by which it is produced

plugs in the force plate form the countersunk hole *E* and the two small holes leading from it which are countersunk on the opposite side of the work; also these plugs carry a T-shaped member for forming slot *F*. The faces of the plugs in the base plate contain cavities in which the arc-shaped lug *G* is formed; also a T-shaped projection for slot *H* and pins for forming the countersinks *J*.

The longitudinal sectional view shows the dies with one plug removed from both the base and force plates and with both plugs in place in the third station, where a section of the work is shown in heavy lines. The amount of displacement of the charge of powdered condensite is reduced by the 2000 pounds per square inch hydraulic pressure exerted, to approximately one-third its original volume. In designing a positive mold it is, of course, essential to know the exact amount that the material is compressed so that the depth of the chase can be determined accurately; otherwise the work will be molded too thick or too thin, as the case may be. The materials that are used in making the various die parts are the same as those used in similar die parts already described.

* * *

MOLDING THREE-PART WORK IN A TWO-PART FLASK

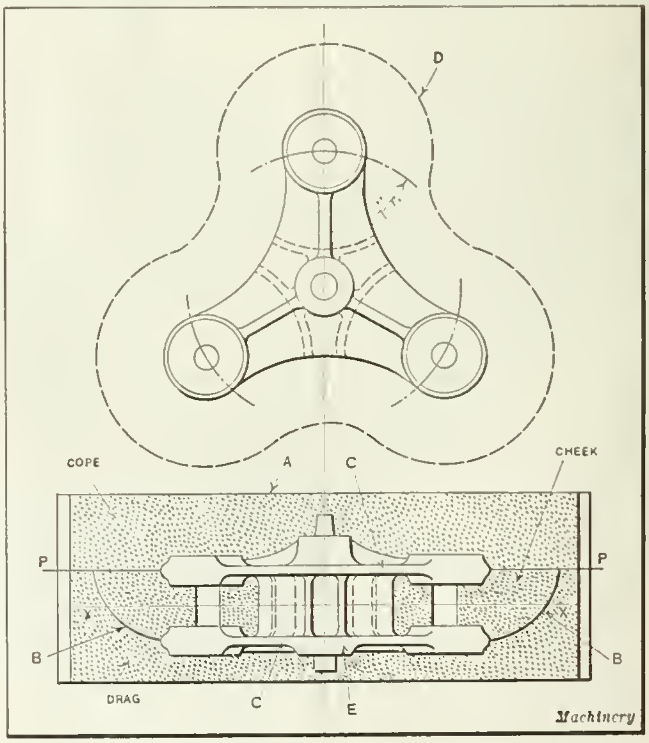
By M. E. DUGGAN

A method of molding three-part work in a two-part flask is here illustrated. The pattern is that of a spool reel frame having the parting line at *XX*. It was originally designed to be molded in green sand in a three-part flask instead of in a two-part flask as described in the following. The writer has found that this method of molding is not often brought to the attention of those outside the foundry, and for that reason believes that the following description will be of general interest.

The procedure in making the mold is as follows: First a bottom board of wood is laid down on the floor of the foundry. The cope flask is then laid on top of this board with the edge or side *A* in contact with the board, the side coinciding with the parting line *PP* being uppermost. Molding sand is next shoveled in up to the top of the flask. After being rammed and the surplus sand struck off, either by hand or by the use of a trowel, the sand is dug out of the center of the mold so as to permit burying the pattern up to the parting line *PP*. Then the space left around the pattern is again filled in and the sand struck off level with the top of the flask or parting line. The molding procedure described in the foregoing is what is known in foundry parlance as "green sand match."

The "cheek" shown within the curved lines *B* is made as follows: The space within the side frames *C* is filled in with molding sand to the outer edge of the pattern; the molding of the cheek is then continued so that this part of the mold is shaped or formed within the section indicated by the dotted line *D*. Iron rods are laid crosswise in the cheek to aid in securing and supporting this section of the mold. The filling in with sand, tamping, banking, and shaping of the curved part of the cheek is all done by hand. The shape or outline of the cheek is not required to be exact, although some patternmakers employ a sweep to finish the work.

The drag flask is next placed in position on the cope and molding sand filled in and rammed up in the usual manner. The drag flask is then lifted off and the top half *E* of the pattern drawn. If necessary, the mold is mended, after which the drag is returned to its position on the cope flask. A bottom board is then laid on top of the mold and the whole assembly clamped securely with iron clamps and wedges. The mold is next rolled over and the cope lifted off. The sand is then shaken out of the cope, after which the cope is put back on the drag. When the cope is in place, the pouring sprue sticks are set in position in the mold and sand shoveled in and rammed up. After venting the mold and withdrawing the sprue sticks, the finished cope is lifted and the upper half of the pattern drawn out. Cores are then set in place and the mold finished in the regular way and made ready for pouring.



Spool Reel Frame molded in Two-part Flask

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, August 14

WITH the settlement of the recent labor disputes it was hoped that industry would gather momentum. So far direct evidence of improvement is wanting and fresh trouble has arisen over the reduction of wages in the engineering trades. The proposal of the employers has been rejected by ballot of the unions concerned, about 60 per cent of those voting being against a settlement on the terms offered. As, however, only about 15 per cent of those entitled to vote recorded their opinion, this attitude is not looked upon as serious, and the advice of the leaders to accept the conditions in spite of the adverse ballot is not surprising.

Whatever the merits of the frequent statements of high costs of production, it is anything but satisfactory to witness the falling of wages in the skilled engineering trades to figures lower than still obtain in a large number of unskilled occupations. There have been many misgivings on this point, as it is felt that the ultimate result will be a secession from skilled trades of the better type of men and a consequent lowering of the calibre of the engineering trades as a whole. The serious condition of unemployment during the past months has been a weighty argument in favor of the unions accepting the terms, and no doubt the majority of the men abstained from voting in the recent ballot because the alternatives appeared to be lower wages or unemployment.

The next question to be considered in the negotiations is the question of payments by results. The opinion is expressed that many leading firms will shortly be adopting payment by results in one form or another. The hostility on the part of the men toward piece-rate systems may be influenced by a convincing guarantee on the part of the employers that present time rates once fixed shall not be altered unless a change in materials or method of production warrants it.

The machine tool industry shows little definite improvement. Makers, generally speaking, are working full time, but with a considerably reduced number of employes. Important machine tool firms in the Midlands report some big inquiries for tools for the automobile industry, and they expect to be busy by the autumn.

It is confidently anticipated that the railways will be in the market again very shortly, and in the Manchester district orders have been booked for heavy and medium-sized machines suited to the requirements of the electrical industry.

Reductions of 20 to 25 per cent below current list prices of standard lines have stimulated some business, and some orders have been influenced by the consideration of the reduction in manufacturing costs that the installation of new machines is likely to effect, rather than by the question of actual first cost.

Overseas Trade in Machine Tools

The official returns for the overseas trade in machine tools for June show that the drop that took place in May has been continued almost uniformly during June both in tonnage and total value. The tonnage for June was, exports 560, imports 186. The value of the exports was £78,445, that of the imports being £25,562. The values per ton rose in both cases, the exports reaching £140 per ton and imports £137 per ton. The curves for exports show a drop during the last twelve months from 1600 tons to 600 tons, the value falling in a corresponding period from £250,000 to £78,000. For the first half of this year exports are only about half of those of the same period last year, and what is more serious, the tonnage is only 83 per cent of the pre-war average.

The exported machine tools still include a preponderance of lathes, of which 216 were exported in June. Apart from machine tools not coming under the usual standard classifications, drilling machines were the next most important export—109 being exported during June. Most classes of machine tools were imported in about equal quantities.

General Engineering

In the automobile industry, there is a good demand for light passenger cars, sufficient to keep the makers moving, but industrial vehicles sell slowly and no improvement is expected until trade is more firmly established. Crane makers are doing fairly well and have secured some good foreign contracts. Structural engineers report nothing to justify undue optimism, but confirm the general belief that business has now taken a definite turn.

In the locomotive industry, the long-expected continental and Indian orders have not yet matured, and buyers seem still to be waiting for lower quotations. The Imperial Government Railways of Japan have ordered thirty-four complete electric locomotives from the English Electric Co., Ltd. Eight of the locomotives are for heavy express passenger service, and weigh approximately 96 tons each. They are designed for hauling a 415-ton train at a speed of about 60 miles per hour. Most of the work in connection with the locomotives will be carried out at the works of Dick Kerr, Ltd., Preston. The English Electric Co., Preston, has undertaken the electrification of 2500 kilometers of the French Midi Railway. The same firm is also carrying out the electrification of the Arthur's Pass section of the New Zealand Midland Railway.

A maker of laundry machinery announces more orders in July than in any month this year, and a general opening up of business suspended during the last two years. In shipbuilding circles the conditions are still very depressing, and new work is not forthcoming despite the lower production costs in effect.

Developments in the Engineering Field

The last two or three years have seen an important increase in the attention given to malleable iron castings in this country. There had been a tendency to look upon malleable iron castings with suspicion, due in the past no doubt to a tendency of manufacturers to adhere to old-fashioned and rule-of-thumb methods. The result has been that nothing like the development of these valuable products have been made here that has been made in America. The recent conference of the Institute of British Foundrymen of Birmingham served to focus attention on the development and improvements that have been effected, and considerable attention was paid to the paper read by Professor Touceda on the practice of American foundrymen. It is expected that the near future will see a great increase in the use of malleable castings.

The National Physical Laboratory, which has already carried out useful work in the development of inspection methods, has been turning its attention to the production of plane surfaces accurate to within 0.00001 inch. It has also applied new processes to the production of snap gages and the preparation of the faces of end measuring rods which will be maintained as standards in the Laboratory.

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STANDARDIZING MACHINE TOOL NAMES

Reference has been made previously in MACHINERY to the activity of the National Machine Tool Builders' Association in connection with the standardization of parts and dimensions within practicable limits, the economy of which is now recognized by machine tool manufacturers everywhere. Would it not be well to carry standardization a step further and apply it to the selection of names for different classes of machine tools?

Many machine tools of the same type now have different names, some of which are misleading and have little or no explanatory value. The names "turret lathe" and "screw machine" are sometimes applied to machines of the same type; drilling machines are also known as "drill presses" or "drills"; the expressions "face grinder" and "edge grinder" are used to designate the same type of machine, which is also true of the names "vertical turret lathe" and "side-head boring mill." The "flat turret lathe" and the "turntable lathe" are similar, as are "multiple-spindle horizontal milling machines" and "rail milling machines." Names such as "grinder," "grinding machine" and "floor grinder," as applied to corresponding types, are confusing and lacking in descriptiveness.

The term "automatic screw machine," though sanctioned by common usage, is a misnomer, and "automatic," as a substitute, is too indefinite. Machines designed primarily for threading bolts and rods are either "threading machines" or, more commonly, "bolt cutters." "Slabbing machines" and "rotary planers" are similar, according to some classifications. "Power hacksaws" are also known as "metal-cutting machines," and the names given to certain other classes of cutting-off machines do not indicate whether the machine is of the cutting-off tool or saw type. There is also room for improvement in selecting names for some gear-cutting machines, as well as tool grinding machines and multiple-spindle drilling machines of different designs. The use of "high-sounding" names should be avoided, especially when accuracy is sacrificed. For instance, many machines are classified as "automatic," when they are strictly semi-automatic.

Buyers frequently refer to a classified product index or directory to obtain the names of firms manufacturing various types of machine tools, and standard names, selected with reference both to their descriptive qualities and the most prevalent usage, would prevent much confusion. A reasonable degree of name standardization would be worth whatever effort might be required to bring about such an improvement.

* * *

ARRANGING SHOP EQUIPMENT

Every shop executive knows that machine tools and other shop equipment should be so arranged that the material to be machined may travel through the shop by the most direct route; the ideal arrangement is that which permits every part to move from the stock-rooms through the machining departments to the shipping department in as nearly a straight line as possible. To obtain this result very careful planning is necessary in locating the different departments in the shop and the machines within each department. Two methods are generally used to group machine tools so as to simplify the travel of the material through the plant.

Under one method all the machines of a certain class are placed in one group or department. For example, lathes should be in one place, drilling machines in another, automatic screw machines in a third, etc. Under this grouping method the departments are located so that the material passes from department to department in the order of the operations to be performed on it, the departments, as far as possible, being located so as to eliminate the trucking of material back and forth.

When the work to be handled is comparatively large, a second method sometimes known as "process grouping" is frequently used. In this case machines of different types may be placed in a group in the same department in such order as to complete a part without moving it from the group. For example, if a part is to be turned, planed, milled and drilled, four machines for performing these operations may be placed in a group. This plan will save considerable handling of heavy pieces, but is applicable as a rule only when the product of the plant remains practically the same from year to year.

The grouping of machines of one type in each department is more economical when the work is small, and when changes in the design or character of the product are likely to be made; it also makes it possible to have an expert in charge of each class of machines. The second method is better for heavy work, particularly when it is of a uniform and permanent character.

* * *

TWO FACTORS IN SAFETY WORK

The campaign started some ten years ago to provide safer working conditions in shops and factories has resulted in the adoption of many safety devices which have materially reduced the number of accidents. Manufacturers of machine tools and other shop equipment have provided guards to prevent the operator from coming into contact with any dangerous moving parts. Ingenious safety appliances have been incorporated in the design of power presses, because the operators of these machines probably are exposed to greater dangers than those handling other types of machine tools. But the provision of guards and other safety appliances and the instruction in their use, is but one factor in safety work. The other is the assurance that the operators will make such use of the safeguards that they will be shielded effectually from accident.

In a large press shop a man was recently injured by having the fingers of one hand crushed between the dies. Every press in that factory was equipped with a safety device so arranged that in order to release the clutch and bring down the upper die, it was necessary to operate two levers, one being actuated by each of the workman's hands. In the circumstances, it seemed impossible for the operator to expose either of his hands to injury, as both had to be out of the way when the die descended; but examination of the machine referred to showed that the operator had tied down one of the levers so that he was able to trip the press by operating only one handle. In other words, he had taken the trouble to render inoperative the provision for his safety installed at considerable expense by the company. Little can be done to eliminate accidents to operators who deliberately take such chances and will not listen either to advice or instruction. They take their lives in their own hands.

Prices, Wages and Cost of Materials

By F. N. MACLEOD, President, Abrasive Machine Tool Co., East Providence, R. I.

LET it be said right at the start that increased prices of machine tools are necessary if this American industry is to permanently maintain the high standards for which it has been known for a generation. The low prices prevailing today, due to keen and sometimes destructive competition, in most branches of the machine tool industry, cannot prevail for long. Increases must be made to meet the higher costs of today as compared with pre-war days. Any return to pre-war figures would entail a return to pre-war wages, pre-war taxes, pre-war railroad rates, pre-war material prices, or in a word, to a pre-war status in every respect, which every reasonable person knows to be an impossibility.

The Question of Wages

It is true that wages in the machine tool industry at the present time are practically twice what they were before the war, expressed in dollars and cents, but when compared with the wages paid in other industries demanding equal skill it cannot be said that they are high. The machine tool industry demands an intelligent, loyal, and skilled body of men. Men of this caliber must be paid more than a mere living wage. During the war, wages and prices in this industry advanced in practically the same ratio, and as living cost—expressed as a whole—has somewhat receded from its peak, wages in this industry have been reduced in a greater proportion. In many other industries (for example, the textile and leather industries, where selling prices during the war tripled and quadrupled) wages advanced in much greater proportion than in the machine tool industry. As a result, mill employes who in the past were paid less than machinists, have, during the last three or four years been paid as much as and in many cases more than the prevailing rate for a skilled mechanic. The skill and knowledge demanded of good machinists and toolmakers certainly entitle them to a higher reward than is paid to the comparatively unskilled labor of the textile and some other industries.

They are not now receiving these wages, and the industry is suffering as a consequence. It will continue to suffer more and more as years go on, unless the machine tool builder insists upon higher prices for his product and a reasonable profit, which will enable him to pay higher wages and thereby attract a better class of workers, thus elevating the industry to the plane to which its importance entitles it. Unless this is done, it will also be difficult to attract the right sort of apprentices to this industry, as they must have something better than a mere existence to look forward to in life.

Present Wages and Fixed Charges Increase the Cost of Manufacture

It might be said that the machine tool business is a separate and distinct industry in so far as the mechanics employed are concerned; it demands a good education and a high order of intelligence, as well as loyalty, and to attract a desirable type of employe it will be necessary to remunerate him at least equally as well as other industries requiring skilled labor. This is as much to the interest of the buyers and users of machine tools as it is to the manufacturers. The tool builder makes but one profit out of his product whereas the purchaser of his machines is deriving a continual income therefrom; consequently it is to his interest that the tools purchased should be of the best workmanship and of the most enduring nature.

The fixed charges that really constitute the main item of overhead in a machine shop have increased during the last ten years in a far greater ratio than either prices or wages. Federal, state and municipal taxes today mount to figures that would have been considered impossible ten years ago. Freight rates are from 50 to 75 per cent higher, and selling expenses have increased, due to many causes, not the least of which is the nearly doubled railroad fares and hotel expenses. The dealers' commissions have been increased in nearly every instance, and the buyer demands more free service and credit extension than ever before. These two items alone add a considerable sum to the total expense of doing business.

A fact that should not be overlooked is that the part of the overhead chargeable to each machine or unit built is much greater today than it was three years ago when tool shops were running to capacity. Another item entering into this load of overhead expense is the amount chargeable to idle buildings and equipment, which unfortunately is not usually taken into consideration. This overhead has to be paid, and while machine tool builders in their competitive efforts have reduced prices to a point where a smaller part of this overhead is paid by the customer than was the case three years ago, the manufacturer in the meantime has been using up his surplus in taking care of this additional load. This condition certainly cannot continue. The time is at hand when the selling price must include the total overhead, even when production is comparatively small, and price increases seem to be necessary in the machine tool field in order to cover all these increased costs which the changed conditions have brought about.

Cost of Material

The cost of material entering into the construction of machine tools is in most cases a comparatively small item among the total costs—that is, a slight fluctuation of 10 or 20 per cent in the price of the raw materials would not materially affect the total selling price, probably not more than 2 to 4 per cent.. Nevertheless, with materials approximately 25 to 50 per cent above the pre-war level, this item alone adds from 5 to 10 per cent to the actual cost of the machine, and with freight rates considered in addition, the total increase is a material factor.

The cost of power to operate a machine shop today is about twice what it was prior to 1914—at least in the districts located far from the coal mines. Here, again, the high freight rates add materially to the fuel cost. The list could be continued indefinitely, since practically every item entering into machine tool production has increased by a much greater percentage over the pre-war level than present machine tool prices have, as compared with pre-war figures.

Machine Tool Prices Must Advance

To sum up, it may be said that if the industry is to continue to spend money on the development of better types of machine tools, for which skilled workers will be required—with both skilled brain and skilled hand—the industry must be placed in a position where it can pay wages commensurate with the type of men required. With this end in view, machine tool prices must advance.

It is not a question of whether machine tools are to be reduced any further. It is a question of *how much* they are to be *increased*. The buyers and users of machinery must realize that they cannot "squeeze blood out of a turnip," and that the present low prices are not based upon production costs, but are purely the result of keen, not to say ruinous, competition in an overstocked market. Even though machine tools were considerably advanced in price during the war period, the increases were nowhere nearly equal to the increases in other commodities, such as shoes, clothing, etc. Hence, such a drastic deflation as should take place in some of these other industries is an impossibility in the machine tool business, nor should there be any advocacy of reducing wages in this field where the workers are already paid much less than those engaged in the building, transportation, printing, and clothing trades.

It should be impressed upon every buyer and user of machine tools that it is in their interest to maintain a high standard of workmanship in the machine tool industry, because their profits are directly dependent upon the standard of machine tools that the American machine tool industry will produce in the future. High-grade men can only be attracted to this industry by maintaining a reasonable rate of wages. It is merely repeating a thought that has often been expressed and that ought to be thoroughly understood by everyone in the machine shop field, that the development and improvement in machine tools is the keystone upon which the prosperity of all other industries depends. Users of machine tools can increase their output and thereby reduce their costs by the introduction of highly productive machines, and they should be willing to pay the price for the service which is rendered.

* * *

MACHINE TOOL EXHIBITION IN NEW HAVEN

Plans are being made for an exhibition of machine tools and appliances to be held in the Mason Laboratory of the Sheffield Scientific School, Yale University, New Haven, Conn., September 21 to 23. The exhibition will be held under the joint auspices of the New Haven branch of the American Society of Mechanical Engineers and the Department of Mechanical Engineering of Yale University. The purpose is to bring before the manufacturers of Connecticut and the engineering students of the university the latest developments in machine tool practice. There is no charge for space, and no admission fee for spectators, as the exhibition committee is giving the exhibition as a means of stimulating industry and hastening the return of normal business conditions. Papers relating to machine shop subjects will be read each evening by men well known in the industry. Exhibitors are also invited to show motion pictures of their machines and appliances and to have representatives present to demonstrate and explain the operation of the machines exhibited. The privilege to exhibit is by invitation only—about 150 invitations having been issued.

* * *

MEETING OF SECRETARIES OF NATIONAL METAL TRADES ASSOCIATION

The local branch secretaries of the National Metal Trades Association met August 16 and 17 at Milwaukee, Wis., for their semi-annual conference. Among the papers read and discussed were the following: "An Up-to-date Employment Bureau," by Chester M. Culver; "Objections to Legislation Favoring Unemployment, Health Insurance, and Old Age Pensions," by J. M. Manly; "Experience of the Grand Rapids Branch of the National Metal Trades Association with their Mutual Workman's Compensation Insurance Bureau," by A. W. Blodgett; "Comparative Wage Schedules," by W. J. Cronin; "Need and Value of Economic Education of Employes," by Donald Tulloch; and "Turnover—Causes and Remedy," by T. G. Silkman.

CONVENTION OF THE STEEL TREATING AND DROP-FORGING SOCIETIES

During the entire week of October 2 to 7 the American Society for Steel Treating and the American Drop-Forging Institute will hold their respective conventions in Detroit, Mich., with headquarters in the General Motors Bldg. In connection with these conventions the fourth international steel exposition will be held. Practically all of the 50,000 square feet available for display space has been sold, and the exposition is expected to be the largest of its kind ever held. Both gas and electrical furnaces will be shown in operation, and many other exhibits may be viewed in working condition.

Technical Sessions

The technical sessions of the convention will be held October 3 to 6, when papers on a great number of subjects of interest to those treating steels and making drop-forgings will be read. Among the many subjects that will be taken up are problems of casehardening, electric furnaces, formation of scale, heat-treatment of automobile springs, tool steels and their structure, and heat-treatment and properties of duralumin. There will also be a symposium on hardness testing, dealing with many of the problems involved in proper hardness testing methods. Papers will be read on the significance of hardness tests, and on hardness and its relation to magnetic properties.

During the convention, arrangements will be made to visit some of the leading automobile plants and other well-known shops in Detroit, including the Ford Motor Co. (both the Highland Park plant and the River Ridge plant), the Cadillac Motor Car Co., the Lincoln Motor Car Co. and the Hudson Motor Car Co. Visits to the Detroit Twist Drill Co., the Central Forge & Gear Co., and the Detroit Steel Products Co. have also been arranged for. The visits to the plants will be distributed over four days of the convention, two plants being visited each day, so as to prevent overlapping and give everybody an opportunity to visit the plants in which they are most interested.

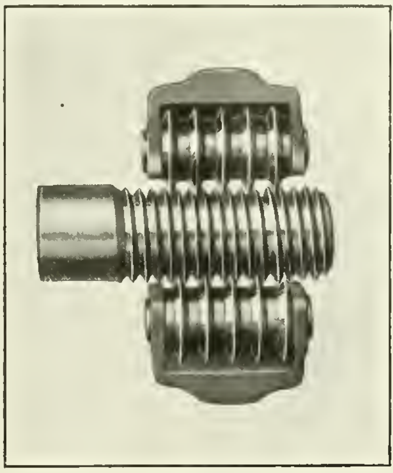
Another feature of the convention will be a symposium on metallurgical education. There have been many requests from members of the American Society for Steel Treating engaged in the teaching profession for a conference with metallurgical engineers, so that the universities and colleges might better prepare their students for the greatest possible usefulness in practical work. At this conference it is not proposed to discuss how to teach metallurgy, but to dwell upon what metallurgical subjects should receive the greatest emphasis.

Officers of American Society for Steel Treating

The election of the following officers of the American Society for Steel Treating has been announced: President, T. D. Lynch, research engineer, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.; second vice-president, W. S. Bidle, president, W. S. Bidle Co., Cleveland, Ohio; secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio; director, S. M. Havens, assistant treasurer and manager, Ingalls-Shepard Division, Wyman Gordon Co., Harvey, Ill. The following officers remain in office from last year: First vice-president, R. J. Allen, metallurgist, Rolls-Royce Co. of America, Springfield, Mass.; treasurer, J. V. Emmons, metallurgist, Cleveland Twist Drill Co., Cleveland, Ohio; director, J. J. Crowe, metallurgist, Philadelphia Navy Yard, Philadelphia, Pa.; director, A. E. White, past president, and director of the Engineering Research University of Michigan, Ann Arbor, Mich.; director, F. P. Gilligan, past president, and secretary-treasurer of Henry Souther Engineering Co., Hartford, Conn. The board of directors of the society is composed of all the officers. The new board will enter upon its duties at the close of the annual convention.

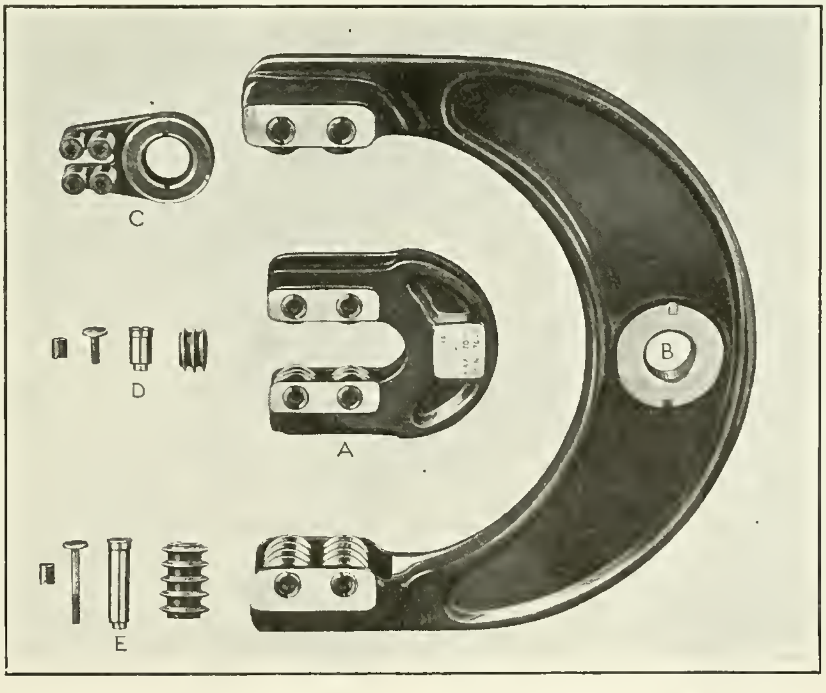
New Type of Adjustable Thread Snap Gage

By CHARLES G. JOHNSON, General Manager, John-Sons Gage Works, Hartford, Conn.



ONE advantage of snap gages is that the sense of feeling need not be entirely relied upon in checking a part, as the sense of sight may also be used. The relation between the gaging elements and the part being inspected may be determined by the amount of light showing between their contact surfaces. Light passes through a very small opening, but is shut out entirely where contact exists. The design of a given snap gage, has a considerable effect, of course, on the extent to which the sense of sight may be employed. The John-Sons Gage Works, 67 Blue Hills Ave., Hartford, Conn., in placing on the market an adjustable thread snap gage made in the styles here illustrated, has provided a means of employing both the sense of touch and the sense of sight in inspecting the different elements of male threads either individually or collectively. By "elements" is meant the size, lead, thread form, concentricity, and straightness of the part.

This gage is provided with two sets of gaging rolls for the "Go" and "Not Go" inspection of parts, the outer rolls being the "Go" set and the inner ones the "Not Go" set. Each roll has a series of annular ribs of the same form as the thread to be inspected, and these ribs are spaced to project between every second thread. Left- or right-hand threads and single or double threads may be gaged because of the fact that the annular ribs on the rolls have no helix angle. The rolls are free to rotate on their axes, a feature that provides for the distribution of wear over a large surface and consequently lengthens the life of the gage. By using one rib on each roll of a set, the pitch diameter of a thread can be accurately determined, and by using the entire length of the rolls the accuracy of the thread form and the lead and the presence of any taper can be ascertained. A staggered thread or one out of round may be detected by rotating the part between the rolls. In the heading illustration is shown clearly the existence of an inaccuracy in the lead of a U. S. standard die cut thread.



Different Styles of Adjustable Snap Gages for inspecting the Elements of Male Threads

Other advantages of this thread snap gage are that it can be used for inspecting work in motion, and work cannot be cramped between the gaging rolls. The latter are interchangeable to provide for inspecting threads of the same diameter but of different pitch with the same gage. The rolls of a set are also adjustable toward one another a total distance of 0.040 inch. This adjustment is obtained by rotating the eccentric bushing upon which each roll is mounted. The rolls are set correctly by the use of a master thread plug which is left soft because no wear results from making the settings. After adjusting the rolls, they are locked in place by tightening a binding screw.

The gaging rolls of Style *A* are approximately 3/8 inch in length, and those of Style *B* are 1 inch long. Style *A* is recommended as being the most suitable for general application except in cases where a long thread must be positively checked for lead and for threads having a pitch coarser than ten threads per inch. Style *C* is made for gaging A.S.M.E. threads from No. 0 to 12, inclusive. The group of details *D* belong to Style *A*, and those in group *E* to Style *B*. The frame of each gage is a heat-treated iron casting.

* * *

BALANCING PLANT EQUIPMENT

A factor in shop operation that is not always given the attention it deserves, is a proper balance of the machine and tool equipment. Sometimes a shop has too many of one type of machine tools and too few of another. In buying equipment, a careful study should be made of the capacity of each machine, so that the output of all the machines may be equalized—that is, so that various parts may be produced in the right proportion; otherwise, some parts will be made in too large quantities, while others will be insufficient in numbers, and some operations will always be far ahead of others. If the probable production required from the plant is first estimated and then the probable production of each machine determined, it will be possible to estimate accurately the number of machines required to handle a given production. If this is not done, some departments will be required to work over-time in order to catch up with the production in other departments.

Sometimes the machine equipment is properly balanced, but production is crippled, due to incompetent supervision of certain departments or faulty operation of the equipment. Things of this kind can be remedied only by a thorough study of all the departments.

The Future of American Machinery and Tools in Europe

By A. L. VALENTINE, formerly "Directeur technique" of the Societe des Usines Curial, Paris, France*

The author of this article has had an unusual opportunity to gain first-hand information with regard to the machine and tool situation in continental Europe. For the last three years he has been "Directeur technique" of the Societe des Usines Curial in Paris, for which company he built and equipped one of the most modern small tool factories on the European continent. In preparing this article, he has availed himself of the assistance and opinions of one of the best known sellers of American machine tools in Belgium, who is connected with one of the foremost European dealers—a man who is considered an expert in his line and who knows intimately the commercial side of the European market for American machine tools and small tools. Mr. Valentine, before his engagement in France, was for fifteen years superintendent of the Small Tool Division of the Pratt & Whitney Co., Hartford, Conn.

PREVIOUS to the war there were few European mechanical engineers who were not convinced and willing to admit that American machinery and tools were superior to those made in any other country. After the armistice, and especially during the last two years, the machine tool and small tool industry in some of the European countries has rapidly developed, and there is danger of a change of opinions, especially in France and Belgium, and also in Italy and Spain. Before the war the price of the American product was low enough so that it could easily compete with any domestic machinery and tools. At the present time this situation with regard to price does not exist, and consequently the sales of American products in this field—especially small tools—are very small. American manufacturers have attributed the limited sales almost entirely to adverse exchange conditions, but other even more important factors have also had a very great influence.

The writer believes that when the rates of exchange have been finally stabilized, there still will be a comparatively small market in Europe for American machine tools and small tools. He bases this opinion upon his experience during the last three years, when he was in a position to study the situation in all its phases intimately, not only in France but in other European countries as well. It appears that there is only one means by which American manufacturers may continue to retain their hold upon the European market in this field, and that is by manufacturing in branch factories in Europe, a subject which will be dealt with in greater detail later. Several months ago one prominent American manufacturer took steps in this direction, and in the near future will produce his tools in one of the European countries for the European market; there are to his knowledge at least, two other manufacturers who are now making investigations with the same aim in view.

Stocks of Machine Tools in France

A thorough explanation of the causes which tend to curtail the market for American machinery and tools in Europe goes back to the time when the armistice was signed. At the end of the war the allied nations reduced their imports because of the tremendous shipments that had been received by them during the war, and those that were actually on the way at that time, all of which would first have to be put to peaceful use before there would be a further demand. If all other conditions had remained as before the war, there would, however, only have been a temporary falling off in demand; and had business and exchange remained normal, even the great quantities of machines in good condition that were available would soon have been absorbed. Due to the business crisis on the continent, there are even at this time, especially in France, large quantities of machinery and tools still to be disposed of. Right outside of Paris there are large warehouses filled with unused machine tools and other machinery remaining from the surplus stock of the war. These warehouses equal in extent the size of a machine tool plant that would employ between 3000 or 4000 men, this comparison being given in order to furnish an idea of the quantity of machinery available. It will be long before this machinery is absorbed by French industries.

The Manufacture of Machines and Tools in Europe

The surplus stocks, however, are not the most serious factor in the situation. During the war a few French and Italian manufacturers established departments in their own shops, in which they not only manufactured their own machines and tools but also started to make for the market as well. When the armistice was signed, quite a number of firms were in a position to furnish satisfactory equipment of all kinds to the domestic market. In the three years following the armistice, a very important machine and tool industry was developed in France and Belgium, and to some extent in Italy; in the small tool field especially, there has been great activity. It ought also to be mentioned in this connection that as far as France, Belgium, and Italy are concerned, there has been very little actual copying of American machines and tools.

The high rate of exchange has encouraged these firms, but it is problematical how many of them will be able to hold their markets permanently against American and German competition. Nevertheless, while many of these new concerns have already failed owing to the unstabilized business conditions in Europe, and while several more will fail, there is a substantial number who have the financial strength to weather the storms, and who will succeed and grow more active as time passes. The competition they will offer will severely influence the market for American machines; to quote verbatim a prominent seller of American machine tools in Europe: "There is at present a strong tendency on the part of our customers to buy machines made by their own countrymen, with the conviction that they buy good machines well adapted for their requirements. Such machines are particularly planers, shapers, upright drilling machines, radial drilling machines, vertical boring mills, lathes of all kinds, punching and shearing machines, drop-hammers, foundry equipment, pneumatic tools, electric and air drills, and air compressors. The only American machines for which I can see a future market in Europe are certain classes of milling machines and grinding machines, gear cutting machinery, special machinery, and, to a small extent, planers. In the small tool line the situation is still more difficult, because, besides what has been done in France and Belgium, we feel very much the German, Swiss, and Swedish competition."

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German Competition Active and Successful

The German competition in measuring tools and measuring instruments of all kinds is especially active, and the tools sold are of a high quality and accurate. Continuing the quotation of the selling expert: "The manufacture of twist drills and reamers has taken on such an important aspect that there is very little room left for the American product, and the prices at present, at least, cannot possibly be met by American competitors. In the manufacture of plain milling cutters, saws, side milling cutters, cutters for cutting gears, and gear hobs, there has also been an important development in France and Italy, and there are several manufacturers capable of producing as good tools as those made in America. The workmanship and the quality of the steel employed in the manufacture of these tools compare well with those of any American make."

The writer himself has had an opportunity to compare cutters for cutting gears of American and German make, and has found that the German tools are remarkably accurate, and at the present time, of course, very much cheaper. Imports from Germany into France, Belgium, and Italy are neither encouraged nor popular, but when the quality is equal and the price is lower there is only one course for the buyer to pursue. The natural result is an ever-increasing effort on the part of the people in France, Belgium and Italy to meet by their own manufactures the competition of the foreign product by quality as well as price, and a visit of American manufacturers to some of the French and Belgian shops where machine tools and small tools are made would prove a revelation. In this way only can the real situation be understood thoroughly and it would be appreciated that the competition can be met only by actual manufacture of American designs in Europe.

The Present Development of the French Industry

The extent to which the national spirit has been aroused in Europe by the war has also given a tremendous impetus to all commercial and industrial activities. Plans are now being made in France for the manufacture of small tools in greater quantities than before, and it seems safe to say that it is only a question of a couple of years before France, Belgium, and Italy will be able to supply themselves with everything they need in the small tool line—except possibly in the line of precision tools, as there has been no real effort made as yet to produce tools of this kind, because the market is comparatively small. But the capacity of the French, particularly, for producing precision tools, if the need arises, is unquestioned; and when their manufacturing industries have been placed on a basis of mass production, they will doubtless turn out precision tools and instruments that will be on a par with those made in America, Germany, and Switzerland.

It should not be overlooked that in addition to the difficulties caused by the exchange situation, European manufacturers are largely assisted in their efforts to introduce their products in their home markets by the lack of quality in some of the machine tools and small tools which were shipped to Europe during the war and during the boom period after the war. Some firms whose reputation before the war was of the very highest, injured their standing considerably during the war, and the new firms that have sprung up in Europe to manufacture competing lines have taken every advantage of the situation. It is of the utmost importance that there be no deterioration in the quality of American machine tools supplied to the European market. As a matter of fact, the European buyer today is more insistent upon quality and accuracy than ever before.

How to Hold the European Trade

In the writer's opinion (and he is supported not only by dealers in machine tools but by prominent industrial men in both France and Belgium) there is only one way in which American manufacturers can compete in the European market, and that is by manufacturing in Europe and by beginning to do so now, before it becomes too late. The advantages obtained would be the reduction of costs due to eliminating freight charges, customs dues, and insurance; and the use of the much cheaper European workmen, who, when properly guided, and with the work properly systematized, show a remarkable aptitude, and who, when given the proper equipment, actually produce more than the majority of American workers. The continental labor conditions today are very much better and more favorable than those in the United States. The raw materials are cheaper, and the quality fully as good. High-speed steel, particularly, is excellent. The expense of stocking machines with agencies should also be considered. At present the agencies, as a rule, do not carry in stock a sufficient quantity of machines and tools.

The market for cutters and reamers and even twist drills could be regained quite easily by equipping factories in France with special American machinery and placing a few American specialists in charge. The market for taps and dies could easily be held by this means, because that market is as yet not captured by the European manufacturer, although there are two firms who are working very earnestly toward supplying the domestic demand in this line.

It would seem that American manufacturers would have everything to gain by a radical change in their attitude toward the European market. The high rate of exchange would enable an American manufacturer to build or buy factories abroad at a price that would appear to be comparatively cheap. The appearance of well-known, well-equipped and financially strong American firms in these three countries, producing machines and tools of high reputation, accuracy and quality, would soon discourage any attempts to start new European concerns in this field.

* * *

BILL TO REDUCE PASSPORT FEES

Commercial travelers abroad have found the large passport fees payable in the United States and abroad a heavy burden. Steps are now being taken, through the introduction of a bill in Congress by Representative Mills of New York, for reducing the passport fees assessed by the United States Government. This will reduce immediately the passport visé fees of the countries which have a standing provision that their fees are the same to citizens of any country as the amount assessed to their nationals by that country. Other countries who have raised their passport fees will doubtless reduce them if the United States leads the way. Under the terms of the bill, a passport would be issued to an American citizen for $5, valid for two years; and the fee for viséing passports would be reduced from $10 to $2. Those interested in this measure may communicate with the Chairman of the House Committee on Foreign Affairs, the Honorable Stephen G. Porter, and the Chairman of the Senate Committee on Foreign Relations, the Honorable Henry Cabot Lodge. The bill is known as H.R. 12235, and it is believed that its enactment would be of material aid to international trade. All nations realize the burdensome tax imposed by the passport fees, but they all followed the lead of the United States in imposing this tax upon travel. It is certain that other nations would gladly follow if the United States would lead the way in reducing this burden.

Wire Forming

Second of Two Articles Dealing with the Methods Used in the Manufacture of Wire Goods and the General Principles Applied in the Design of Typical Wire-forming Machines

Section of a Wire-forming Shop

In the first article on this subject, published in August Machinery, the basic principles of wire forming, forming dies, and tooling methods for the production of wire articles were presented, supplemented by examples of wire forming. In the present installment, articles that require special arrangements of tools and ways of operating them are dealt with. All wire forming is, in a greater or less degree, special, and it would be possible to select a great many examples, each of special interest and containing unique manufacturing processes, but those here shown are typical of the nature of the work. The practice described is that of the Eastern Tool & Mfg. Co., Bloomfield, N. J.

Making an Over-all Slide

The manufacture of the over-all slide shown in the upper left-hand corner of Fig. 6 involves wire-forming work of an interesting nature and calls for the application of many of the principles of wire forming which were noted in the previous installment of this article. The slides are made from soft steel square drawn wire, No. 15 W & M gage (0.072 inch). The work is done on a No. 2 Nilson wire-forming machine and is produced complete in one sequence of operations. The wire is fed through the straightener rolls in the regular way and against a stop, at which time it bears against the front surface of the king-post, in the position illustrated in Fig. 7 which shows the incoming wire passing over the completed work before that pieced is stripped from the king-post.

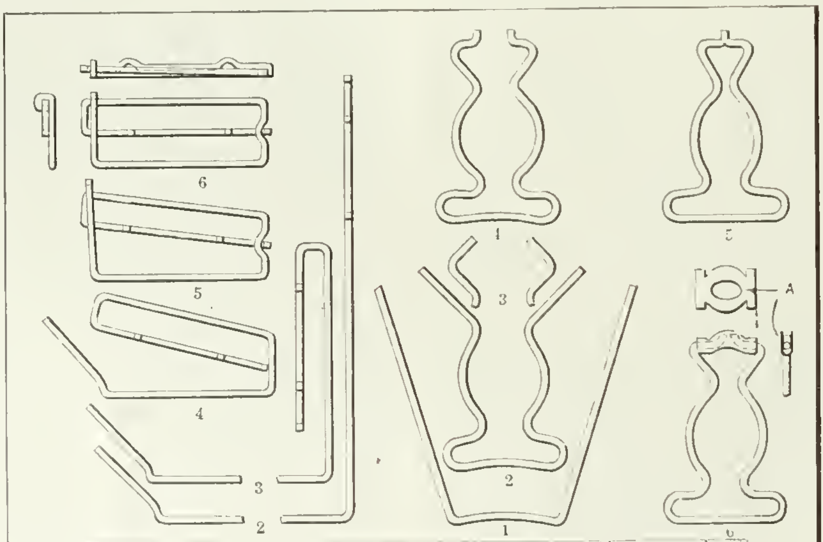


Fig. 6. A Number of Shapes produced in the Manufacture of Wire Slides and Loops for Over-alls

The position of the wire relative to the stop is indicated at *A* in Fig. 9 where it first rests on a step preparatory to bending the crimps and the hook end. It is necesssary to prevent the wire from sagging so that it will rest on this step, and for this purpose a guide is employed the end of which is barely visible from the right-hand side of the machine at *A*, Fig. 8. The front opening of this guide is V-shaped so that the end of the wire can readily ride into the locating slot, where it is engaged by a small spring finger from beneath, which properly locates the wire at the level of the step mentioned. The die for forming this end of the wire is visible at *B*. This die and the cut-off *A* (see Fig. 7) operate in unison, and the cut-off is designed with a shoulder for the purpose of producing a bend in the end of the stock after it has been severed. The shape produced in the first operation is indicated in the illustration Fig. 6, which also shows the work in the six different stages of its manufacture.

The front die shown at *B* in Fig. 7 is next advanced and bends the wire with the aid of the king-post, into the shape indicated in Fig. 6 and also in the diagrammatic lay-out, Fig. 9. In this illustration the lower end of the king-post around which the completed work is to be formed is indicated at *B*. The front die *C* contains a groove by means of which the wire is located in one plane during all subsequent forming operations. This groove produces a right-angle bend at one end, and, by reason of a cut-away corner in the groove, an angular bend in the opposite end. This angular bend is produced for a special purpose and the slide could not be formed, at least according to the methods here described, unless this angular bend were first produced. The wire that forms the 90-degree angle sweeps around until it rides up the top surface of a screw-head *D* which contains a slot in which the wire becomes lodged. The wire is prevented from becoming dislocated from this slot during the next bending operation by a spring wire, the end of which is arranged about as shown at *F*.

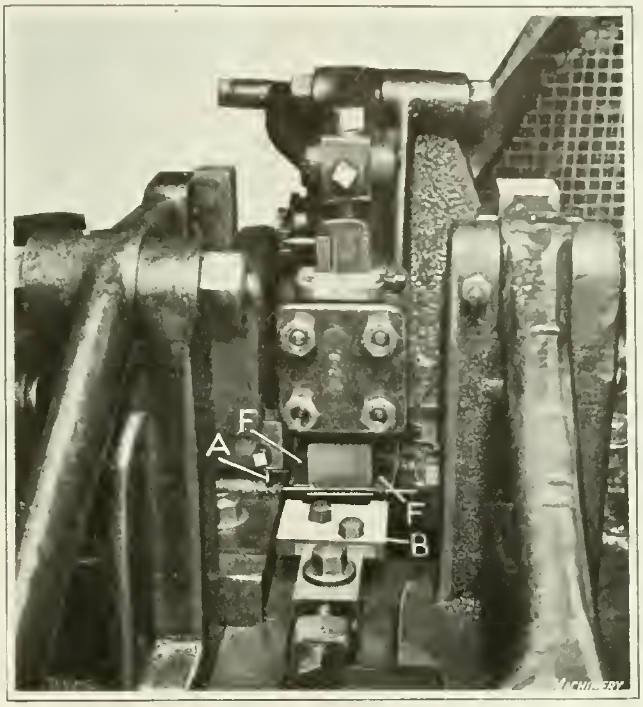


Fig. 7. Front View of Wire-forming Machine showing the Front Die, King-post and Incoming Wire

The under side of the front die is cut away below the groove. This is done to permit the final forming of the slide. The wire is held by the front die and by the slot in the screw *D* while the next bending operation occurs, which is performed by an auxiliary lever *A*, Fig. 10, which is designed to fulcrum by means of lever *B*, connected to an auxiliary cam on the regular camshaft at the right-hand side of the machine. This lever has a specially shaped nose, which insures that the wire will become directly engaged by the lever, regardless of any slight misalignment with the slot in the end of the lever.

The auxiliary cam is shown at *C*, Fig. 8, in which illustration the pivoted lever *D* and its connection to the auxiliary slide may be seen. This illustration shows the lever as the bend is in process of completion and calls attention to the need of special means for holding the stock in the groove of the screw-head while the bend is occurring. This is necessary because as the stock is being bent, its outer end rides up the sloping surface of the back die, *J*, Fig. 10. This illustration furnishes in graphic manner the relative positions of the dies at this stage of manufacture.

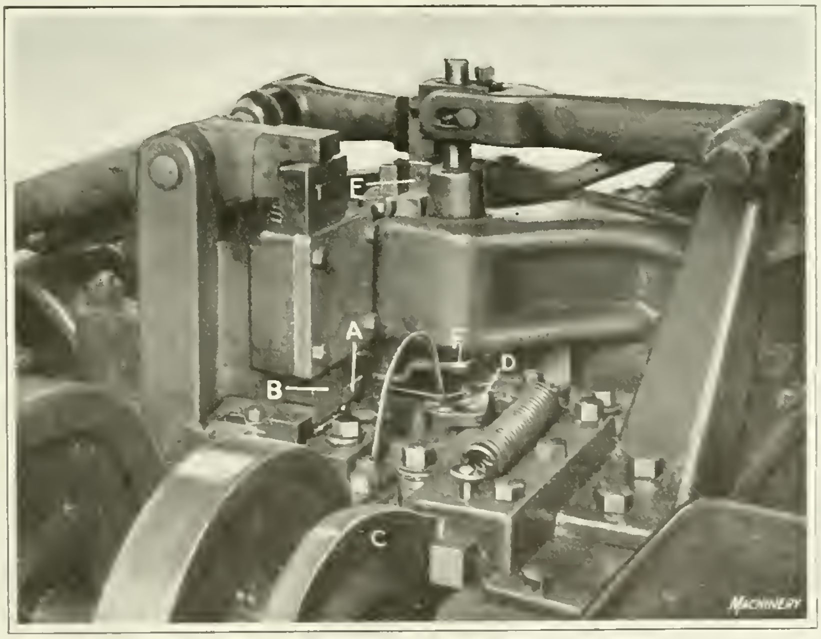


Fig. 8. View of Right-hand Side of a Wire-forming Machine illustrating the Use of an Auxiliary Bending Lever

The position of the auxiliary lever shown in Fig. 8 at *D* is indicated in broken outline in this diagrammatic illustration and its position at the completion of the bend at *A*. As the end of the wire sweeps over the sloping surface of the back die *J*, this end will become slightly bent so that the hairpin loop will be completed with one end bent slightly askew.

Before the purpose of this intermediary bend can be understood, a clear idea of the design of the king-post should be had. In Fig. 10, a top view of the king-post *G* is shown as well as the shape at the lower end around which the wire is formed. Referring to the partial side elevation of the king-post it will be seen that its lower end is shaped with an angular slope *E* which runs into a shelf *F* on which the over-all slide bears during all bending operations. The wire is held against the front of this king-post by the front die so that the hook end of the hairpin loop, which has just been slightly offset upward, will come in contact with this angular surface *E* as shown, as the hairpin loop is completed.

Shape 4, Fig. 6, is next formed. An auxiliary piece attached to the side of the die *A*, Fig. 11, has a sloping end *D*, to lift the wire out of the screw-head groove in which it was located during the previous operation, and to guide it into the groove in die *A*, as this die proceeds to form the loop into a 90-degree bend. Wherever it is necessary to dislodge a wire or to reposition it in the correct operative plane, extensive use is made in wire-forming work of dies designed in the manner mentioned, or as previously described for the swinging lever *A*, Fig. 10.

The slight bend produced by passing the end of the wire over die *J*, Fig. 10, enables the angular surface *E* to be made abrupt enough so that the hook end of the wire will readily follow down the surface to shelf *F*, as Shape 4 is being made. The result is that this end then becomes offset in the opposite direction owing to the fact that the hook end bears on the shelf, a condition which is necessary in order for it to be subsequently passed under the right-hand end of the slide. This occurs during the advance of the side die *A*, Fig. 11, and before the opposite side die *B* (also shown in Fig. 10) has had an opportunity to come into the operative position

Figs. 12 and 13 are views taken during the forming of the over-all slide with the aid of a mirror placed beneath the wire-forming machine. The first of these shows the position of the operative parts as they appear from beneath just before the beginning of the operation illustrated in Fig. 8; the second view from below shows the side die completing Shape 4, Fig. 6. In these two illustrations the front die is indicated at *A*, the back die at *B*, the side dies at *C* and *D*, and the

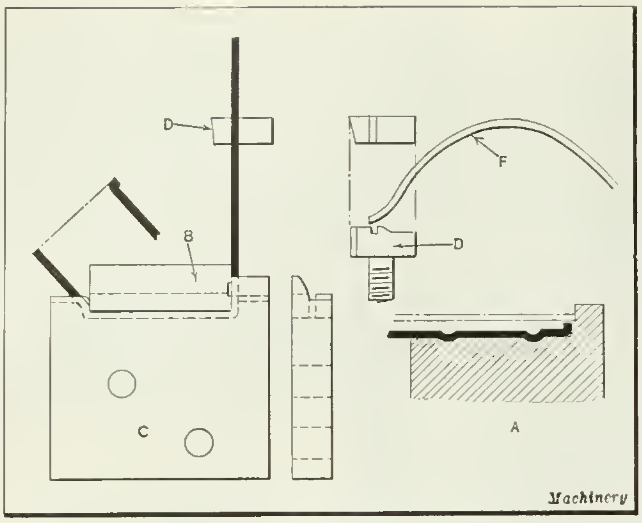


Fig. 9. Diagrammatic Illustration of Stop and Die Positions used in making the First Two Shapes of an Over-all Slide

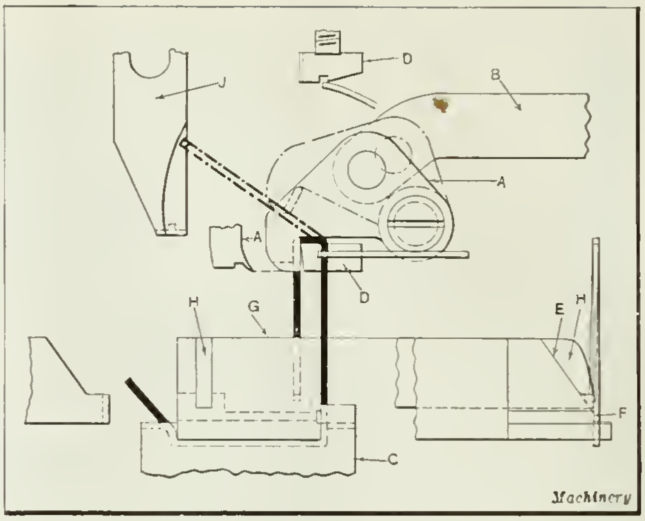


Fig. 10. Lay-out showing Positions of Dies and Work after forming the Over-all Slide into the Shape shown

stripper which surrounds the king-post around which the slide is formed, at *E*.

Final Forming Operations

As the die *A*, Fig. 11, continues to advance it produces Shape 5, Fig. 6, working in conjunction with the die *B* which by this time has advanced and started to complete the bending of the short angular end. The hairpin loop of the wire would strike this angular end and the hook end would not be permitted to pass under the opposite end if provision were not made for avoiding these interferences. This is accomplished by a vertical slide in the king-post. The slide is indicated at *H*, Fig. 10, and its lower end at *F*, Figs. 12 and 13, while the means by which it is operated from the top of the machine is shown in Fig. 8. Here the slide is indicated at *E* and it will be seen that an auxiliary cam-lever is connected to the slide, which actuates its movement as determined by the setting of a special cam provided for the purpose. The slide is brought to bear on the hairpin loop, forcing it slightly downward so that the two side dies may then continue to close the work.

The final movement of die *A*, Fig. 11, just prior to the complete closing of the slide, produces a slight depression in the side of the work into which the hook end of the hairpin loop will snap when the 90-degree bend in the slide has been completed. The king-post contains a shallow groove *E* into which this bend is formed. Die *B* introduces in its design, other principles in wire forming that should never be overlooked. The rear part of the front surface is cut away at an angle so that the working end is just wide enough to pass between the front die and the back die when all are in their advanced positions. The dies remain closed throughout the last operation which is that of curling the end of the wire into its final shape as shown in Fig. 6. The back die *J* which does the curling, produces a thrust at the end of the wire which might cause it to buckle or break if it were not supported, and so die *B* remains in contact with the wire as shown in Fig. 11 until the work is completed.

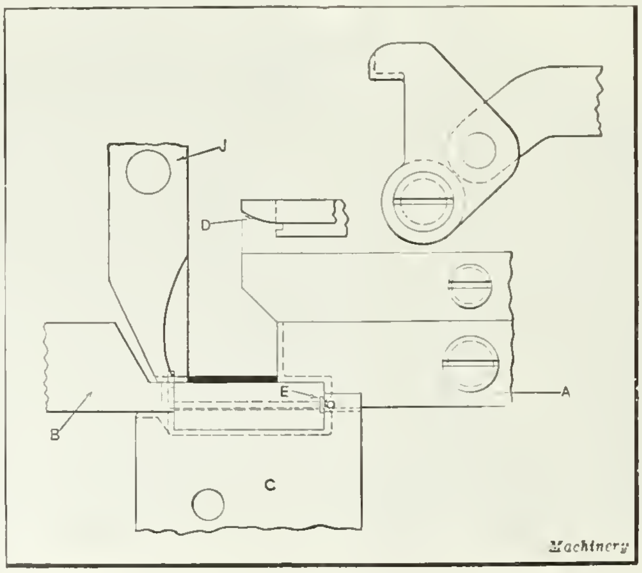


Fig. 11. Closed Position of the Slides after the Work has been completely formed

All the dies then recede, and the stripper which is formed to surround the king-post partially as shown at *F*, Figs. 7 and 8, is depressed, forcing the finished work from the king-post while the wire for the next over-all slide is being fed in over the finished work (see Fig. 7). The machine operates at a speed which will produce 80 finished slides per minute, but the average hourly output is about 3400 pieces.

Forming Over-all Loops

The over-all loop shown in the lower right-hand part of Fig. 6 is formed from 0.075-inch diameter semi-hard cold-drawn steel wire. An E. J. Manville 4-slide wire-forming machine is used to produce the work up to Shape 5, and a specially equipped power press is employed to complete the loop. The arrangements for straightening, feeding, guiding and stopping the wire are the same as those commonly employed on this type of machine. The guide, which is indicated at *A*, Fig. 16, is more clearly shown in this illustration than was possible in the illustrations of previously described tooling arrangements. The work is first bent to Shape 1, Fig. 6, by the front die which remains in its advanced position throughout the remainder of the forming work. As this shape is produced, the ends of the wire sweep over the side dies which are liberally curved at the edge to permit this to occur. The wire which is then in tension, snaps down into its proper plane after passing over the side dies so as to be engaged by the dies as they are brought into operation.

The two pairs of side dies *A* and *B*, Fig. 14, are brought into operation simultaneously to produce the two sharp bends in each side of the work, as the diagram shows. These dies are attached to separate blocks, one of which is shown at *B*, Fig. 16, each adjustably arranged to compensate for wear and for varying sizes of loops. The blocks which carry these die members, each have a cut-out section in which a lever-forming member *C* is located. As the blocks are advanced, the levers *C* are brought into position so that they may be directly operated, in the manner to be described.

These two levers produce

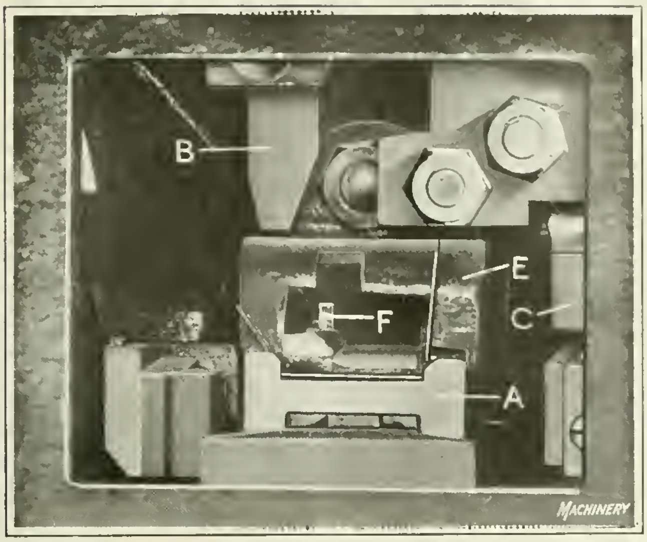


Fig. 12. View from Under Side of the Die Opening of the Machine shown in Fig. 8 with the Dies at Work

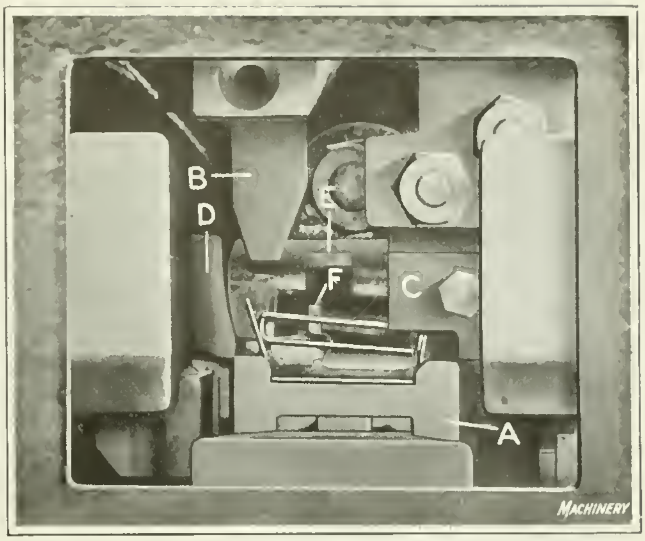


Fig. 13. Another View from Under Side of the Die Opening showing the Advanced Position of the Dies

Shape 3, Fig. 6, and by the time that they have advanced to the position indicated in Fig. 14, the back die *D*, also shown in Fig. 16, has also advanced so as to contact with rollers on the ends of levers *C* and by means of the cam surface on each side of the back die, causes these levers to fulcrum and bend the ends to approximately a 45-degree angle. By this tooling arrangement additional bending dies are brought into play without requiring auxiliary cams for the purpose, and the arrangement is one that may often be employed where the nature of the work will permit. Fig. 15 illustrates the method of producing the two bends at the upper end of the loop. As levers *C* continue to fulcrum, the toe of the lever forms the wire around the king-post sufficiently to bring the ends into alignment with the groove in the end of the die *D*. This die then engages these projecting ends and as it advances, produces the sharp bend shown.

Attention is called to the construction of the king-post at this end, in that a separate piece *F* is attached to the main part of the post which may be readily replaced as wear occurs. This construction is of double importance, in that it simplifies making the king-post and provides for the rapid wear which the sharp corners at this end of the post is subjected to.

The shape thus produced—Shape No. 4—contains a concave bend that is formed by the front die *E*, Figs. 14 and 15. This curvature is designedly produced and introduces the method of shaping the completed article. This end of the king-post is also a separate member *D*, Fig. 18, which is concaved on the front surface. This curvature gradually changes until at its lower extremity it is convexed as shown at the right. Directly in front of the lower part of the king-post there is a guiding member *C* (shown at *E* in Fig. 16) so that as the stripper forces the formed loop down, the concave bend in the wire will be removed by means of the 3-point contact formed by the two lugs on member *C* and the high point on the convex of *D*. The result is that the open ends of the wire close, which produces Shape 5 and completes the forming work.

The two ends not only come together but they overlap, this being done to produce a tension in the wire for engaging the sleeve by means of which the two ends are subsequently assembled. In order to make it possible for these two ends to overlap, the grooves in the separate piece *F*, Fig. 15, are offset an amount approximately equal to the radius of the wire. The production time for this job is about the same as for the over-all slides, that is, 3400 per hour.

Special Equipment for Assembling the Sleeves

The closed ends of the wire loop are assembled into a sheet-metal sleeve *A*, Fig. 6, and the making and assembling of these sleeves is performed on a Baird power press equipped

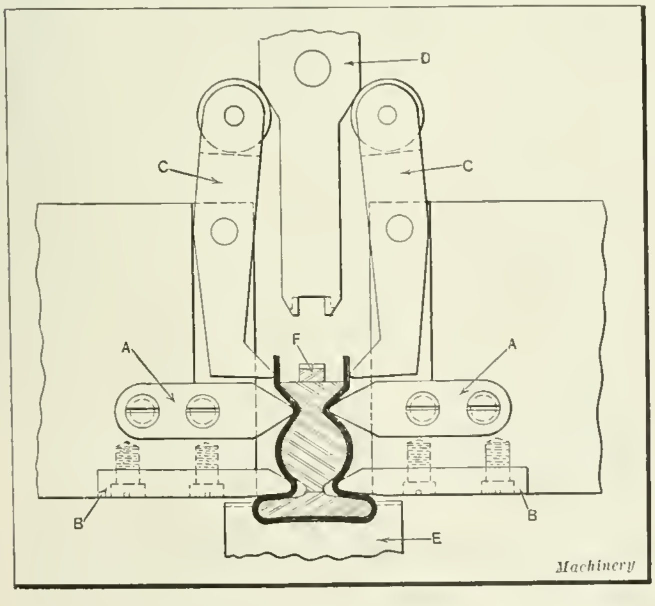


Fig. 14. Lay-out showing the Position of the Dies during the forming of an Over-all Loop

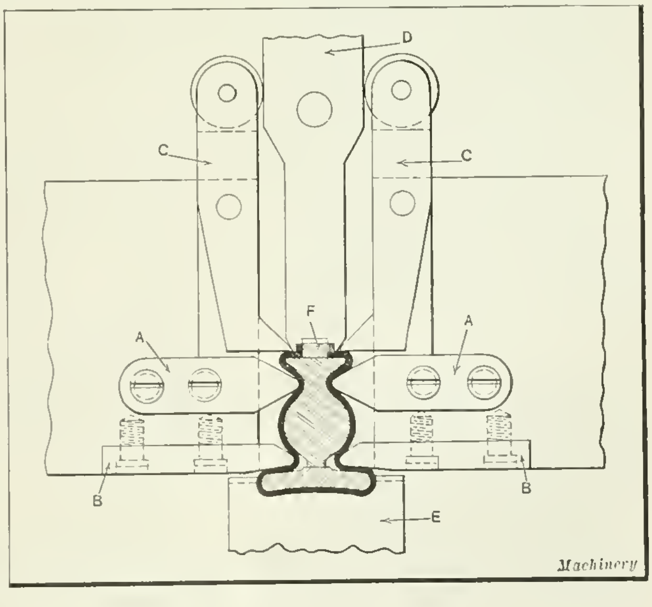


Fig. 15. Position of Dies after the Approximate Shape of the Work has been obtained

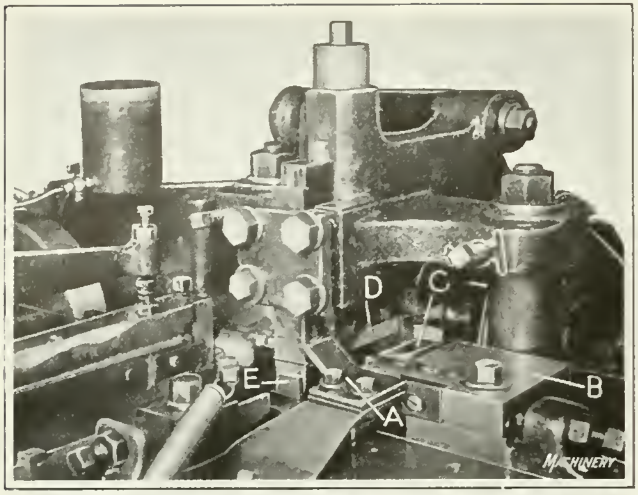


Fig. 16. Front View of Wire-forming Machine set up for making an Over-all Loop

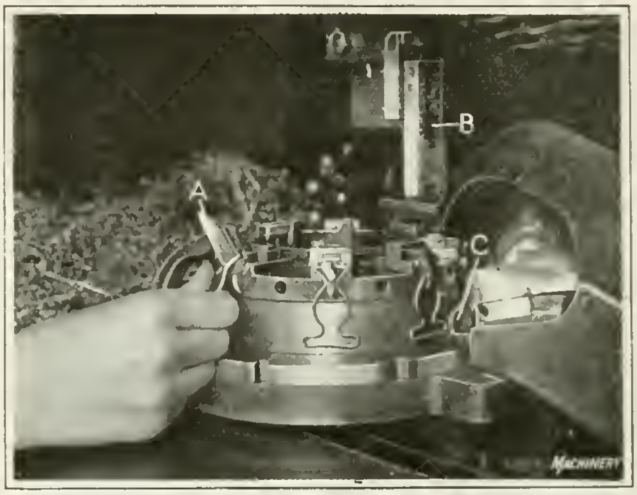


Fig. 17. Dial Fixture used on a Power Press for assembling the Sleeves in Over-all Loops

with a follow-die and a dial fixture. The front of this machine is shown in Fig. 17. The ribbon stock from which these sleeves are made is fed from a coil at the rear, blanked out, punched and bent to a U-shape in the follow-die. With each stroke of the press ram a sleeve is seated in a holder in one of the eight stations of the dial indexing fixture, with the open end uppermost.

The fixture is indexed with every stroke of the press, successively bringing the stations into position under horn *A*. Each sleeve is held tightly in place by a flat spring in back of each station, which bears against the end of a pin extending radially through the holder in which the sleeves are located. The index slide and pawl are located on the opposite side of the machine and operate in the regular manner from an eccentric. As the operator passes the loops over tapered horn *A* they are sprung open to the proper width to permit them to pass into the sleeves, and the tension thus produced has a tendency to force the loops into a vertical position bearing against the base of the fixture, which is the position occupied by two of the loops in the illustration. Lugs projecting from the dial plate assist in holding the ends of the loops apart until the sleeves have been closed around them.

As the work advances into alignment with the closing die *B* attached to the side of the press ram, this member closes the ends of the sleeve around the wire. In the next position the lower end of the work passes through a channel at the end of ejector *C* which is a rocking member, the channel end being raised and lowered with each operation of the press by means of suitable lever connections. The outer wall of the channel is crescent shaped in section, so that the wire can readily pass up the rise of this section as it passes into the channel. The ejector then rocks, causing the loop to snap up out of position and against the covered chute through which it is delivered to a suitable receptacle, completing the manufacture of the over-all loops. This work of assembling the sleeves is performed at the rate of about 2750 per hour.

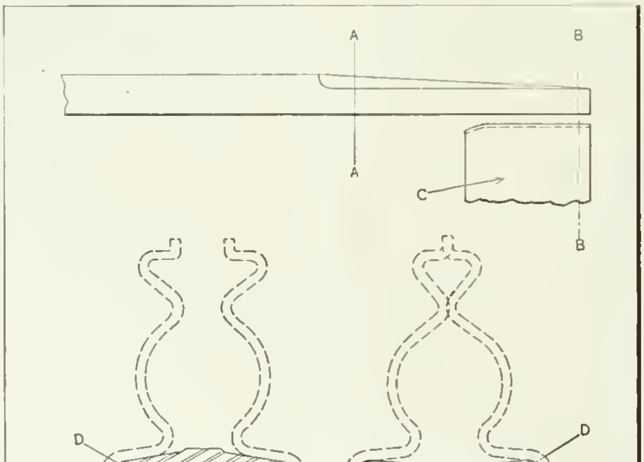


Fig. 18. Specially Shaped Horn attached to the King-post, and Sketches illustrating its Purpose in forming an Over-all Loop

A NATIONAL ENGINEERING MUSEUM

A proposal has been made by the DeLamater-Ericsson Commemoration Committee for the purpose of establishing a national engineering museum. In seeking a permanent place for the DeLamater-Ericsson historical collection, the committee conferred with the Smithsonian Institution at Washington, and in reply the secretary sent his latest report on the National Museum, which is under his custody. The concluding paragraph of this report reads as follows:

"Museums devoted to history, art, and the natural sciences are established in all of the larger nations of the world and many of them have established in addition, educational museums of engineering and industries. Thus England has her South Kensington Museum; France her Conservatoire des Arts et Matiors (at Paris) and Germany her Deutsches Museum (at Munich); but nowhere in this nation of ours, the most advanced in the application of the engineering and mechanical arts, is there a similar institution. The commanding place in the world which the United States has reached in the short space of seventy-five years is due largely to the full development and utilization of mechanical power in the exploitation of her natural resources. It is this that has made it possible for the people in the United States to enjoy a standard of living far above that under which the peoples of the rest of the world exist, and still no public sign of appreciation either national or otherwise is to be found anywhere. What more suitable monument could there be therefore than a Museum of Engineering, and where could there be found a more logical place for it than as a part of the great National Museum?"

In connection with the annual meeting of the American Society of Mechanical Engineers in New York next December, there will be exhibited a part of the historical collection of the DeLamater-Ericsson committee at the Engineering Societies' Bldg., New York City. H. J. F. Porter is in charge of the exhibition and chairman of the joint committee on the National Engineering Museum.

The Machine Tool Industry in Sweden

THE construction and building of machine tools has probably reached a higher degree of development in Sweden than in any other European country—England and Germany excepted. This is due largely to the fact that Sweden, although one of the smaller countries in Europe, has a highly developed mechanical industry and, for its size, is an important user of machine tools. The following article gives a brief review of the development of the machine tool industry in Sweden, with the names of the leading manufacturers and a brief review of their activities.

The total production of machine tools in Sweden in 1920 amounted to nearly $7,000,000; the value of wood-working machines built in the country exceeded $5,000,000. In the metal-working and wood-working machinery industries, which are generally classified together, the entire number of men employed in 1920 was about 6000. It should be remembered, however, that on account of the industrial depression, 1920 was a poor year in Sweden, especially in the machine tool field. Hence, the value of production given is much less than the normal production of the shops, and does not in any way represent their capacity.

The machine tools built in Sweden are mainly for domestic consumption, although there is some export trade. The types built are therefore especially intended to meet the demands of the industries of the country, and for that reason sometimes differ considerably from the general types offered by American, British and German machine tool builders.

At the present time there is a severe depression in the machine tool industry partly on account of the keen competition with other countries, particularly Germany, and partly because the industries which are the main consumers of machine tools are also suffering from an industrial depression, and therefore are not in need of new equipment. It is believed, however, that when normal conditions again return, the Swedish machine tool industry will regain the position which it had formerly created for itself.

Development of the Machine Tool Industry

The making of machine tools in Sweden dates from about 1850. As in many other countries, it started with the building of machine tools in shops engaged in other machine-building activities. These shops produced the machines for their own use, merely to aid them in the manufacture of their product. Meanwhile the development of machine tools in England, America and Germany went forward with great rapidity and at the same time the Swedish industry grew so that the domestic demand for machine tools became more and more pronounced. At that time a number of the Swedish shops which in the past had been devoting themselves mainly to the manufacture of other products, began to specialize on machine tools, and gradually some of them gave their entire attention to this line of manufacture. In the following is given a brief outline of the development of some of the best known machine tool building shops in Sweden.

Leading Machine Tool Building Plants and their Products

Köpings Mechanical Works were founded in 1856, and began at an early date to engage almost exclusively in the building of machine tools, which at the present time constitute their sole product. This shop has created for itself a good reputation, and is known for careful workmanship, the use of first-class materials, and good designs. During the war, particularly, this firm maintained a considerable export trade. The shop owns its own foundry, and is known to use the most modern methods in both design and construction. Among the machines made are engine lathes from 16 to 44 inches swing, built with either cone-pulley or single-pulley drive, for both belt and direct-motor drive. Gap lathes in several sizes are also built, as well as turret lathes, wheel lathes, roll turning lathes, axle lathes, centering machines, open-side planers for large work, upright drilling machines, radial drills, horizontal drilling and boring machines, plain and universal milling machines, universal tool grinding machines, tool grinders, and foundry grinders. This company employs about 300 men, and the normal value of its production is about $800,000 annually.

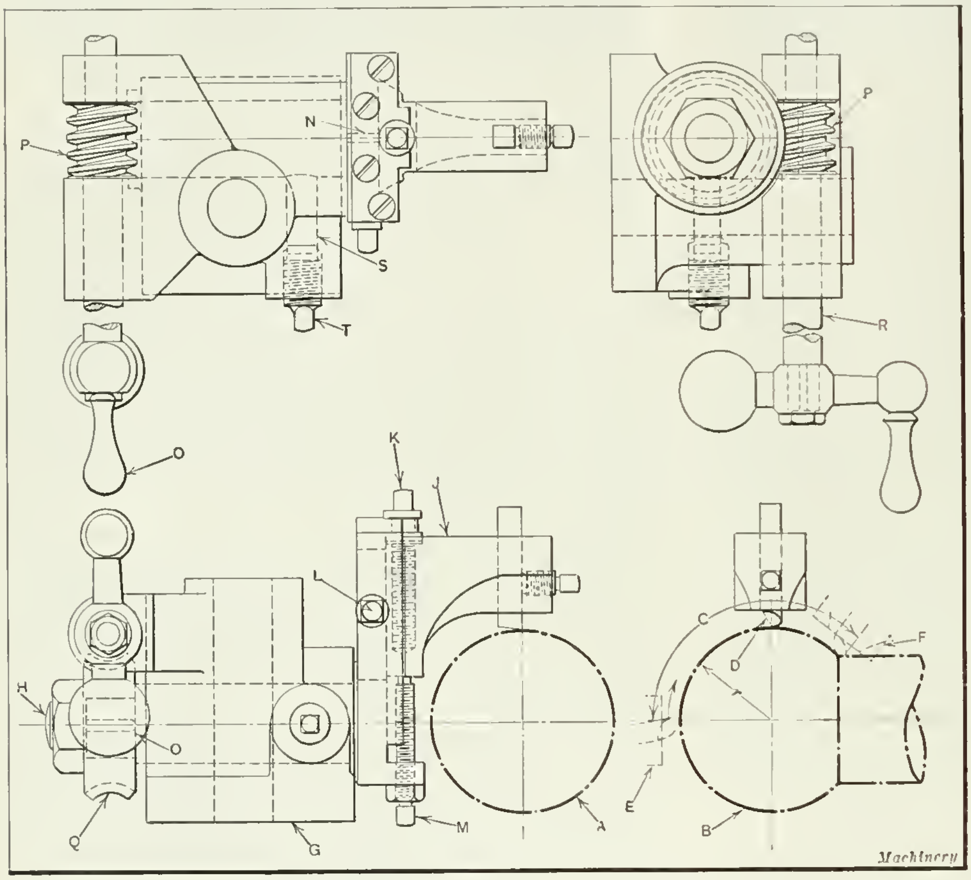
Lidköpings Mechanical Works were started in 1874, and have gradually developed until they are now engaged entirely in the manufacture of machine tools. This concern also has a good reputation for first-class designs and workmanship. In this shop engine lathes up to 44 inches swing, with ranges similar to those mentioned for the Köpings Works are made, as well as gap lathes. This shop also specializes on lathes for ammunition making, and, in addition, builds open-side planers up to the largest standard dimensions, surface grinding machines and universal grinding machines. These shops have also made a specialty of building boring machines for big guns. The number of men employed is about 300, and the normal annual value of production, about $700,000.

Enköpings Works were started in 1886, and have gradually specialized on machine tools, especially lathes, shapers, milling machines, drilling machines, grinding machines, and power hammers. This plant is also among those that are best known and has been able to work up an export trade. It employs about 400 men with an annual production value of about $550,000.

Munktells Mechanical Works, in Eskilstuna, while not building machine tools exclusively, have developed this branch so that during recent years one-third of the shop's production has been in the machine tool field. This shop builds engine lathes in practically the same ranges as the Köpings Works. It has also specialized in power presses, which are built in practically all modern construction and sizes, including double-acting power presses in weights up to 30 tons. Friction screw presses are also built. Another line manufactured by this company is drop-hammers, made in sizes up to 2600 pounds weight of drop, the whole machine weighing over 30 tons. This firm is also among the well-known builders in the machine tool field, and in times when industrial conditions permitted it, have conducted a considerable export trade. About 400 men are employed in the machine tool branch of the works, and the annual production is normally about $1,100,000. This firm operates the largest foundry in the Scandinavian countries. The works were originally started in 1832 and began building machine tools about 1850.

Among other machine tool plants in Sweden may be mentioned Thule in Malmö, started in 1908 and specializing on shapers, of which four sizes are built—14,- 16-, 20-, and 25-inch. This shop employs about 120 men, and produces normally about $275,000 worth of shapers a year. Gerhard Arehns Mechanical Works in Stockholm are mainly devoted to the making of match-manufacturing machinery, but are also making milling, drilling and grinding machines. Their vertical milling machines especially have won a good reputation. Halldin & Co. in Orebro, started in 1868, have gradually specialized in the manufacture of power presses. Pytagoras Works in Norrtälje build mainly lathes. They employ about 100 men, and the manufacturing value of their product is about $275,000 annually. The Swedish Machine Works (Svenska Maskinverken) in Stockholm specialize in turret lathes, with a normal production capacity of over $500,000 a year.

The Atlas-Diesel Co. in Stockholm specializes in horizontal boring and drilling machines, upright drilling machines, pneumatic drills, milling machines (both of the vertical and horizontal type) as well as cylindrical grinding machines. The Arboga Mechanical Works in Arboga build forging presses. The Storebro Co. in Storebro, started in 1894, employs about 200 men, building lathes and milling machines with a normal annual production valued at about $275,000. Askersund Mechanical Works in Askersund build tool grinders and pneumatic and power hammers.



Ball-turning Attachment for Tool-room Lathe

Woodworking Machinery Industry

The building of woodworking machinery is highly developed in Sweden as a result of the great demand for machinery of this type in a country having a large saw-mill industry. Among the leading works devoted to this line of manufacture are Bolinders in Stockholm, Munktells in Eskilstuna, Askersund Works in Askersund, Falkenbergs Works in Falkenberg, Jonsereds Co. in Jonsered, and the Swedish Machine Works in Stockholm.

* * *

BALL-TURNING ATTACHMENT FOR LATHE

By F. H. SOVEREIGN

Various methods may be employed to machine spherical surfaces, but the size of the piece to be machined, its design, and the requirements as to quantity and accuracy are naturally determining factors in selecting the method to be used.* An attachment designed by the writer to handle the various classes of spherical turning work ordinarily met with in the tool-room is shown in the accompanying illustration. This attachment has a range of adjustment that meets the usual requirements for turning the spherical ends of ball-crank handles and similar tool-room work. If desired power feed can be applied to the attachment by connecting the end of worm-shaft *H* with the knuckle joint shaft of the lathe relieving attachment. The operation of the attachment will be readily understood by referring to the illustration.

The end view of the work to be machined (looking toward the lathe headstock) is represented by the heavy dot-and-dash circle at *A*. At the right of this view is indicated diagrammatically the path followed by the tool in turning or finishing the work to the spherical form indicated by the side view shown in heavy dot-and-dash lines at *B*. The arc through which tool *D* is required to move is represented by *C*. The radius *r*, or distance of the cutting tool from the center of the work, determines the diameter of the turned ball. The extreme positions of the tool are clearly indicated by means of the dotted lines at *E* and *F*.

Base *G* of the attachment is a casting mounted on the compound rest of the lathe. In attaching base *G* to the compound rest, care is taken to see that shaft *H* is set at right angles to the lathe spindle. On the inner end of shaft *H* is a rectangular section with a dovetail groove in it in which the dovetail tongue of the tool-slide *J* is fitted. The tool *D* is positioned for turning spherical work to the required diameter by adjusting slide *J* by means of screw *K*. When properly adjusted to the required radius *r*, slide *J* is locked in place by screws *L* and *M*. It should be noted that a slot *N* is cut at the back of the dovetail groove to permit screw *L* to exert the required clamping action on the dovetail tongue of slide *J*.

In operation, the tool is moved through arc *C*, or whatever part of a circle is necessary to produce the required form, by means of ball-crank handle *O*, worm *P*, and worm-wheel *Q*. Worm *P* is keyed to shaft *R*, while worm-wheel *Q* is keyed to shaft *H*. A friction block *S* is provided, which can be adjusted by screw *T* so that just the right pressure will be exerted on spindle *H* to insure smooth operation of the tool, or it can be adjusted to lock the spindle in a fixed position.

The more important dimensions of the various details entering into the construction of the attachment shown are: Height of shaft *H* above bottom of base, 1 19/32 inches; diameter of shaft *H*, 1¼ inches; maximum width of the tool-slide dovetail, 1⅞ inches; and length of tool-slide dovetail, 2¼ inches. The worm *P* has a right-hand single thread that is cut to fit the 12 diametral pitch teeth of worm-wheel *Q*. Worm-wheel *Q* has 24 teeth and consequently a pitch diameter of 2 inches. The maximum diameter of work accommodated by this attachment is about 3 inches. The dimensions given are those employed in the design illustrated, but these dimensions could easily be varied to meet special requirements. In order to insure accuracy, the hole for shaft *H* should be bored to size with the casting mounted on the compound rest of the lathe on which it is to be used.

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*Spherical turning attachments for different types of machine tools and the methods of their application are described in Volume 5 of MACHINERY'S Encyclopedia beginning on page 444.

Diamond Tools as Cost Reducers

Use of Diamonds for Cutting Various Materials—Preparation of the Diamond—Economies Introduced by the Application of Diamonds as Manufacturing Tools—Multiple-stone Diamond Dresser for Emery Wheels

Bortz, or "white" diamonds, brazed into steel holders, have many uses as metal finishing tools. They are employed for numerous machining operations that formerly were performed with steel tools. This article gives a brief description of the preparation of diamonds for commercial use, indicates how they are set in the holders, and furnishes information regarding their cost. An approved method of setting diamonds in wheel dressers, as well as in a number of metal-cutting tools is described, together with the kind of work for which each tool is suitable. The article concludes with a few examples showing the application of diamond tools in a number of plants.

ONE of the most common industrial uses of diamonds is for drawing dies for fine gages of wire. A complete description of the preparation, setting, and refinishing of diamond wire-drawing dies was published in MACHINERY, November, 1919, page 264. Other common commercial applications of the diamond are found in the cutting of stone, cement, glass, porcelain and similar hard substances, but the introduction of diamonds in place of hardened steel tools for machining operations is comparatively recent.

The variety of work for which the diamond cutting tool is suitable is not appreciated by manufacturers. If the use of diamonds as emery wheel dressers be excepted, there is no application of diamonds as cutting tools in the average machine shop. There remains, therefore, much to be said which should interest both the mechanic and the manufacturer—particularly the manufacturer, because he is vitally interested in the problem of reducing production costs. If he can be convinced that by substituting a diamond cutting tool for a steel one he can considerably reduce his operating expenses, he will soon appreciate the economies which diamond tools make possible.

For machining bronze, brass, and similar metals which are not brittle, and for performing various machining operations on hard rubber, fiber, compressed paper pulleys and gear blanks, strawboard, gutta-percha, bakelite and various other composite substances now in commercial use, the diamond is especially suitable on account of its ability to retain its cutting edge when producing great quantities of duplicate parts without frequent attention or resetting.

Work which has a uniform diameter over a considerable length, such as the brass sliding tubes of a telescope or hard rubber typewriter rolls, is successfully turned by the use of diamonds and without the slightest perceptible variation in diameter occurring in tens of thousands of parts. Diamond tools may also eliminate some operations which must be performed when a steel tool is used for finishing. The surface produced on brass and bronze is comparable to a fine lapped finish and therefore eliminates the necessity of reaming, finish-boring, grinding, or lapping to obtain the desired surface. It will be seen that the variety of work to which the diamond tool can be applied is very extensive. Its use for machining iron and steel is not practical, however, as these metals are likely to cause the brittle diamond to crack or chip.

Preparation of the Diamond for Setting in a Tool

The process of setting a diamond in a tool is simple to describe, but requires great skill on the part of the man who performs the delicate work. The most common type used for industrial purposes is the bortz diamond (see Fig. 1) which is found in the same mines of South Africa as those from which sparkling gems are obtained. Bortz diamonds (sometimes called crystal diamonds) are unsuitable for jewelry owing to their color, impurities and structure. Furthermore, they are difficult to cut. The black diamond or "carbon," as it is called in the vernacular of the diamond trade, is found only in Brazil. The best specimens are as hard and durable as bortz. Owing to its porous structure, its cutting edge is more suitable for a roughing cut than for a finishing cut. Bortz diamonds have a laminated structure, the boundry of each layer of which is known as a "cleavage plane."

The diamond worker studies the stone carefully before determining the location of these cleavage planes, and then proceeds to cleave the diamond or split it "along the grain." It is common knowledge that nothing but a diamond or diamond dust will cut another diamond. In cleaving one of these precious stones, the surface is first cut to a certain depth preparatory to splitting, by means of a special machine having a thin copper disk charged with diamond dust. When the proper depth of cut is reached, the stone is cleaved by giving it a sharp blow along the seam. All this is part of a very expert trade. It is stated that an experienced man can cleave any stone—with few exceptions—exactly as he plans.

All subsequent sawing, cutting holes and shaping that is required to form the stone properly for any particular

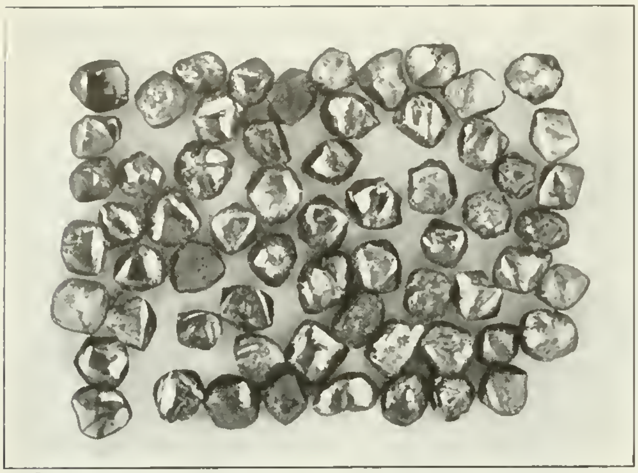


Fig. 1. Collection of Rough Bortz Diamonds

service as a cutting tool, is done by lapping the diamond with power-driven tools charged with diamond dust, or by hand using another diamond of suitable size and shape. The largest diamonds used for industrial purposes are not much more than 20 carats, and the smallest size stone which can be used in a cutting tool is ⅛ carat. (A carat is equivalent to about 3 1/6 grains Troy.) It is advisable to use a diamond of the largest possible size that is suitable for the work at hand, as this permits the diamond to be reworked and reset if necessary; also a large diamond has a greater percentage of salvage value than a small diamond, thus making the net cost much less. The comparative costs per carat of diamonds of different sizes will be taken up in a later paragraph.

Types and Characteristics of Settings

The next step after cutting and shaping the diamond to its approximate form and producing the cutting edge is to set it securely in a steel holder. The setting of the diamond is of vital importance to the strength and serviceability of the tool. There are two styles of settings—the steel setting in which the diamond is partially fitted into a hole in the end of the holder and the metal peened over it to hold it in place, and the brazed setting in which the stone is held securely in the hole by molten speiter. An example of each of these types, cut away to show the position which the diamond occupies in the setting, is illustrated in Fig. 2. The brazed setting, shown in tool *O* is more satisfactory for all classes of work and particularly for hard, tough materials on account of the yielding nature of the diamond pocket which offers a less rigid resistance to the material while the tool is taking the cut than in the case with the steel setting.

Overheating a diamond, no matter how it is set, is responsible for more trouble with diamond tools than any other cause. The idea seems to be common among workmen that as a diamond is hard, it will stand almost any pressure and frictional heat; this is true of the diamond itself, but the setting is affected to the extent of loosening its hold on the stone, causing the latter to drop out of its pocket.

The coefficient of expansion of a diamond is less than of steel, but when the diamond is heated by the cutting action, it expands before the heat penetrates to the steel to a degree which will cause the steel to expand. The increased volume of the diamond must go somewhere. The diamond is naturally brittle and has a laminated structure. The heat weakens this structure, causing the confined stone to crack along the lines of cleavage, due to the pressure caused by its confined position; or the diamond literally creeps out of the steel setting. A frequent repetition of this causes the stone to loosen sufficiently to fall out. The brazed setting is better in that it allows for the expansion of the diamond without causing the setting to be disturbed perceptibly, provided, of course, that the diamond is not excessively heated.

Characteristics and Cost of Diamonds

A diamond is crystallized carbon and is the hardest known substance. It will stand a white heat without disintegration or visibly affecting its wearing qualities. Men who use emery wheel dressers may have noticed the phenomenon of a diamond becoming white-hot when truing a wheel, even while a stream of cold water is impinging on the stone. This unusual characteristic of the diamond to retain its hardness after being excessively heated is further illustrated by an experiment which was recently conducted in the shops of Arthur A. Crafts & Co., 125 Summer St., Boston, Mass., where much of the data here presented was obtained. This experiment consisted of heating a diamond cutting stone to a white heat and quenching it in cold water and repeating this performance one hundred times. The tool carrying this diamond was then shipped to a customer. After having been in service for several weeks, truing grinding wheels, it was found to be in no different condition, apparently, than when new, and entirely unaffected by the severe treatment to which it had been subjected.

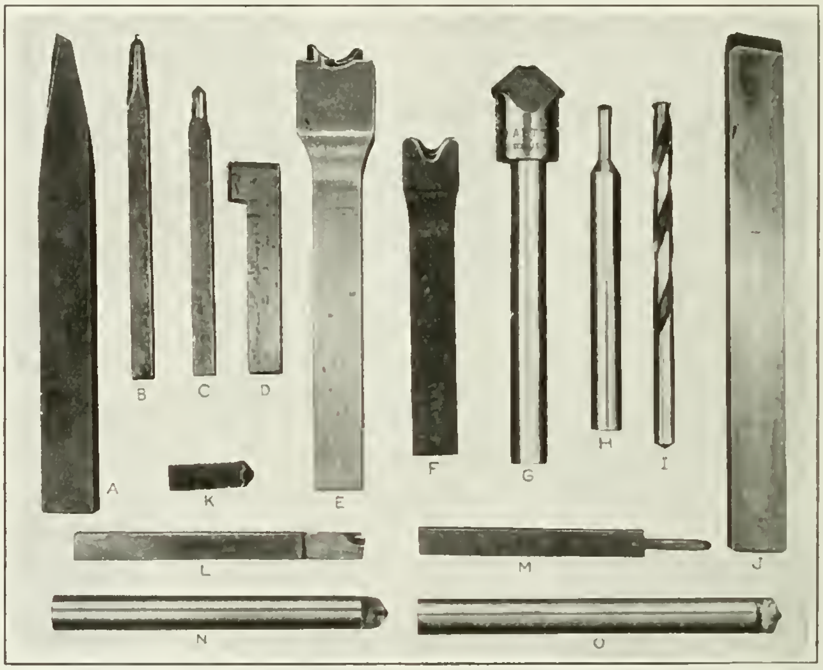


Fig. 2. Types of Diamond Cutting Tools

One of the first questions likely to be raised regarding the use of diamonds for reducing manufacturing costs would be in regard to the initial cost of the diamond itself. It is true that the first cost of a diamond tool is comparatively high, but this is practically the only expense involved, which makes it plainly evident that the larger the quantity of work machined the greater the saving in tool expense. Diamonds vary in value per carat according to the size of the stone. A large stone weighing, say, 20 carats, if of good even grain, may be worth as much as $80 a carat, but this same stone automatically diminishes in value per carat as the stone is divided or cleaved into smaller pieces so that stones weighing 5 or 6 carats, taken from the same original diamond, will shrink in value to about $45 per carat. Smaller diamonds weighing, perhaps, 1 carat decrease in value to about $5.

From the foregoing it will be understood that much care in the preparation of the stones is required on the part of the diamond worker, for otherwise a great deal of diamond chips and dust would result which means an additional expense. Incidentally, it may be mentioned that all chips which are too small to be set are pulverized by means of a pestle and mortar and the dust thus obtained graded by floating in olive oil. The dust is then utilized to charge the cutting surfaces of the metal tools used in shaping the diamonds.

Multiple-stone Diamond Dresser for Emery Wheel

In referring to comparative costs of diamonds with respect to their size and usefulness for a particular service, attention is called to the two emery wheel dressers shown in Fig. 4. The multiple-stone type, carrying four small diamonds, brought out by Arthur A. Crafts & Co., has been used with satisfaction by several machine builders and tool manufacturers, and has proved its economy over the single-stone dresser of large size.

The multiple tool contains four diamonds of the best grade, the total weight of which is about 2½ carats. The price of the tool is $30. The single-stone dresser has a 2½ carat diamond of the best grade, but owing to its greater size this diamond is worth $75. With the multiple tool the wear is divided among four points so that the advantage of a sharp tool is maintained longer than can be possible with a single stone. In addition there is less pressure per stone and less heat generated; also the larger cooling area of the holder helps to maintain the secure setting of the diamonds. After the diamonds have been worn down to ⅛ carat, they can no longer be reset and they have a salvage value of about 50 cents each, so that the net cost of the tool is $28.

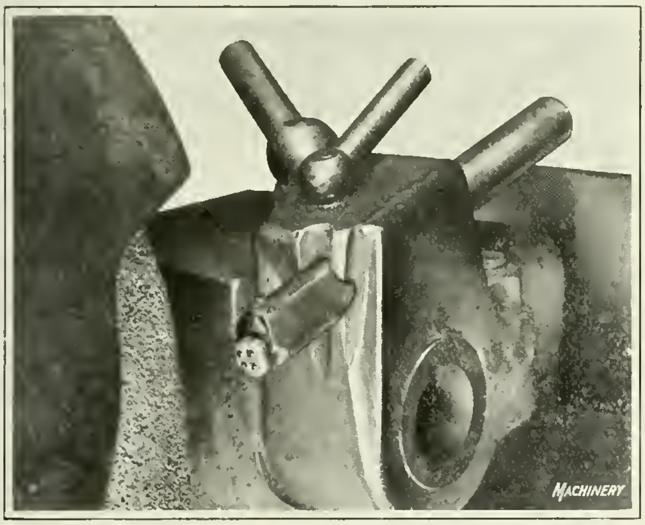


Fig. 3. Four-stone Diamond Wheel Dresser set up for truing a Grinding Wheel

The single-point tool, in order to perform the same amount of work as the multiple tool, will wear down to a broad flat surface much quicker than will the smaller diamonds; also more heat may be generated which is likely to result in loosening the setting after repeated use. As a result, more frequent resetting is required which adds to the net cost of the tool. When the diamond becomes worn so that it is too small to be reset it has about the same salvage value as the other diamonds. The net cost then, is $74.50.

The application of the four-stone dresser is shown in Fig. 3 in which it will be seen that it is located in the holder with the diamonds set square with the face of the wheel. In traversing the diamonds back and forth over the face of the emery wheel, the two leading stones, one upper and one lower, take most of the cut and the second pair which follows directly behind, removes the slight irregularities remaining on the face of the wheel. The same total depth of cut is taken as would be used with a single diamond tool. It might at first be thought that the small stones which first traverse the wheel would remove so much of the bonded abrasive that they would become unduly worn and overheated and thus eventually throw the bulk of the service on the rear pair; but both the bearings and the bonded wheel itself yield sufficiently under the pressure of the first two diamond points so that when the two rear diamonds are brought into use they remove practically the same amount of abrasive from the face of the wheel as do the leading stones. Any wear which occurs on the leading stones permits the following pair to start cutting, and all four must give service before the tool is used up.

Obtaining the Best Results with Diamonds

Practically the only uses to which diamond tools can be commercially adapted for cutting steel is in the scribing of sizes, names and other identification marks on the finished surfaces of such products as scales, micrometers and various other tools and gages. In fact, one well-known tool manufacturer makes use of a diamond tool for inscribing the sizes on their standard line of hardened limit gages. The tools used on this class of work are carried in the revolving spindle of a profiling machine. The depth of cut is about 0.010 inch.

Diamonds should not be expected to give good results where there is any serious vibration of the work. In short, any condition which makes the tool chatter is undesirable, particularly if the material being machined is very tough or if it is high in tensile strength. High rotative speeds for the work are recommended, say 200 surface feet per minute for all types of tools. A slow feed should be used in combination with the high rotative speed.

The tools shown at *A* and *J*, Fig. 2, are ordinary turning tools with different types of diamond settings. The cutting edge of tool *A* is a diamond over ⅜ inch long. Either of these two tools would be suitable for turning the compressed paper pulley shown at *G*, Fig. 5 or the fabroil gear blank *I*. Tool *D*, Fig. 2, was used for facing the molded bakelite timer shown at *C*, Fig. 5, as well as the ends of the copper inserts which are assembled in the timer. It will be noticed that the diamond is not rounded at the corner but that it is cut with a straight angular face at the nose of the tool. This is a special precaution taken to eliminate a difficulty formerly encountered with the use of a round-nosed tool. The chips produced in facing the inside of this timer, when a rounded diamond was used, were comparatively wide at the upper part and tapered down to a thin edge near the point of tangency of the tool with the surface being produced by the facing operation. This thin wedge-like chip would break near the lower part of the rounded portion of the diamond and cause the tool to become dull. By squaring off this rounded corner an even chip was produced which did not have the destructive effect experienced with the rounded stone.

Other Types of Diamond Tools

Tools *E* and *F*, Fig. 2, are used for forming fiber flanges on the wooden spool *H*, Fig. 5. Tool *E* is an improvement over tool *F* in that there are two diamonds mounted separ-

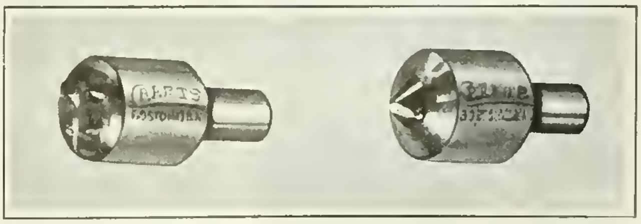


Fig. 4. Single- and Multiple-diamond Wheel Dressers

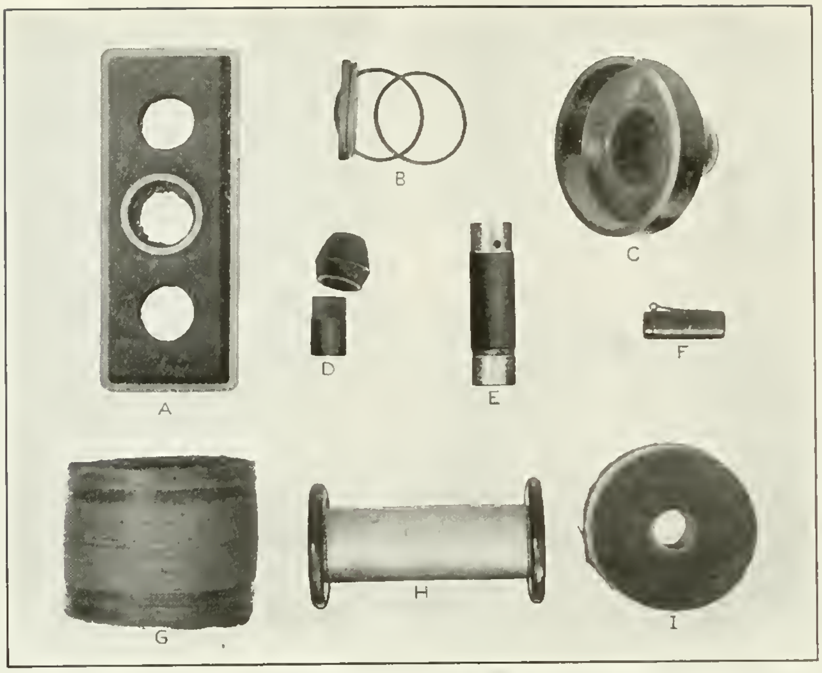


Fig. 5. Articles made from Tough Non-metallic Materials for the Manufacture of which Diamond Tools are used

ately in it instead of one. This provision allows for variation in wear without increasing the thickness of the flange or its curvature, it being only necessary to shift the tool the proper amount from right to left, in order to round opposite sides of a flange or disk-like part. It will also be appreciated that the cost of a tool of this kind is comparatively less than where one large diamond is used valued at considerably more per carat. Not only is a greater first cost involved in using a single-diamond tool, but the resharpening of a tool of this type is more expensive.

A rather unusual design of diamond cutting tool is shown at *G* in the collection of tools. There are two full-length diamond lips each about ½ inch long set in this countersink, which is used for countersinking holes in hard rubber, or other tough substances, for the accommodation of screwheads. Tool *H* is a glass drill carrying a two-lipped diamond. The twist drill *I* is mounted with a thin diamond, a natural flat crystal. Added strength and wearing qualities are furnished a stone if it can be used without removing the original surface. The lips of the diamond are formed with cutting edges having suitable clearance angles as in an ordinary twist drill, and the diamond is set into the web between the lips by brazing.

The tools *L* and *M* are used either for grooving or as cutting-off tools. Tool *L* has square corners as would be required for cutting a square groove and the view enables the brazed setting of the diamond to be observed. Tool *M* has a rounded cutting edge formed on the diamond, as would be required for forming a groove of circular section. At *K* is illustrated the end of a diamond tool which has been employed for a long period of time; the curved depression in the steel above the diamond has been worn away by the flow of chips. In order to produce as much wear as this tool has been subjected to, simply by the friction of chips, the diamond must have been in service many times longer than it would be possible for a steel tool to endure. In fact, it has often been found that the cause for resetting a diamond is not due to any deterioration of the diamond itself but to the action of chips wearing away the steel which supports it.

The other parts shown in Fig. 5 and not mentioned in connection with the collection of tools, are the hard rubber cover shown at *A* in which two end holes are bored; the screw plug *D* also made of hard rubber on which threads are cut; fiber connection *E*, the ends of which are turned; the celluloid rings *B* used for eyeglass rims; and the hard rubber fountain pen top *F* which is bored, beveled, and rounded in the closed end with diamond tools, used in screw machines.

Examples Illustrating Application of Diamond Tools

The use of diamonds for turning long cylindrical parts which must have a uniform diameter throughout has previously been referred to and one instance of this application is that of turning the brass sliding tubes of telescopes and field glasses, this use of diamonds being made by the Bausch & Lomb Optical Co., Rochester, N. Y. These tubes are often several feet in length and present a condition which by the use of steel turning tools caused considerable trouble in maintaining a uniform diameter throughout.

Another common use of diamonds for turning tough materials of long cylindrical shape is found in the manufacture of hard rubber typewriter rolls. Diamonds are also extensively used in the various turning and boring operations performed in the manufacture of hard rubber fountain pens, and it is stated that a single turning tool will give accurate results on this kind of work for months, turning out hundreds of thousands of these parts without affecting the cutting edge of the tool or without need of resetting the stones.

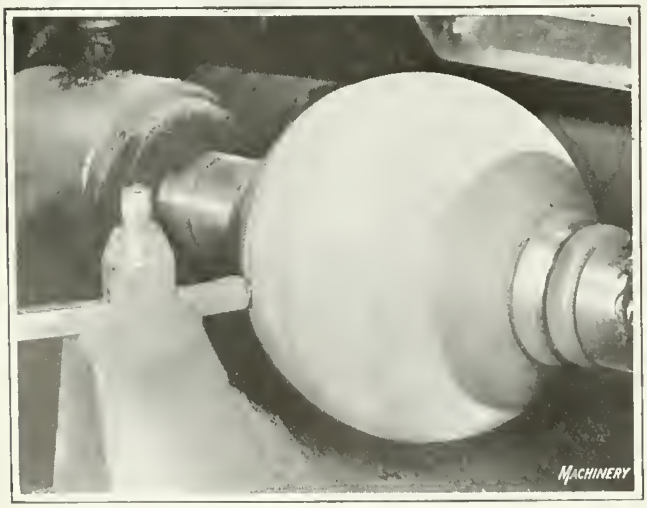


Fig. 6. Lathe set up with Diamond Tool for turning a Bowling Ball

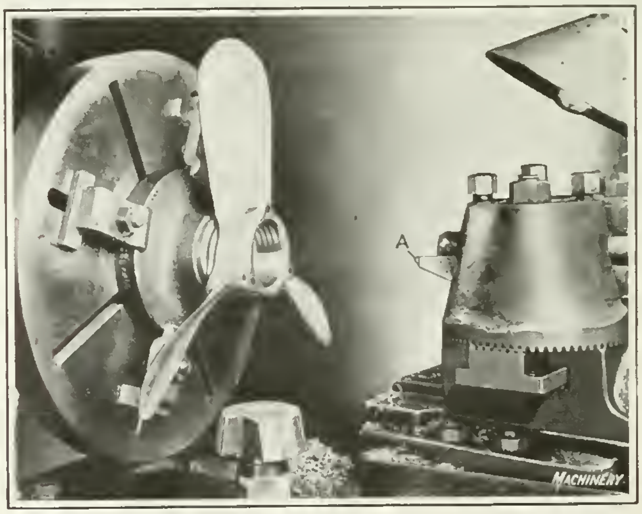


Fig. 7. Taper-boring a Bronze Bushing in a Fan with a Diamond Tool

Bowling balls and similar spherical articles made from gutta-percha, fiber or some form of molded composition are turned with diamond tools. Such a use of diamonds is illustrated in Fig. 6 in which a set-up used for turning a bowling ball is shown. This lathe is equipped with special cupped head- and tail-centers, the diamond tool being located in the tool-post in the regular manner.

In the manufacture of aluminum fans for automobile engines, the Taft-Peirce Mfg. Co., Woonsocket, R. I., uses diamond boring tools for finishing the interior of taper bronze bushings with which these fans are furnished. This method of finishing was resorted to after other methods had proved inefficient. The work is now being finished without need of any subsequent operations to produce the desired degree of finish. Formerly an attempt was made to grind these bronze bushings, but the trouble experienced in charging the surface with abrasive resulted in this method being discontinued. The result obtained by the use of the diamond tool is comparable to that obtained by broaching or by burnishing or lapping; in addition, uniform results are obtained with one tool, for an indefinite length of time.

The fan is located on a special plate which is attached to the faceplate of a Lodge & Shipley lathe and the fan is secured against this plate by a large headed bolt which seats against the inner counterbored shoulder. The arrangement is illustrated in Fig. 7 which shows the diamond itself at *A*. The cutting speed is 180 feet per minute, and a very slow feed is employed. The time required to finish-turn this bushing including chucking the work, is 10 minutes.

A new field for diamond tools has been found in the manufacture of radio apparatus. Many of the parts used in radio instruments can be machined to advantage with diamond tools. It is reasonable to expect that diamond tools will be more and more widely applied when manufacturers become more familiar with their usefulness.

* * *

THE OBJECT OF COST KEEPING

The cost-keeping records of a manufacturing firm should aid in (1) determining the selling price of completed parts or machines; (2) determining the price of repair parts; (3) determining whether a part or device should be made in the shop or produced outside; (4) determining upon the value of newly proposed manufacturing methods, by comparing data of past performances with new records; (5) furnishing such statistics as may be of value in economically managing the plant—for instance, scrap costs, comparative costs of similar parts or units, and cost due to breakdowns. It is considered a good plan to have the cost records show the length of time consumed when the operation has been performed under both the day and piece-work system of payment. In starting a cost system, the uses of every figure collected should be ascertained; otherwise the system will deteriorate into red tape, and cost more than it is worth.

* * *

VALUE OF MACHINE TOOLS AND METAL-WORKING MACHINERY EXPORTED TO FRANCE. 1912-1921

Year*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal-working Machinery
1912	....	....	....	....	....	$1,267,831
1913	....	....	....	....	....	1,936,908
1914	....	....	....	....	....	1,771,525
1915	....	....	....	....	....	8,695,826
1916	....	....	....	....	....	13,316,702
1917	....	....	....	....	....	29,254,379
1918	$5,873,301	$2,874,676	$2,620,350	$11,368,327	$8,902,203	20,270,530
1919	1,744,254	1,390,159	2,989,457	6,123,870	9,661,410	15,785,280
1920	912,345	520,932	2,405,836	3,839,113	3,756,620	7,595,733
1921	556,265	127,140	715,879	1,399,284	2,645,077	4,044,361

Machinery

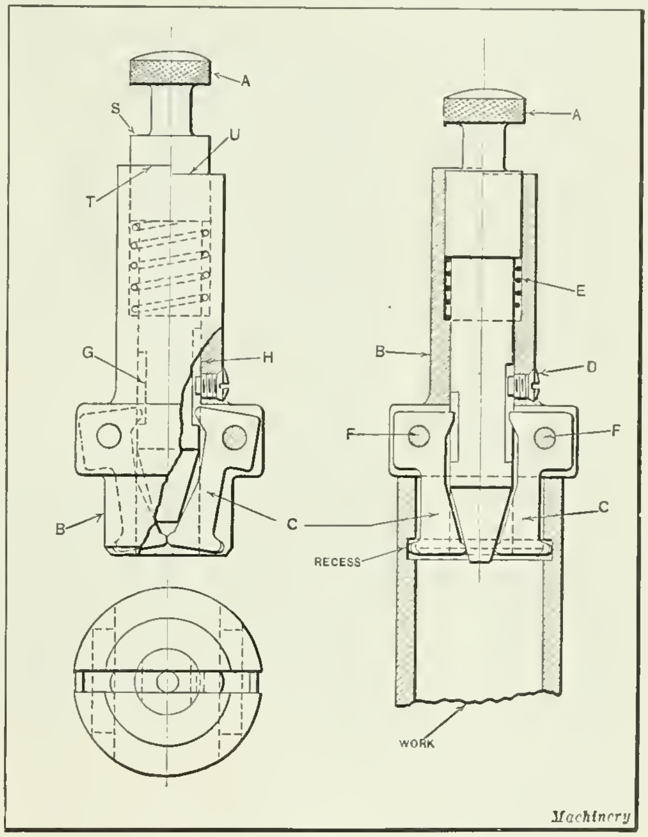
*Amounts given are for fiscal years up to and including 1918, and for calendar years thereafter. The Department of Commerce statistics did not give machine tool exports separately previous to 1918.

GAGE FOR TESTING DEPTH OF RECESS

By J. T. LONGDON

The illustration shows a limit gage of strong and simple construction that the writer designed for gaging the depth of the recess in small tubes. In use, the body *B* is inserted into the work as far as the shoulder will allow, and the plunger *A* is pressed down until stopped by the action of the gaging pieces *C* coming in contact with the bottom of the recess in the work. The relative positions of plunger *A* and the pieces *C* when in the gaging position are shown in the view at the right. When plunger *A* is pushed down, the gaging pieces are revolved on pins *F* so that their lower ends are forced outward into the recess to be gaged. When the shoulder *S* on plunger *A* coincides with the top step *T* on the body *B*, the gaging pieces *C* will be set to measure the minimum diameter of the recess in the work, and when the shoulder *S* coincides with the bottom step *U*, the gage will be set to measure the maximum diameter of the recess.

Referring to the left view, flats *G* and *H* are cut in plunger *A*. The flats provide clearance for the upper ends of pieces *C*, and form shoulders which on the return stroke of plunger *A* engage with pieces *C*, causing them to swivel inward, thus withdrawing their measuring points from the work. The gaging pieces are protected when not in use, and a spring *E* actuates plunger *A* on its upward stroke. A set-screw *D* prevents plunger *A* from rotating. The height of the step on body *B* is governed by the number of degrees in the included angle of the conical section of plunger *A* and the amount of tolerance allowed on the work. When the tolerance is small, the number of degrees in the included angle of the conical section of plunger *A* should be equally small to give a step on body *B* high enough to permit easy reading.

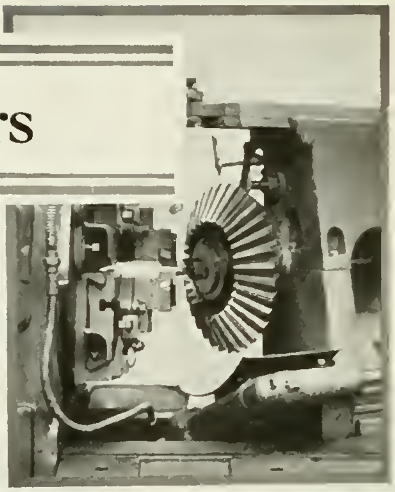


Limit Gage for testing Depth of Recess

* * *

The importation of machinery into Mexico is three times greater than it was ten years ago. From 1909 to 1921 over $122,000,000 worth of machinery of all kinds was bought by Mexico, and in 1921 alone the total value of machinery imported was $34,000,000.

Cutting Bevel Gears



Generating the Teeth of Large Bevel Gears—Formulas for Checking Chordal Thickness of Bevel Gear Teeth—Last Installment of a Series of Three Articles

By FRANKLIN D. JONES

Although the generating type of bevel gear planer is the kind used for finishing the teeth of small bevel gears, especially when accuracy is essential, large gears of coarse pitch are usually cut on a templet type of planer. In fact, the generating type of machine capable of cutting fairly large gears of coarse pitch, is comparatively recent. The templet type of machine is used invariably for very large gears, but Gleason generators are now made for cutting bevel gears which formerly were beyond the capacity of a generating type of machine. The Gleason generator shown in Fig. 1 will generate teeth of one diametral pitch, and has a capacity for pitch diameters up to 25 inches for miter gears. This machine operates on the same fundamental principle as the Gleason generator previously described, although the design is entirely different. It has two cutting tools like the older designs of generators, and these tools operate on both sides of the tooth which is finished before indexing to the next tooth. The head carrying the work-spindle is adjusted about a vertical axis, in accordance with the angle of the gear to be cut, and the tool-slides are also given an angular adjustment in a vertical plane to provide for the converging form of the teeth. The number of cutting strokes per minute is regulated by change-gears and the stroke length by a slotted crank as on the other machines.

When it is considered desirable to take both stocking and finishing cuts without removing the gear from the machine, this may be done readily. Stepped tools are used for the stocking cuts, and the generating motion is not utilized. This change for either roughing or finishing cuts can be made quickly. Fig. 2, which is a rear view, shows a planer taking stocking cuts.

How the Generating Motion is Derived

The tool-slides are carried by a drum-shaped member which has a bearing in the main column of the machine. When the planer is operating, this drum has a rolling motion acting in conjunction with a rolling movement imparted to the gear being cut. This generating motion is obtained by connecting the tool-carrying drum with the work-spindle through a suitable combination of gearing. The resulting motion is the same as that obtained from rocking crown and master gear segments together, as described in connection with the other generators, but compound change-gears are used in this large machine, and the extent of the rolling motion is controlled by a reversing mechanism. A graduated scale enables the operator to check the extent of the rolling motion, as determined for the particular gear being cut.

Testing the Thickness of a Bevel Gear Tooth

When setting up a machine for finishing the teeth of bevel gears, it is essential to cut the teeth so that the thickness along the pitch circle is equal to one-half the circular pitch, minus whatever slight amount may be allowed to provide clearance for the teeth of a mating gear. The backlash adopted by the American Gear Manufacturers' Association for different diametral pitches and for diameters from 3 to 20 inches, is as follows: 2 pitch, backlash 0.012 to 0.015 inch; 3 pitch, 0.10 to 0.012 inch; 4 pitch, 0.008 to 0.010 inch; 5 pitch, 0.008 to 0.009 inch; 6 pitch, 0.006 to 0.008 inch; 8 pitch, 0.006 to 0.007 inch.

When the first tooth is finished, its thickness at the pitch line is tested either by using a solid or non-adjustable gage made to suit whatever pitch is being cut, or by using a vernier gear tooth caliper, which is a graduated measuring tool applicable to any pitch within its range. The gage or caliper is applied to the large end of the tooth and is held approximately in alignment with the end surfaces or back cone when testing the tooth thickness. The distance between the measuring points equals the chordal thickness of the tooth. As the chordal thickness of gear teeth of the same pitch varies for different numbers of teeth, a solid or non-adjustable gage can only be absolutely correct for one number, but the use of solid gages is common, as they are considered sufficiently accurate for practical purposes; moreover, solid gages are preferable to a vernier caliper as a shop tool because the vernier caliper must be adjusted and there is always a chance of error when taking the reading.

Formula for Chordal Thickness and Corrected Pitch Depth

When the chordal thickness must be calculated, this can be done by using the same formula as for spur gears, assuming that the bevel gear teeth are of standard proportions. If N = number of teeth; T = chordal thickness of pitch line; D = pitch diameter, then

$$T = D \times \sin \frac{90 \text{ degrees}}{N} \qquad (1)$$

When the gage or caliper rests upon the top of a tooth, the lower ends of the jaws must contact with the sides of the tooth, at the point where the chordal thickness was determined; that is, at the pitch line when using the formula just given. If a vernier gear tooth caliper is used, the horizontal scale is set to the chordal thickness T, and the vertical scale to a dimension known as the corrected pitch depth or corrected addendum. The value of H may be determined by the following formula, in which S = pitch depth or addendum; R = pitch radius; N = number of teeth; and a = pitch cone angle:

$$H = S + \cos a\left(R - R \cos \frac{90}{N}\right) \qquad (2)$$

This is unlike the formula used for spur gears, as it is necessary to allow for the fact that a bevel gear tooth is measured at an angle to the plane containing the pitch circle.

Formulas based upon the back cone distance B have been widely used for determining the chordal thickness and corrected pitch depth of bevel gears, but the same results are obtained with the comparatively simple formulas given in the foregoing.

Example—Find the chordal thickness and corrected pitch depth of a pinion having 20 teeth of 1 diametral pitch, and a pitch cone angle of 26 degrees 34 minutes.

The pitch diameter = 20 ÷ 1 = 20 inches.

$$T = 20 \times \sin \frac{90 \text{ deg.}}{20} = 20 \times 0.07846 = 1.569 \text{ inches}$$

The addendum for 1 diametral pitch equals 1 and

$$H = 1 + 0.89441 \ (10 - 10 \times 0.99692) =$$
$$1 + 0.89441 \times 0.0308 = 1.028 \text{ inches}$$

Formulas for Teeth having Modified Pitch Depths

When cutting gearing having teeth of special pitch depths or thicknesses, the formulas previously given for finding the chordal thickness and corrected pitch depth, must be changed to allow for variations from the standard tooth proportions. The following formulas, which are applicable to bevel gears having either standard or special teeth, take care of any variation of tooth thickness, as when gearing with long and short addenda is used (for reasons that will be explained later). In these formulas, X is equal to the circular thickness of the tooth on the pitch circle; the notation otherwise is the same as that for the formulas which were previously given for standard teeth.

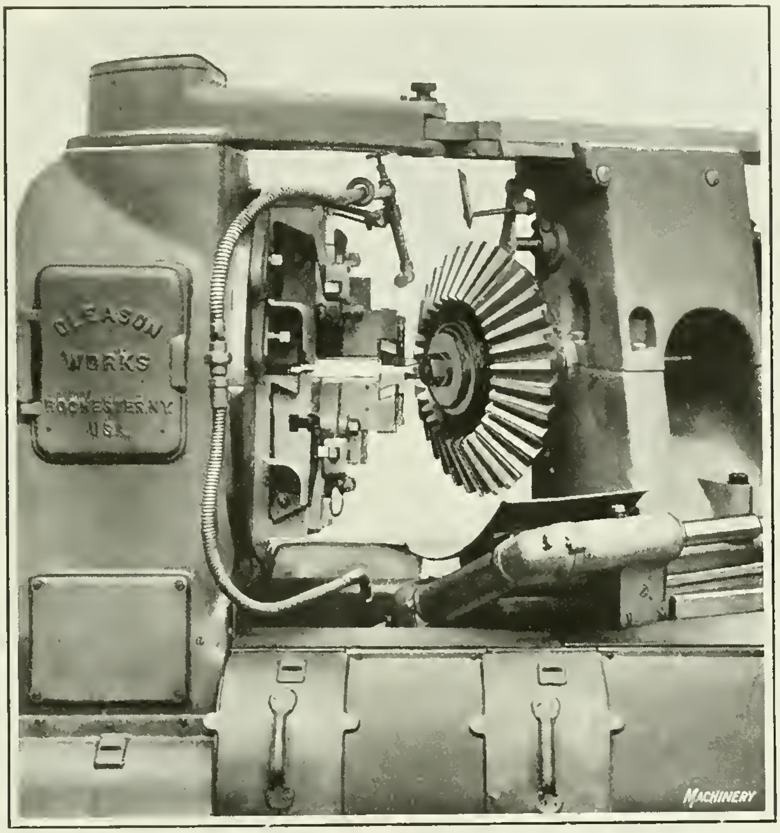


Fig. 1. Gleason 25-inch Bevel Gear Generator

$$T = D \times \sin \frac{90X}{R \times 3.1416} \qquad (3)$$

$$H = S + \cos \alpha \left(R - R \ \cos \frac{90X}{R \times 3.1416} \right) \qquad (4)$$

Circular Thickness when Teeth have Modified Pitch Depths

If the addendum of a tooth is not standard or is not equal to 1 divided by the diametral pitch, the circular thickness at a given pitch depth may be determined as follows: First find the difference between the given pitch depth and the normal pitch depth, and multiply this difference by the tangent of the pressure angle of the gear; multiply the result thus obtained by 2, and then subtract the product from one-half the circular pitch for the gear; for the pinion, *add* the product to one-half the circular pitch. The final result equals the circular thickness corresponding to the given pitch depth.

If X = circular thickness of the *gear* teeth; x = circular thickness of the mating *pinion* teeth; D = difference between normal pitch depth and given pitch depth; P = circular pitch; B = pressure angle of gear, then

$$X = \frac{P}{2} - 2\,D \tan B \qquad (5)$$

$$x = \frac{P}{2} + 2\ D\ \tan\ B \qquad (6)$$

Calculations for Pinion having Special Pitch Depth

A pinion having 17 teeth is to run with a 60-tooth gear. The circular pitch is to be 0.6803 inch, and the pressure angle 14½ degrees. To avoid under-cutting, the pinion teeth are to have a pitch depth or addendum of 0.303 (instead of 0.2165, which is standard for this pitch) and the pitch depth of the gear is to be shortened to 0. 130. Find the chordal thickness and corrected pitch depth for the pinion.

The pitch diameter is equal to 3.68117 inches. The circular thickness of the pinion teeth is next found. The difference between the normal and given pitch depths equals 0.303 —0.2165 = 0.0865. The tangent of the pressure angle of 14½ degrees = 0.25862. Inserting these values in the formula previously given for finding the circular thickness, we have

$$x = \frac{0.6803}{2} + 2 \times$$
$$0.0865 \times 0.25862 =$$
$$0.3848 \text{ inch}$$

$$T = 3.68117 \times \sin \times \frac{90 \times 0.3848}{1.84 \times 3.1416}$$

$$3.68117 \times \sin 5.99 \text{ deg.} =$$
$$0.384 \text{ inch}$$

The corrected pitch depth is now obtained by means of formula (4) previously given The cosine of the angle 5.99 degrees, just determined, is used in this formula, and also the modified pitch depth which is to be 0.303 inch. If the pitch cone angle of the pinion is not known, the tangent may be obtained by dividing the number of teeth in the pinion by the number of teeth in the gear. Thus 17 ÷ 60 = 0.2833 = tangent 15 degrees 49 minutes.

$$H = 0.303 + 0.96214 \times \left(1.84 - 1.84 \times \cos \frac{90 \times 0.3848}{1.84 \times 3.1416} \right) =$$
$$0.303 + 0.96214 \times (1.84 - 1.8299) = 0.312 \text{ inch}$$

Changes of Pressure Angle and Tooth Proportions

As the pressure angle of the gear is the same as the angle of the cutting edges of the tools, gears of any pressure angle required may be cut readily on a generating type of machine. When the pressure angle is 14½ degrees (the angle commonly used outside of the automotive field) the minimum numbers of teeth on the pinion, recommended by the Gleason Works for different gear ratios, are as follows: Ratios from 6 to 1 down to and including 3 to 1 should have pinions with not less than 21 teeth; for a ratio of 2 to 1, 19 teeth; for 1½ to 1, 18 teeth; for 1 to 1, 14 teeth.

If smaller pinions are used, the flanks of the teeth will be under-cut, but this may be avoided either by increasing the pressure angle or by lengthening the addendum of the pinion and shortening the addendum of the gear a corresponding amount. The usual practice for gearing of this kind is to make the addendum of the pinion 0.7 of the working depth, and the addendum of the gear 0.3 of the working depth. The circular thickness of teeth having these proportions may be found by multiplying the circular pitch by the following constants:

Pressure Angle	Gear	Pinion
14½ degrees	0.4341	0.5659
15 degrees	0.4317	0.5683
20 degrees	0.4073	0.5927

This is the last installment of the series of three articles on the cutting of bevel gears, which was begun in July MACHINERY.

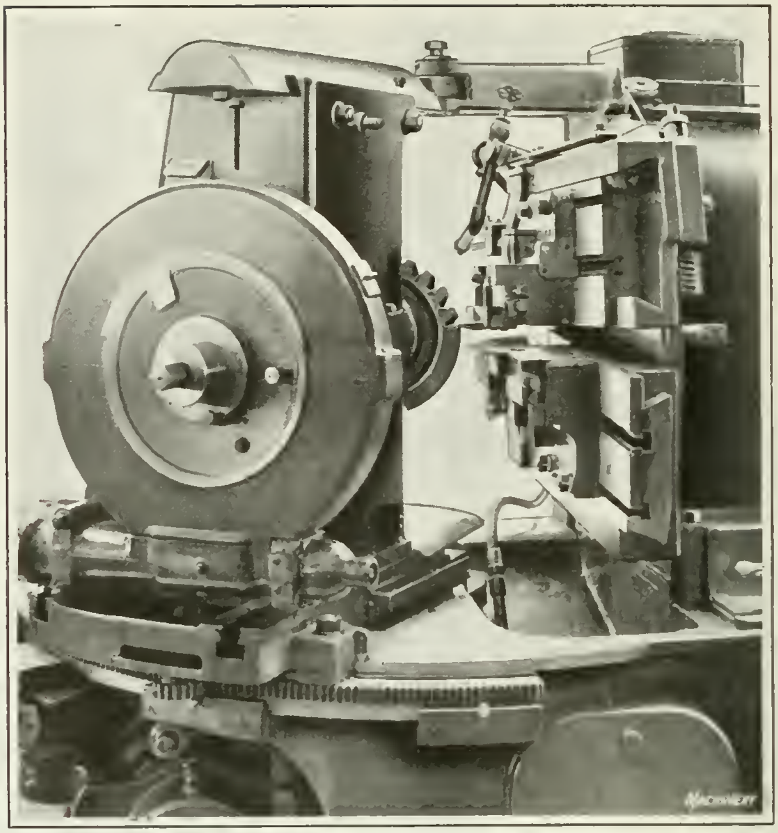


Fig. 2. Taking Roughing or Stocking Cuts on a 25-inch Generator

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PLANNING THE LOCATION OF MACHINE TOOLS

Any industrial plant should have a predetermined arrangement or lay-out of the equipment, if the maximum service is to be obtained from it when in operation. The equipment should be so located that the material will flow through the plant without serious interruptions from the receiving room to the shipping room. Furthermore, the machinery and the entire plant should be so arranged that it can be enlarged with a minimum shifting of equipment.

The simplest way in which to plan the arrangement of the machines in the shop is to use a drawing or blueprint of the floor plan of the building, drawn to a large scale, and to locate upon this drawing or blueprint small pieces of heavy drawing paper or cardboard representing the machines to be installed, cut out to the same scale. In this way the machines can be shifted around on the drawing until a satisfactory arrangement has been found. In placing the machines, sufficient space must be allowed for countershafts and lineshafts. In some plants it is customary also to indicate, by means of a string placed on the drawing, the general route that a part would have to take through the plant while being operated on. Pins may be placed in the drawing and the string stretched around them. This affords a very clear means of showing whether or not the path of the work through the shop is as straight as possible or whether too much moving and trucking of parts back and forth will be required.

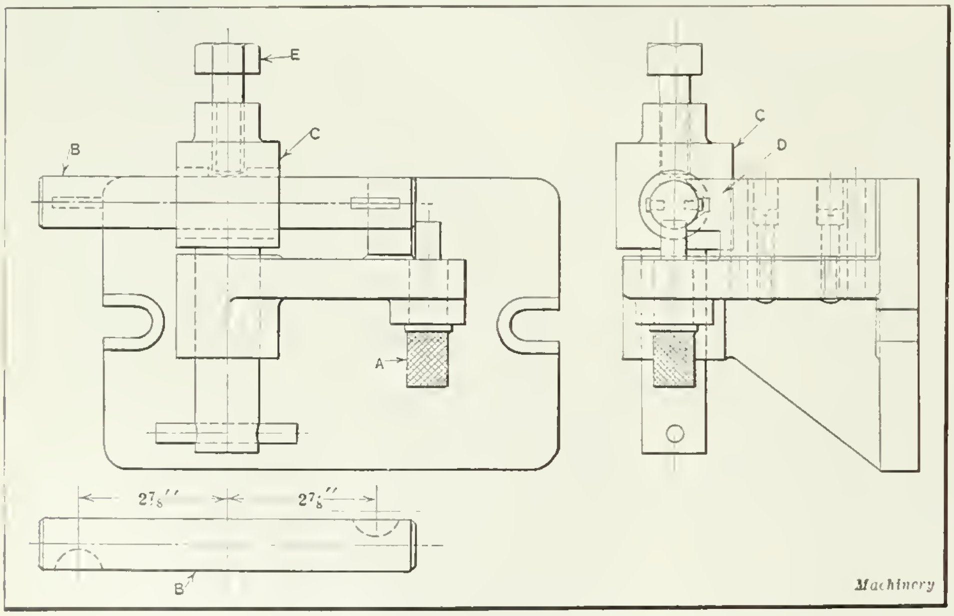
* * *

KEYWAY MILLING FIXTURE

By JOSEPH LANNEN

The fixture illustrated was designed for use in milling two Woodruff keyways located on opposite sides and on opposite ends of the clutch throw-out shaft of an automobile. The indexing arrangement which permits both keyways to be cut in one set-up on a hand milling machine is a noteworthy feature of this fixture. The pin *A* is inserted in the fixture in order to serve as a locating point for the work *B*, which is held in a trunnion *C* at a point equidistant between the keyways that are to be cut. The trunnion has a bearing in the body of the fixture which permits it to turn as well as to slide transversely with regard to the axis of the work. This permits the work to clear the V-block *D* when being indexed.

In operation, the work is clamped in the trunnion *C* by the set-screw *E*, being centered by the V-block *D* and located endwise by the locating pin *A*. The first keyway is then cut, after which the locating pin is withdrawn and the work indexed 180 degrees. The opposite end of the shaft is then placed in the V-block and the second keyway cut.



Fixture used in milling Woodruff Keyways in Short Shaft

VERTICAL SHAPER WORK

By J. M. HENRY

Several interesting examples of the application of vertical shapers to production work were shown in an article on page 483 of February MACHINERY. The vertical shaper has already achieved a position of considerable importance in the tool-room, and its scope of usefulness is gradually being extended to include production work. With the exception of the article referred to, however, very little has been published regarding the actual operation of this type of machine or the great variety of work for which it has proved adaptable. For this reason the writer believes that the examples of vertical shaper work shown in the present article will be of interest to a large number of MACHINERY'S readers.

In Fig. 1 is shown a typical vertical shaper job. The work consists of finishing the sides of eight square pockets in a four-armed block. The limit of accuracy, with respect to the size and squareness of the finished pockets, is 0.0005 inch. In addition to these exacting requirements, the sides of the pockets must be parallel with the sides of the arms and in alignment with the hole in the hub within very close limits.

Previous to the shaping operation, the bottoms of the pockets are finished and under-cut for tool clearance on a profiling machine. The arms are also carefully machined to insure squareness and parallelism of the sides. It will be noted that the work is set up with two of the arms resting on height blocks so that the arm extending upward is brought into a vertical position. In order to locate the work squarely on the machine table, the arbor used to support the work during previous machining operations is clamped to angle-plates as shown. By locating and clamping the work in this manner the sides of the two pockets in the upward projecting arm are brought into the desired position for the machining operation. Roughing cuts are taken with a wide tool, while finishing cuts are taken with a fine-pointed tool. The same method of locating and clamping the work is used in machining the pockets in each of the four arms.

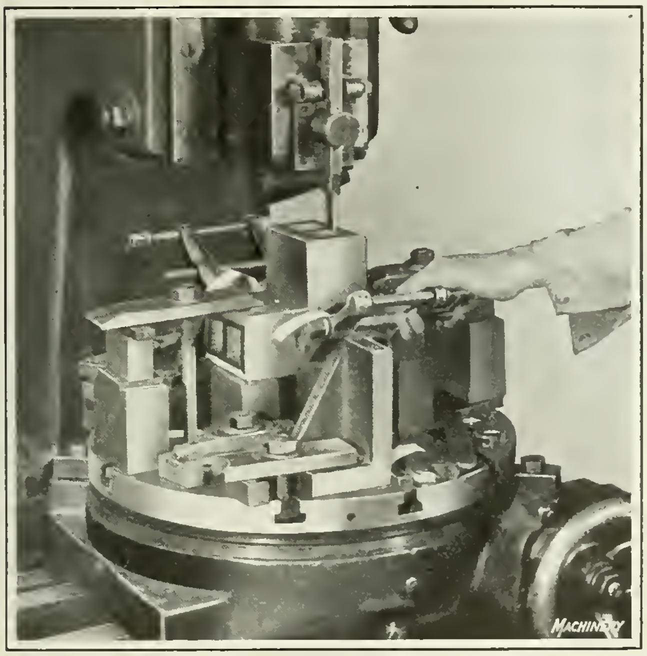


Fig. 1. Finishing Pockets in a Four-armed Block on a Vertical Shaper

It may be of interest here to note some of the features of the vertical shaper that make it particularly well adapted for work of this nature. In the first place, the table is supported by a massive base which provides a firm surface on which to clamp the work. This rigidly supported base is located directly beneath the vertical ram and consequently receives and absorbs the thrust of the tool so that there is practically no chance for inaccuracy due to springing or distortion of the machine frame. The provision of a rigid support for a tool close to the cutting edge, and the fact that the tool-head can be swiveled to any desired position are also advantages.

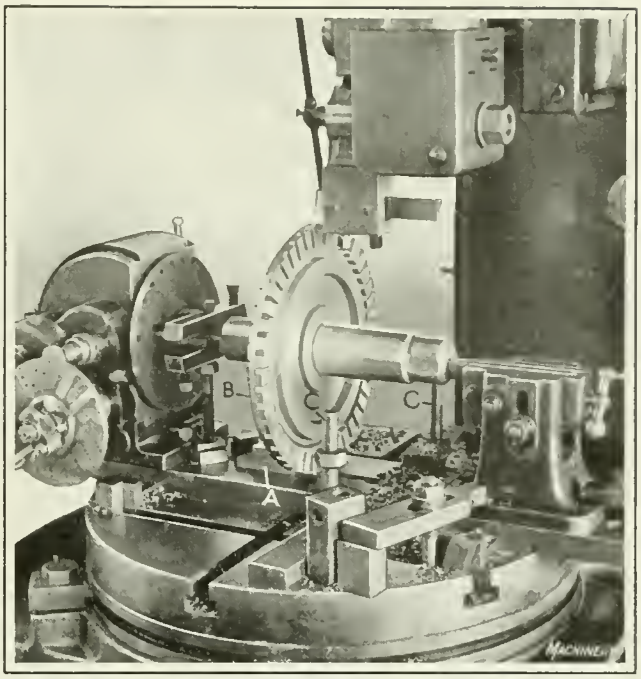


Fig. 2. Cutting Slots in an Index-plate

Slotting an Index-wheel

A rather unusual slotting job is illustrated in Fig. 2. The work consists of cutting the radial slots in an indexing wheel. It will be seen that the work is mounted on an arbor held between the centers of an indexing head. In this case the indexing head is employed simply as a means of supporting the work, the indexing being accomplished by means of a block *A* fitted into the T-slot of the index-head bedplate. This block was designed to engage radial slots *B* which were previously cut on a milling machine. The larger slots which were to be cut on the vertical shaper were required to be spaced exactly midway between the slots *B* on the opposite side of the work. Under these conditions the simple method of indexing by means of block *A* gave very accurate

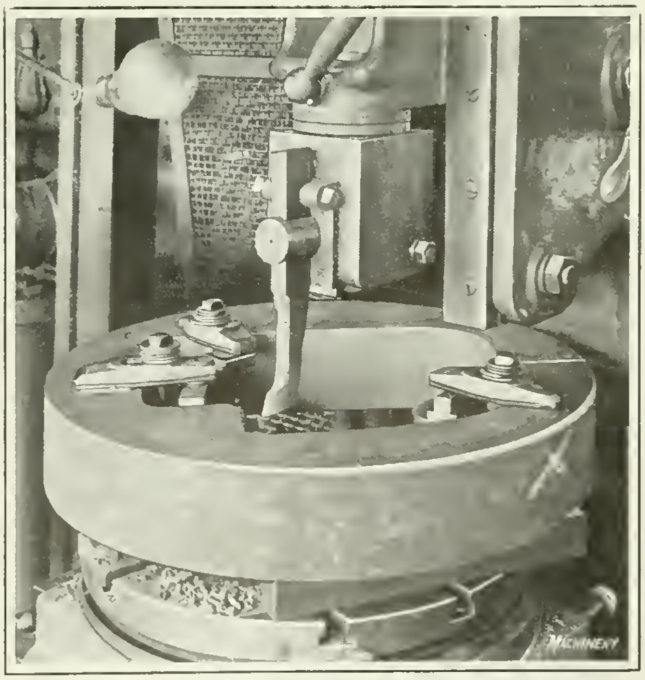


Fig. 3. Machining Opening in Large Blanking Die

results. It is evident that uniformly spaced radial slots could also be cut by employing the indexing head mechanism.

During the slotting operation a parallel supports the front face of the work and prevents the indexing block *A* from springing or distorting the work. The parallel is held in place by bolts *C*, but in order to give a better view of the work, it is not shown in the illustration. The slots are first roughed out and squared with the tool shown in the illustration, leaving 0.002 inch for finishing. The finishing operation is performed with a carbon steel tool, which cuts the slot accurately to size at one stroke. In the finishing operation the tool is stopped at the end of the down stroke and not allowed to draw back over the work. The work is indexed by means of block *A* after each down stroke of the finishing tool. The slots cut in this way are all held to size within a limit of one-quarter thousandth of an inch.

Machining a Large Blanking Die

In Fig. 3 is shown a large blanking die, the opening in which was completely finished in one setting on a vertical shaper. One advantage of the vertical shaper in performing work of this kind is that the tool enters the work on the top face of the die on which the outline or guide lines are usually made. One of the features which also makes the vertical shaper well adapted to die work of this kind is the angular adjustment of the ram. This enables the die opening to be machined with the clearance required to permit the piece blanked by the finished die to drop through the opening. The provision of means for rotating the table and for feeding it either longitudinally or transversely is obviously indispensable in work of this kind

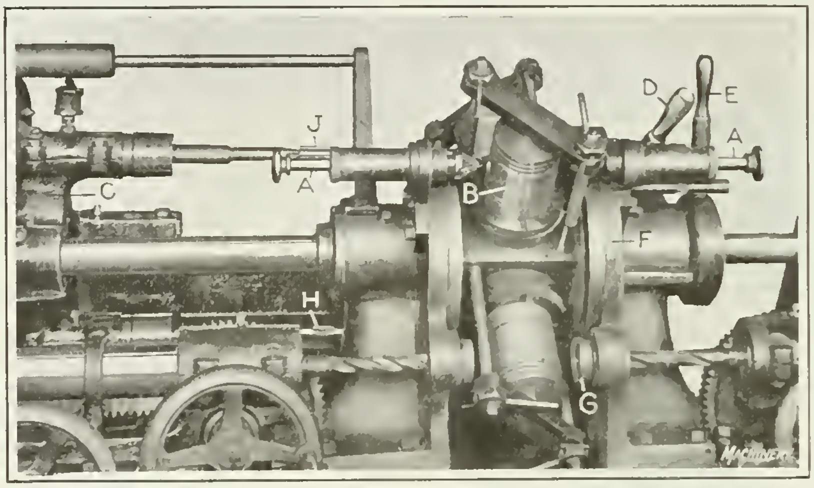
* * *

GERMAN INDUSTRIAL CONDITIONS

A review of the German industrial situation published by the Department of Commerce indicates that the peak of the industrial boom in Germany, which was reached last fall, has been followed by a considerable decrease of activity. The chief factors in the present situation are that there is an approach to the world's market prices which hampers the foreign trade, and the beginning of a reaction in domestic trade following domestic overbuying. Furthermore, the conditions are influenced by the uncertainty as to the future value of the mark, and the adverse effect on Germany's export trade of the fluctuating price system due to this uncertainty. There is also a considerable delay in deliveries, owing to the difficulty of obtaining raw materials and semi-finished products, and money is not so easy as in the past. Further, the export taxes act as a brake upon the foreign trade. The bulletin states that in machine tools the world market price is already reached in certain lines, and as a result there has been a decline in export orders, so that these are now only about 20 per cent of the orders on hand during the peak of the boom last fall. The bulletin concludes that the German industry is apparently confronted with an immediate slump in domestic and export business.

MACHINING PISTON-PIN HOLES IN A REPAIR SHOP

In some of the shops engaged in cylinder regrinding and general automobile repair work, this work is done on such an extensive scale that regular productive machines rather than the make-shift methods sometimes found in repair shops are used in the manufacture of over-size pistons. This is the case in the shop of the Houpert Machine Co., Long Island City, where methods are comparable to those found in an automobile manufacturing plant. The methods used for making over-size pistons in this shop comprise rough- and finish-boring the open ends on a Jones & Lamson turret lathe, rough-drilling the piston-pin hole 1/32 inch under size on a Garvin duplex milling machine, rough-turning on Gridley automatics, finish-turning on Fay automatics, and machining the piston-pin hole on the special machine here illustrated. After the piston-pin holes have been machined, minor operations such as drilling oil-holes, milling reliefs, etc., are performed and then the pistons are sent to the semi-finished stock-bins. The interesting features of the piston-pin hole machine are described in this article.



Horizontal Machine with Turret for accommodating Four Pistons, used for machining Wrist-pin Holes

The machine is of the horizontal type with a four-station, vertically revolving turret, so that the work of drilling, boring, and reaming the piston-pin holes may be continuously performed. The turret head is square and may be set up with proper open-end locating plates to suit the open end of pistons of any regular diameter. In setting up this machine the stations are built up to the proper height by means of plates, these plates fitting over a pilot projecting through each face of the turret. The plates are fitted together by tongue and groove construction, and the top or open-end plate fits accurately into the previously bored piston skirt.

After the proper height has been determined, two 60-degree centers operated by push-rods *A* are advanced to properly locate the piston from the rough-drilled piston-pin hole. The four pistons are clamped down by straps as shown, the work of loading a piston at station *B* being performed while the other three pistons are being machined. At the first work station, opposed drill-heads are advanced to redrill the holes preparatory to boring and reaming. The feed for these two drill-heads is independent of the feed for carriage *C* in which the reamer and boring-bar are carried.

As soon as the tools have completed their operation on a piston, the turret is indexed 90 degrees by handle *D* and clamped by means of handle *E*. The drilling feed for both drill-heads is then engaged before the boring-bar and the reamer are started to feed. After drilling, the piston continues to be advanced to the boring and reaming positions, respectively, which are located at the rear of the machine. Locating bushings in the left-hand head *F* similar to the drill bushing *G* are provided for the pilots on the boring-bar *H* and inserted-tooth reamer *J*. The feeding time for the drills used on this machine can be made to agree easily and effectively with that of the reamer and the boring-bar, thus enabling a high rate of production to be obtained.

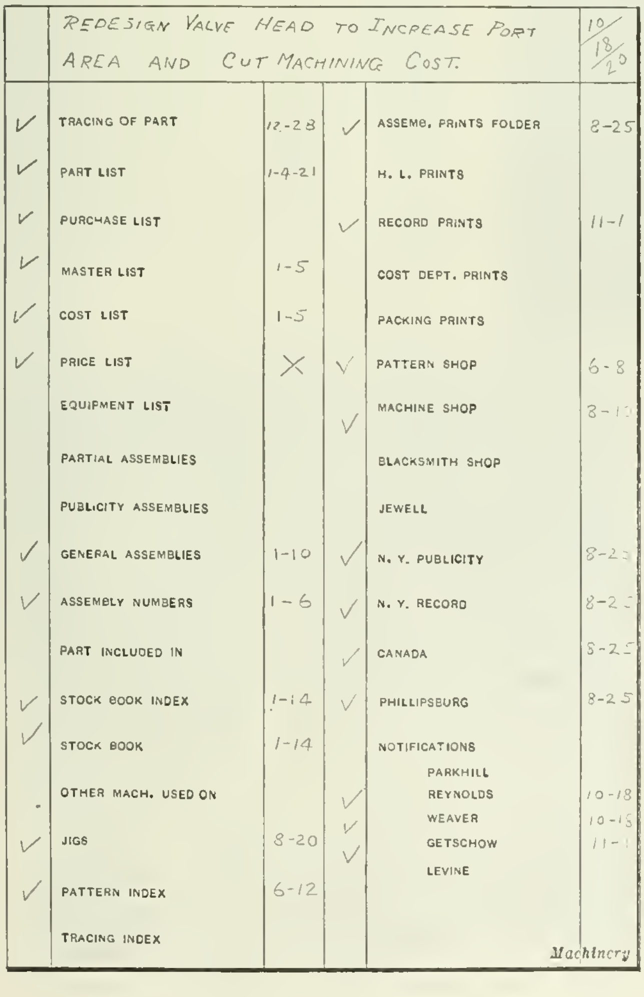
Following up Changes in Design

By HYMAN LEVINE

IN the manufacture of machinery it is frequently found advisable to make certain alterations in design for the improvement of the product. The alterations usually necessitate the correction of drawings, patterns, tools, records, catalogues, prices, and other items; and as these corrections cannot all be made at the same time or by the same man, the person in charge sometimes finds it a serious problem to make sure that they are promptly and accurately attended to.

The task becomes still more complicated when several alterations in design are put through at the same time, each affecting a different set of tools and records, and each requiring a different time for its completion. It is not wise to trust to memory in such cases, as it might result in the omission of some important item and consequent financial loss.

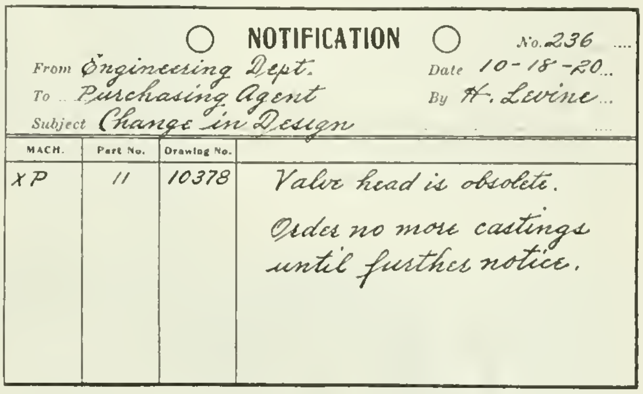
A simple and effective method of following up alterations in design has been developed by the engineering department of a mining machinery plant in the Middle West. This method requires the use of forms or blanks about 4 by 7 inches, which are perforated at the left side and inserted in a loose-leaf binder. A separate sheet is used for each alteration in order to avoid overlapping and confusion. At the top of the form is a space for writing in the alteration to be made, and beside it is a space for the date when the change was decided upon. Below this space at the left is a list of drawings and records that may be affected, and at the right is a list of blueprints and notifications that must be sent out to those who are either responsible for carrying the alterations through or who are otherwise interested in the matter. The column at the left of each list is for check marks, and that at the right is for the dates on which each item is checked off.



	REDESIGN VALVE HEAD TO INCREASE PORT AREA AND CUT MACHINING COST.				10/18/20
✓	TRACING OF PART	12-28	✓	ASSEMB. PRINTS FOLDER	8-25
✓	PART LIST	1-4-21		H. L. PRINTS	
✓	PURCHASE LIST		✓	RECORD PRINTS	11-1
✓	MASTER LIST	1-5		COST DEPT. PRINTS	
✓	COST LIST	1-5		PACKING PRINTS	
✓	PRICE LIST	×	✓	PATTERN SHOP	6-8
	EQUIPMENT LIST		✓	MACHINE SHOP	8-1
	PARTIAL ASSEMBLIES			BLACKSMITH SHOP	
	PUBLICITY ASSEMBLIES			JEWELL	
✓	GENERAL ASSEMBLIES	1-10	✓	N. Y. PUBLICITY	8-2
✓	ASSEMBLY NUMBERS	1-6	✓	N. Y. RECORD	8-2
	PART INCLUDED IN		✓	CANADA	8-25
✓	STOCK BOOK INDEX	1-14	✓	PHILLIPSBURG	8-25
✓	STOCK BOOK	1-14		NOTIFICATIONS	
				PARKHILL	
	OTHER MACH. USED ON		✓	REYNOLDS	10-18
			✓	WEAVER	10-1
✓	JIGS	8-20	✓	GETSCHOW	11-
				LEVINE	
✓	PATTERN INDEX	6-12			
	TRACING INDEX				

Machinery

Fig. 1. Alteration Follow-up Record Sheet



○ NOTIFICATION ○ No. 236

From Engineering Dept. Date 10-18-20

To Purchasing Agent By H. Levine

Subject Change in Design

MACH.	Part No.	Drawing No.	
XP	11	10378	Valve head is obsolete. Order no more castings until further notice.

Fig. 2. Notification Slip used in following up Alterations in Design

When an alteration in design is decided upon, the person in charge of the follow-up makes a note at the top of the sheet, together with the date. Then the list of items is gone over carefully, and a check is placed in front of each one that is likely to be affected. As the work progresses, the date when each item is attended to is noted in the column at the right of the item. When the job is completed the sheet is filed away for future reference. This form reduces the strain on the memory, minimizes oversights, and assists in placing responsibility.

The form shown in Fig. 1 is a record of the changes that were made in the valve head of a pneumatic tool. It was decided to redesign this part so as to provide a larger port area for the passage of air and if possible make the changes in such a way that the production cost would be reduced. The various steps did not follow each other in rapid succession owing to business conditions. A note of the job and the date was first made. Check marks were then placed before each of the items likely to be affected. A notification such as that shown in Fig. 2. was next sent to the purchasing agent to prevent ordering castings of the old design. A similar notification was also sent to the shop superintendent to prevent over-production on this part and to recall the old pattern.

The dates on the follow-up sheet give the history of the alteration from the first to the final entry. The new design was drawn up and approved, and the drawings of the part were available on December 28, 1920. The changes made were such as to require the assignment of a new part number, and therefore it became necessary to note the change on the part lists of the machines on which the valve head is used, on the master list, and on the itemized cost sheets. These, it will be noted, were completed by January 5, 1911. The general assembly drawings of the several machines using this part, were then corrected and a new assembly number given the changed part. The stock-book and its index (a feature peculiar to this plant which was described in detail in August, 1921, MACHINERY in the article, "Record of Materials Used in Machine Construction," page 1133) was also corrected. These were all drafting-room records, and were immediately taken care of. The other items, however, were more difficult to deal with.

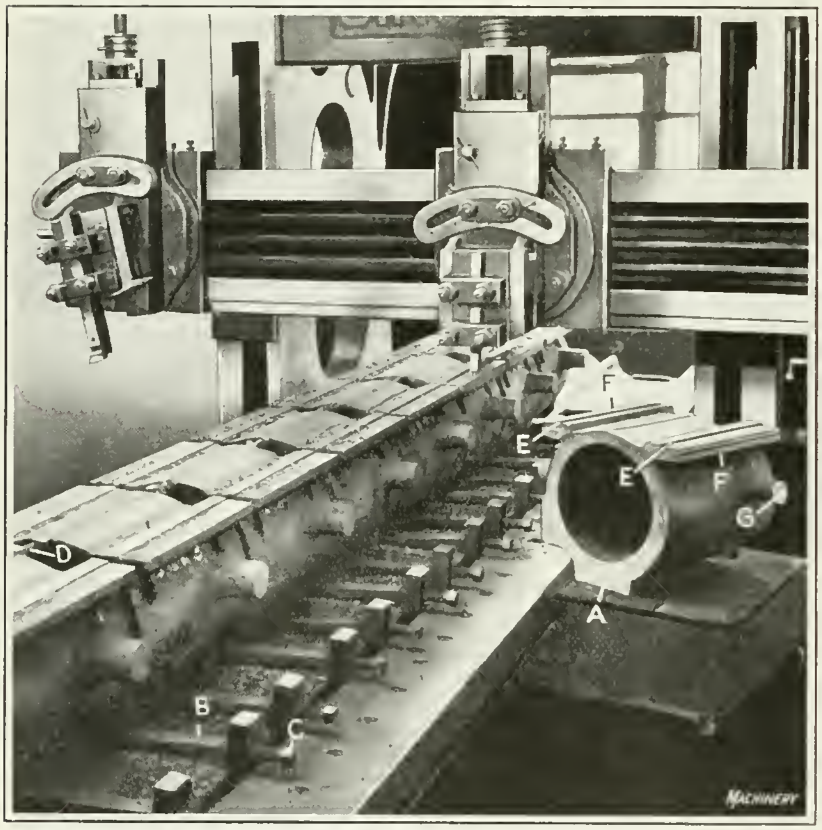
There was a considerable quantity of old valve head castings to be used before employing the new design. Consequently blueprints were not sent to the pattern shop until June 8. It required six weeks to obtain the new castings, but as the old castings were not used until three weeks later, blueprints were not sent to the machine shop until August 10.

Within a few days one of the new valve heads was tried out, and as no changes were found necessary the design of a new jig was begun. When this was completed the necessary blueprints were sent to the tool-room. Blueprints were also sent to the New York, Phillipsburg, and Canada offices and to the publicity department. New blueprints were also inserted in the reference folder containing assembly prints of all machines manufactured at the plant. The first machine using the new valve head was completed and shipped November 1. A blueprint was filed with the records of that machine and a notification sent to the cost department for its guidance. It was decided not to change the selling price of the article, and the check after this item instead of the date indicates that no change was made.

It will be noted that more than a year was required to complete the changes. To have depended upon the memory in the case of each item might have resulted in serious omissions. Although this form was originally intended for changes in design, experience has shown that it can also be used to advantage in handling other jobs that come under the jurisdiction of the engineering department. The retracing of worn-out drawings, the furnishing of blueprints on special request, the preparation of sketches, and similar work are now noted and followed up by records on the form shown in Fig. 1. With slight changes this form can be adapted to use in the engineering and drafting departments of other plants.

PLANING CYLINDER CASINGS FOR AUTOMATIC SCREW MACHINES

In the accompanying illustration there is shown a 36- by 36-inch Cincinnati planer, which is engaged in planing cylinder casings for National Acme automatic screw machines. One of the finished casings is shown standing separately in order to illustrate more clearly the form of the work. A string of ten of these pieces is set up, each casting being supported on the planer table by means of the flat boss *A*. At each side of every casting in the string there is a finger *B* and clamping bolt *C* carried by a plug held in the table T-slot, provision being made in this manner for securing the castings against sidewise movement. These clamping fingers engage the boss *A* on opposite sides. Between each pair of castings there is a strap and hold-down bolt (not shown) to prevent the work from lifting; and a jack *D* to transmit the thrust of the tool from casting to casting is also placed between the ends of adjoining castings in the row. Then at the end of the string, this thrust is carried by a plug and bolt which are not shown in the illustration. On these castings, the operation to be performed consists of planing the base bearing *E*, the sides *F* of this base bearing, and the face of a boss *G* at each side of the casting. There are two tool-heads used on the planer, and a complete string of ten of the castings can be machined in 11½ hours.



Method of setting up Automatic Screw Machine Cylinder Castings for planing

* * *

STANDARDIZATION OF PULLEY SIZES

In connection with Mr. Hoover's plan of simplification in industry which means the elimination of commercially non-essential types, sizes, and styles, some of the pulley manufacturers have indicated that pulleys might be standardized to advantage. As far back as 1919, the Electric Power Club, 1017 Olive St., St. Louis, Mo., adopted specific pulley sizes as the recommended practice for use with each different size and speed of motor. This information is given in the Electric Power Club Handbook, copy of which may be obtained from Mr. S. N. Clarkson, executive secretary of the Electric Power Club.

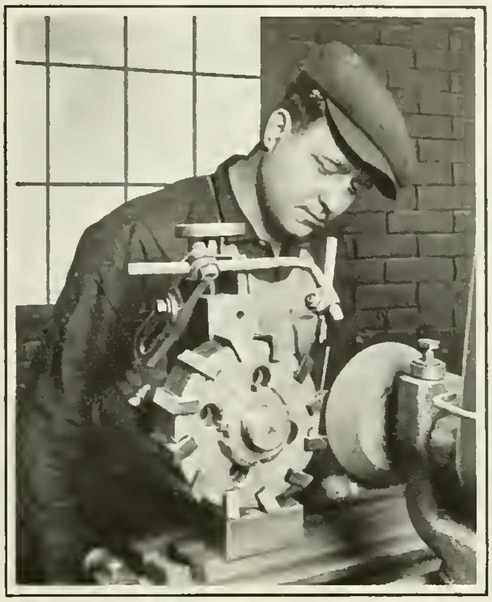
There was some confusion due to the fact that the handbook specified belt width instead of pulley width, but at the annual meeting of the club held recently it was decided to add another column giving the pulley width in addition to the belt width, so that there should be no misunderstanding in future.

If the pulley sizes as adopted by the Electric Power Club were universally recognized, it would tend to standardize the different pulleys on the many machines which are sold for belt drive. As it is now, different manufacturers of machines have their own pulley sizes, and when the purchaser buys a motor to drive the machine, he must order a special pulley in order to obtain the right speed. This is one of the principal reasons why pulley manufacturers think that there are no standard pulley sizes for motors.

The Electric Power Club is an association consisting of the manufacturers that make over 95 per cent of the electric power apparatus and control equipment manufactured in this country. The Electric Power Club Handbook, that gives the pulley sizes referred to, also contains a great deal of other information relating to standards in the application of electrical machinery in the industries.

Grinding in the Small Tool Industry

Grinding Straightedges—Sharpening Cutters—Wheel Selection for Cutter Sharpening—Grinding Plug Gages, Micrometer Parts, Twist Drills, Taps and Dies, Lathe and Planer Tools



Third Installment of a Series of Five Articles on Grinding in Different Industries, by the Engineering and Educational Departments of the Norton Company, of Worcester, Mass.

MODERN grinding methods as applied to the making and sharpening of small tools are of great importance, especially in the machine-building industry. Nearly every shop engages to some extent in producing the various small tools which it uses in its manufacturing processes. This work is not usually thought of as an "industry" in the commonly accepted meaning of the word. On the other hand, there are many concerns engaged solely in the manufacture of small tools to meet the general manufacturing needs of other shops. Strictly speaking, these manufacturers make up the small tool industry which is rightly called a "key industry," because of the dependence upon it of nearly all other industries.

Owing to the varied nature of toolmaking practice, no attempt has been made to go into any great detail, but rather into fundamentals essential to the production of small tools. Grinding methods employed in tool-rooms of manufacturing plants are discussed, as well as those in shops making a specialty of small tool manufacture. The production of the wide range of precision tools in use today is made possible to a large extent by grinding. On account of the close limits imposed, some of the operations necessary in the making of tools cannot be placed upon a production basis in any other way than by grinding. Many tedious hand operations have been replaced entirely, or greatly reduced in duration, by the use of precision grinding machines, and much has been accomplished in the developing of machines adapted for different classes of work.

In modern manufacturing practice, straightedges are ground on a plane surface grinding machine, and further slight refinements which the machine is unable to give are obtained by lapping. An excellent example of the advantage of grinding over previous methods is in the quantity production of blades for combination squares. Three hundred of these blades each 12 inches long are mounted on a magnetic chuck, and the edges finished straight and square within very close limits. The outside limits prescribed for the guidance of the surface grinding machine operators in one shop are given in the accompanying table. As a matter of fact, the operators keep well within these limits.

A difficult operation is the finish-grinding of the blade of a 48-inch square (Fig. 1). The dimensions of the blade are: length, 48 inches; width, 4 inches; and thickness 5/32 inch. The edges are hardened and the center is soft. The long narrow edges must be straight and parallel with each other, as well as square with both sides. Great care must be exercised, not only to keep within the prescribed limits, but to avoid burning the edge of the square during grinding.

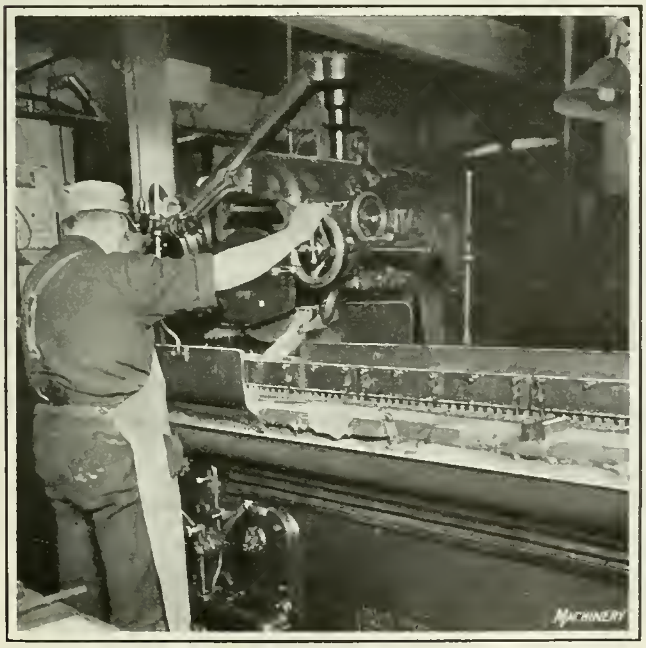


Fig. 1. Finish-grinding the Blade of a 48-inch Square

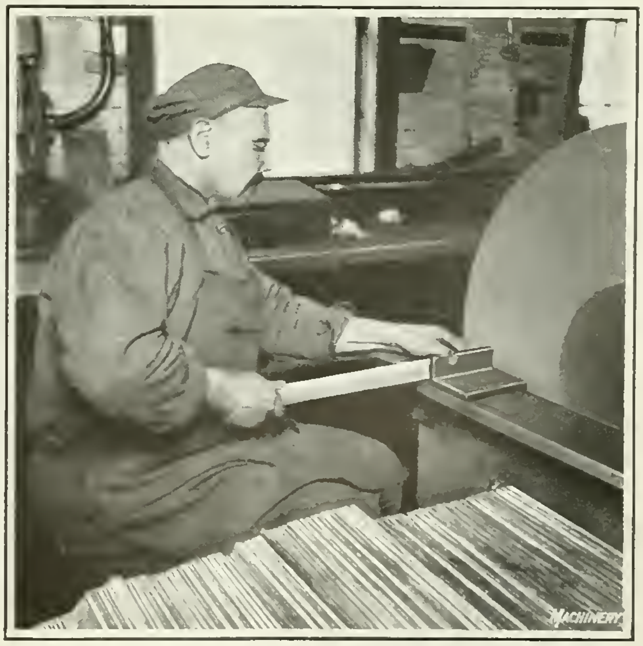


Fig. 2. Method of "Rough-squaring" Ends of Stock for Square Blades

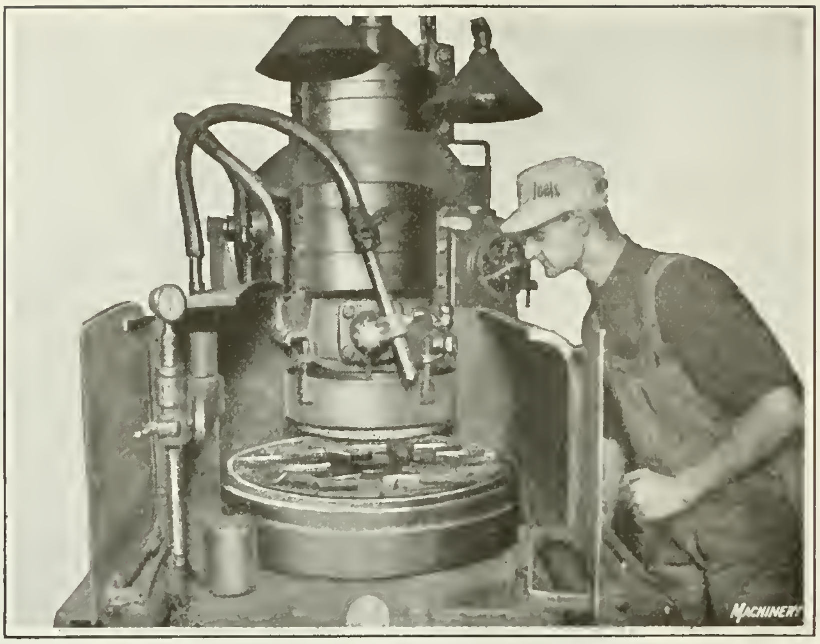


Fig. 3. Grinding the Heads of Combination Squares which are arranged in a Group on a Magnetic Chuck

A method of rough-squaring the ends of stock for combination square blades is shown in Fig. 2. The work is done on disk grinding machines, the disks being coated with aluminous abrasive grain. Combination square heads are very rapidly ground from the rough on a vertical-spindle surface grinding machine, as shown in Fig. 3. From 0.020 to 0.025 inch of cast iron is removed from each side of the square in this operation.

The grinding of milling cutters of the plain, side and formed types constitutes a very important field of the grinding wheel and machine. Machines for grinding cutters vary from simple forms, designed for sharpening a few of the more generally used types, to universal tool and cutter grinding machines having a range which meets practically all requirements. For convenience in describing the common methods employed in the sharpening of cutters, they may be divided in three groups: plain cutters, side cutters and formed cutters.

LIMITS FOR STRAIGHTEDGES

Length of Straightedge, Inches	Limits, Inch	
	Straight	Parallel
Up to 24	0.00025	0.0005
25 to 36	0.0005	0.00075
37 to 72	0.00075	0.001
73 to 96	0.001	0.002

Machinery

Sharpening Plain Cutters

Sharpening a plain cutter is a comparatively simple operation and may be done on a machine consisting of a wheel-head and cross-slide for moving the wheel relative to the work, a means of traversing the cutter relative to the wheel, and a tooth-rest. The cutter is placed on the arbor, and the tooth-rest set to give the clearance desired. Whenever possible the rest should be against the tooth being ground. Cylindrical milling cutters are sometimes mounted on a sleeve for the grinding operation. The sleeve, in turn, is placed on a bar or arbor, which is held between the centers of the cutter grinding machine. In order that the edges of the teeth may be ground parallel, it is necessary that the bar or arbor and the sleeve be straight. It is good practice to grind two teeth, then rotate the cutter and grind two teeth on the opposite side and caliper to see if the machine is set straight. Then each tooth should be moved past the wheel with a steady motion and light cuts, using care to see that the cutting edges be kept radially equal.

To equalize the wear of the wheel, a good method is to grind around the cutter and then rotate it half way, beginning on a new tooth directly opposite the starting point and taking another cut through the complete circumference. By repeating this operation, taking light cuts, the wheel wear is equalized and the cutter is ground cylindrical.

Care should be observed in the method of grinding, that the cutter be kept "round." Each tooth should be moved past the wheel with a steady motion. Burning of the cutter teeth is caused by attempting to remove too much stock at one cut. About 0.003 inch of stock may be removed during the roughing operation, but this should be followed by a

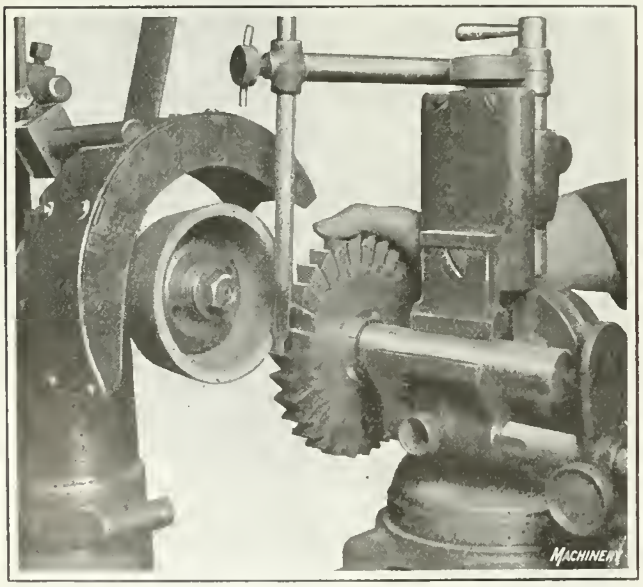


Fig. 4. Machine set up for grinding the Sides of a Side Mill

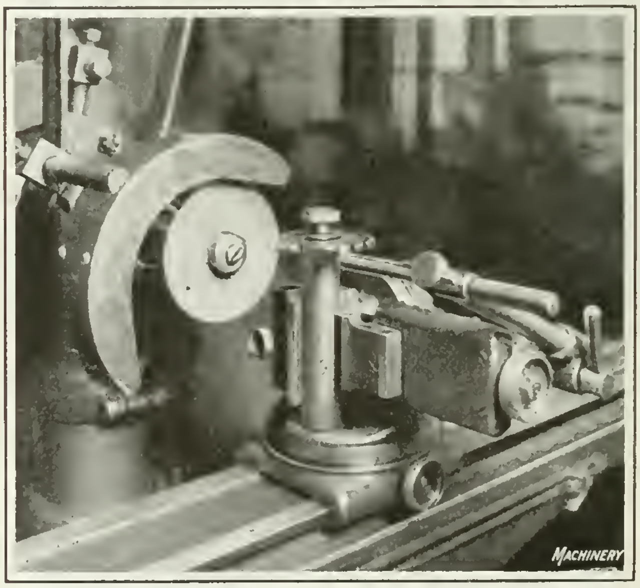


Fig. 5. Arrangement for grinding a Formed Cutter

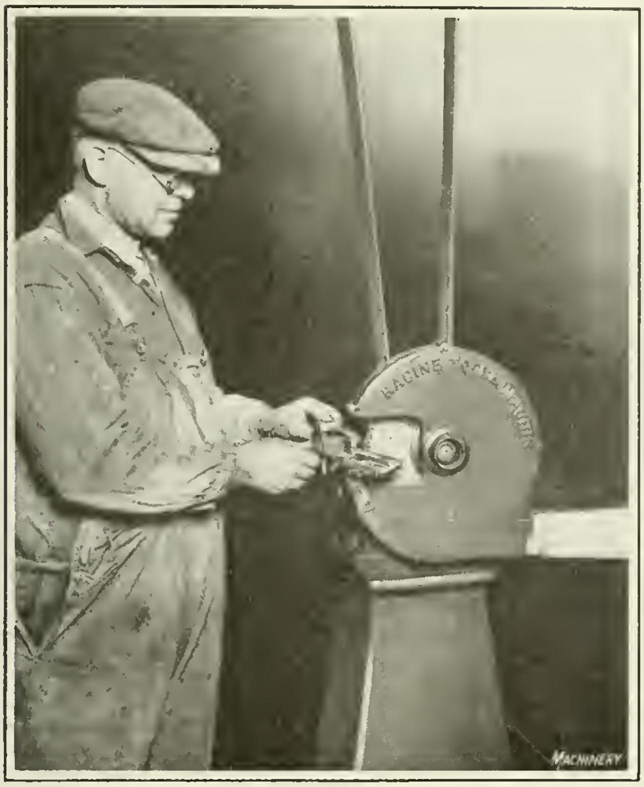


Fig. 6. Cutting off Stellite Cutter Blades by using an Alundum Rubber-bonded Wheel

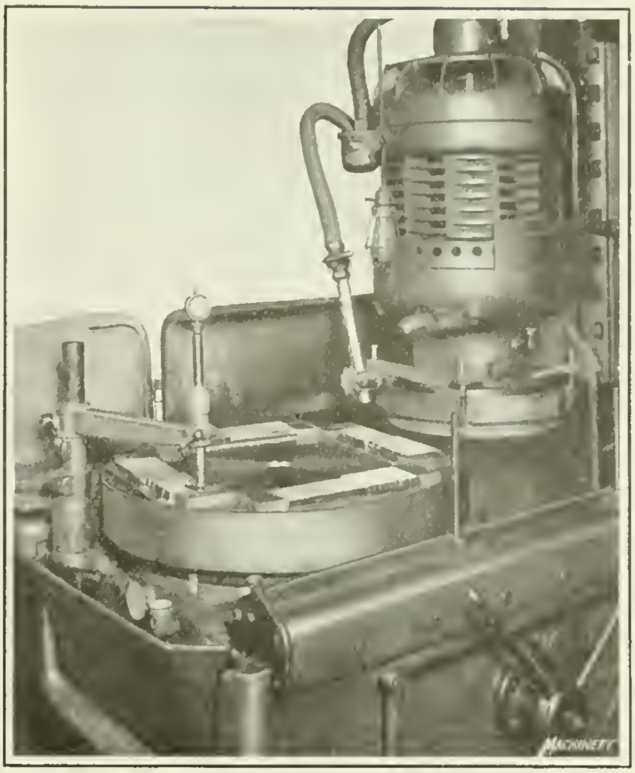


Fig. 7. Vertical-spindle Surface Grinder arranged for grinding the Sides of Stellite Cutter Blades

finishing cut of not over 0.001 inch in depth. The test of whether a cylindrical cutter is "round," or in other words whether the edges are within the surface of an imaginary right cylinder, is made by observing the sparks from the wheel as it comes into contact with the successive teeth.

Grinding Side Cutters and Formed Cutters

Cutters of the side-mill type are ground on the top exactly as with plain cutters. When grinding the sides of the teeth, a cup wheel is usually employed, the cutter being held on the end of an arbor and ground, as shown in Fig. 4.

Formed cutters are ground radially only, with a saucer wheel (see Fig. 5). The cutting edge must be kept in a radial plane, or else the cutter will not produce the intended shape. With this particular type of cutter it is necessary to grind with the rest at the back of the cutting tooth instead of in the usual position on the face.

In all cutter grinding the wheel must run true, and it should be kept clean, for a glazed or loaded wheel draws the temper quicker than one having a clean and true cutting surface. A diamond should be used for truing the wheel face.

Wheel Selection for Cutter Sharpening

The grinding wheel must be of a soft free-cutting grade so as not to draw the temper of the cutting edge and, for the same reason, the cut must be light and never forced. If the wheel is too soft its rapid wear makes it difficult to secure a sharp edge and maintain desired angles and dimensions. The work is usually ground dry. Wheels from grain 46 to 60 are best adapted for both high-speed and carbon steels. Finer wheels have a tendency to burn the work. The wheels most commonly furnished for plain milling cutters are of aluminous abrasives Grades J and K, although Grade I, vitrified and silicate, gives satisfaction, especially in saucer shapes such as Brown & Sharpe No. 60. Formed cutters are commonly sharpened with a saucer or dish wheel, generally Grade J or K vitrified aluminous abrasive.

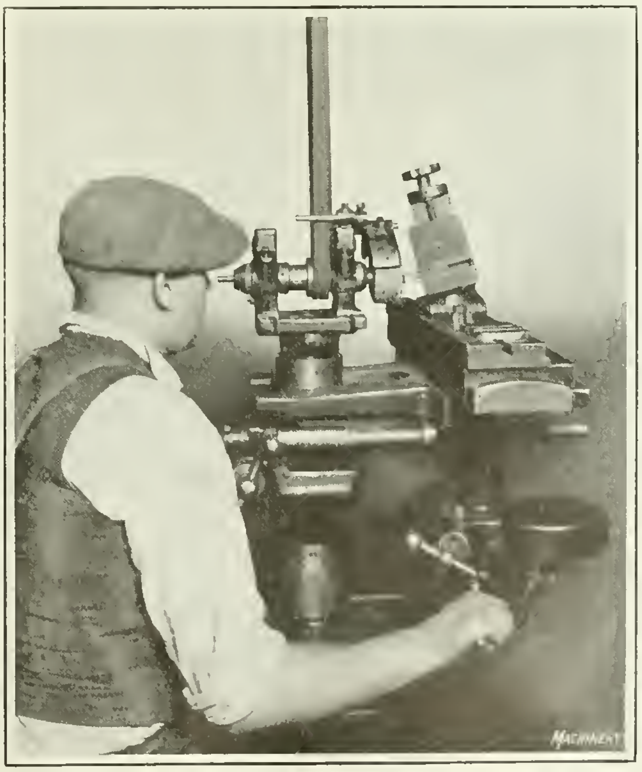


Fig. 8. Grinding Angular Faces of Stellite Cutter Blade

Use of Disk and Cup Wheels for Grinding Milling Cutters

Considerable discussion and investigation has been given to the question as to whether the reliefs on the lands of milling cutters should be ground by disk or cup wheels. The small lines or grooves left on the lands of the cutter by a disk wheel are perpendicular to the cutting edge, while those left by a cup wheel are inclined at an angle with the cutting edge. A relief ground by a disk wheel is slightly concave, which is not true of the relief ground by a cup wheel. To avoid an excessive amount of concavity on the lands of the teeth, a disk wheel (if used) should be as large as it can be without striking the cutting edge of the following tooth and still produce the desired clearance angle; this strengthens the cutting edges.

Careful tests made of the cutting efficiency of cutters

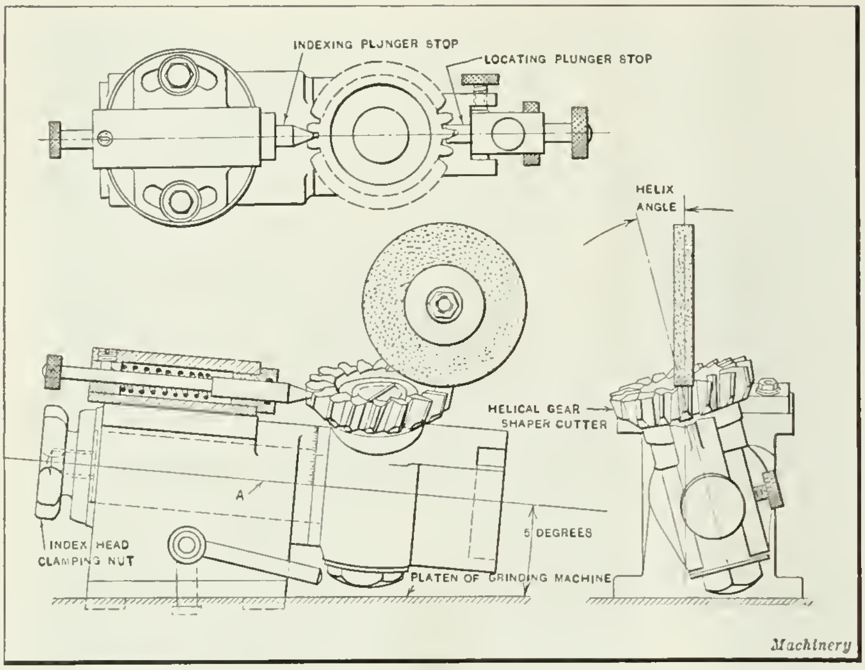


Fig. 9. Fixture for Use when sharpening a Helical Gear Shaper Cutter

of the same material and hardness ground under similar conditions by disk and cup wheels, have shown that the advantage of one type of wheel over the other is slight. In some tests, the cutter ground by a cup wheel proved to be somewhat more efficient. This, however, might be due to the particular material which was being machined, or to the fact that the cutting edge ground by the cup wheel is supported slightly better than that ground by the disk wheel, owing to the concavity left by the latter.

Grinding Stellite Cutter Blades

Cutting tools made of the non-ferrous alloy "stellite" are finding increased application in the machine tool industry. Owing to its properties, the most economical method of machining stellite is by grinding. Stellite is used extensively in cutter blades for milling. In one factory where considerable stellite is used for this purpose, the material is received in the form of bars having the dimensions 11 inches by ¾ inch by ½ inch. These bars are each cut into three pieces 3½ inches long, on a cutting-off grinding machine mounting an alundum rubber bonded wheel. The production of this machine is about 64 pieces per hour, and each wheel averages about 54 cuts before wearing out (Fig. 6).

The small pieces of stellite are then surface-ground on a vertical-spindle surface grinding machine (Fig. 7). About 25 pieces are ground on four of the six sides in one hour, the stock removed from each side being from 0.010 to 0.030 inch in depth, with a limit of accuracy of 0.001 inch. A wheel lasts about four days when grinding this material at the rate given. The three angular faces of the pieces are ground on a tool and cutter grinding machine (Fig. 8). The production averages about 42 pieces per hour for each of the three cuts. The cup wheel used has a life of about 1½ hours on this work.

Grinding Cutters for Spur-gear Shapers

The grinding of a spur-gear shaper cutter is usually done by one of two methods. One method involves the use of a universal grinding machine. The work is held by means of an expansion chuck, and is centered so that it runs true. The head of the machine is set at an angle at 85 degrees, in order to give 5 degrees of "top rake." The sharpening is accomplished by traversing the cutter past the face of the grinding wheel.

Whenever a rotary type surface grinding machine is available, it provides a better method of grinding spur-gear cutters. The cutter is centered by means of a close fitting brass plug, so that it runs true on the magnetic chuck. The work table is tilted at an angle of 5 degrees with its horizontal position, and the cutter sharpened by traversing the grinding wheel back and forth across the face of the cutter.

The diagram (Fig. 9) shows a method of sharpening a helical gear shaper cutter. There are two angular settings necessary. One angular position is the same as the helix angle of the cutter tooth, and the work-holding part of the fixture is adjusted about axis *A* to suit this angle. The other angle is according to the "top rake" required, the rake angle being obtained by setting the fixture at an angle of 5 degrees with the horizontal platen of the grinding machine.

Grinding Blades for Reamers and Inserted-tooth Milling Cutters

When grinding thin high-speed steel reamer blades, the principal problem is to keep the blades straight and cool during the grinding. Fig. 10 shows fixtures used for this purpose. The larger of the two fixtures was designed for use in grinding the surfaces of the blade; and the smaller, in grinding one of the edges of the blade, which is 0.031 inch lower than the other edge. Fig. 11 shows the larger fixture mounted upon the magnetic chuck of a surface grinder.

A method of grinding the hardened steel cutters for inserted-tooth milling cutters is shown in Fig. 12. Twenty-four of the cutters were placed on the magnetic chuck of a small surface grinding machine. From 0.012 to 0.015 inch of stock was removed from each side, the depth of cut being 0.003 inch. Both sides of the cutters were ground, so that a total of 0.030 inch of stock was removed from the thickness.

Grinding Plug Gages

From the manufacturing standpoint, the grinding operations on tolerance plug gages of high accuracy are second in importance only to the final lapping operation on the gaging ends. It is most essential that, in reducing the diameters to the desired oversize for lapping, the grinding be dependably uniform at all times. When the most efficient grade and grain of wheel for each operation is decided upon, the operator should be certain that the cutting action of wheels

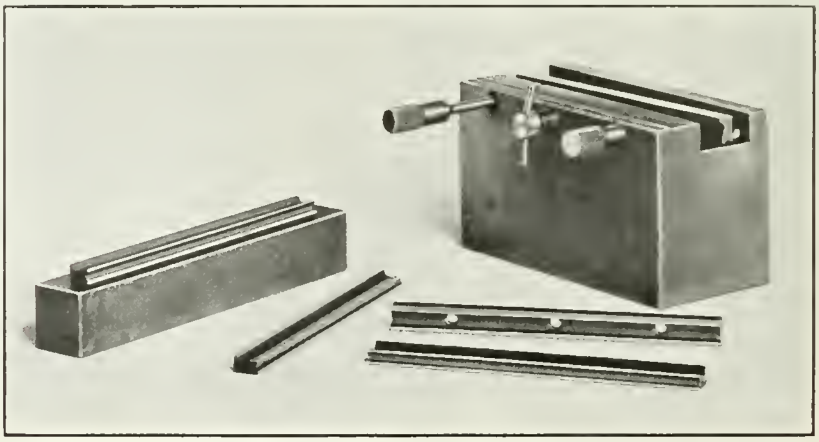


Fig. 10. Grinding Fixtures for Thin Reamer Blades

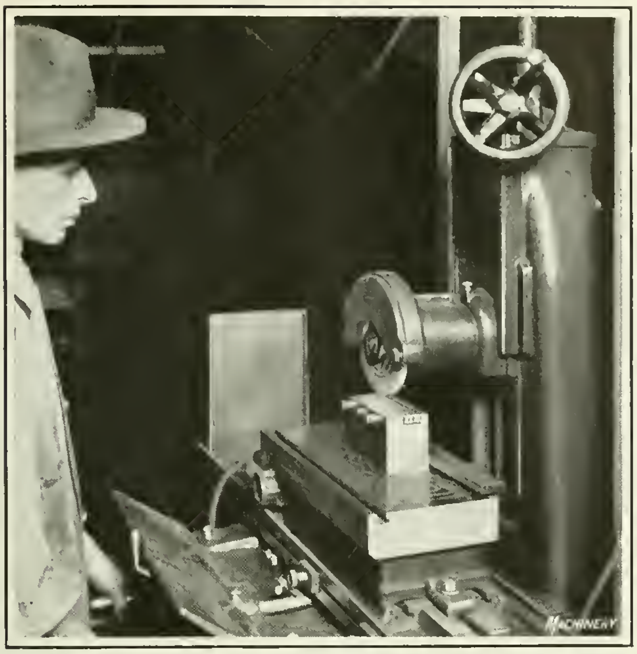


Fig. 11. Reamer Blade Fixture mounted on the Magnetic Chuck of a Surface Grinder

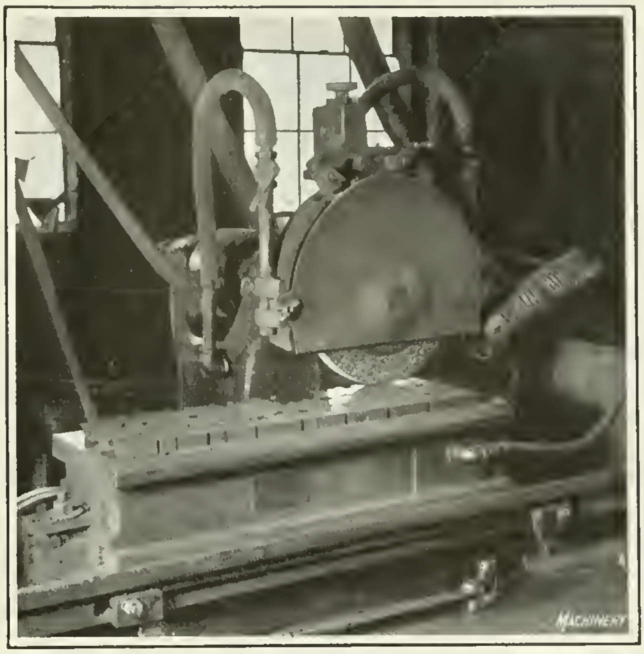


Fig. 12. Method of Grinding Hardened Steel Blades for Inserted-tooth Milling Cutters

received in successive lots, which are marked with the same grade and grain as the original wheel, will be, as far as possible, identically the same on all plugs he is to grind. If this can be depended upon, a great saving of time will result. The rough-grinding operation on two "Not Go" ends of a well-known type of plug gage is shown in Fig. 13, the two gaging ends being ground at the same time. On account of the great accuracy required, quantity production is not so important a factor as are uniform results and finish; consequently the time required to grind the plugs varies greatly, so that any production records on this class of work have little significance. The "Go" end of each plug is ground singly. After the gaging ends have been treated and seasoned, and before they are sent to the lapping department, they are finish-ground to various over sizes, depending upon the type and diameter of the gage. The finish size is as near to the final desired size as it is practical to go. This finish-grinding operation is of great importance. Not only should the amount of stock removed during each cut be absolutely under control, but great care should be observed in the grinding, as the progress made in the lapping operations depends to a considerable degree upon the finish left by grinding.

Grinding as Applied to Micrometer Manufacture

Some of the important grinding methods employed in the production of micrometers in one large plant manufacturing this class of tools, are illustrated in Figs. 14, 15, 16, and 17. The following list of operations shows to what extent grinding and lapping enters into the making of micrometer spindles: Grinding the neck of the screw; rough-grinding the spindle; grinding the outside diameter of the thread; finish-grinding the spindle; lapping the spindle; grinding and lapping the end of the spindle.

The micrometer spindles are ground in a small cylindrical grinding machine. The part ground on one type of spindle (Fig. 14) is 1½ inches long, the finish diameter is 0.235 inch, and the limit of accuracy is 0.0001 inch. Three hundred of these pieces are finish-ground in a nine-hour day. The ends of forty spindles are ground simultaneously in a

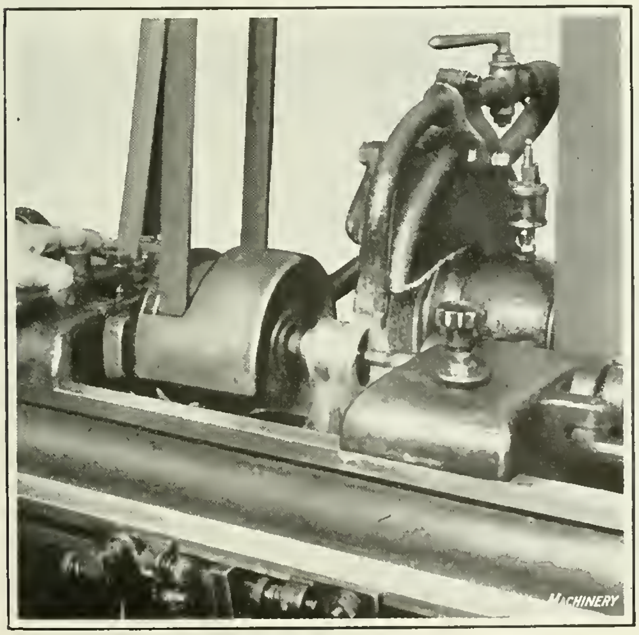


Fig. 13. Illustrating the Rough-grinding Operation on Two "Not Go" Ends for Plug Gages

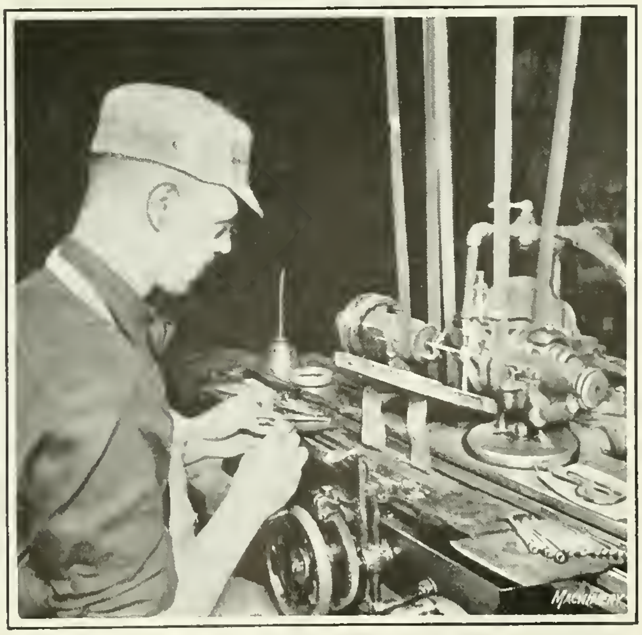


Fig. 14. Grinding Micrometer Spindles with Small Cylindrical Grinding Machine

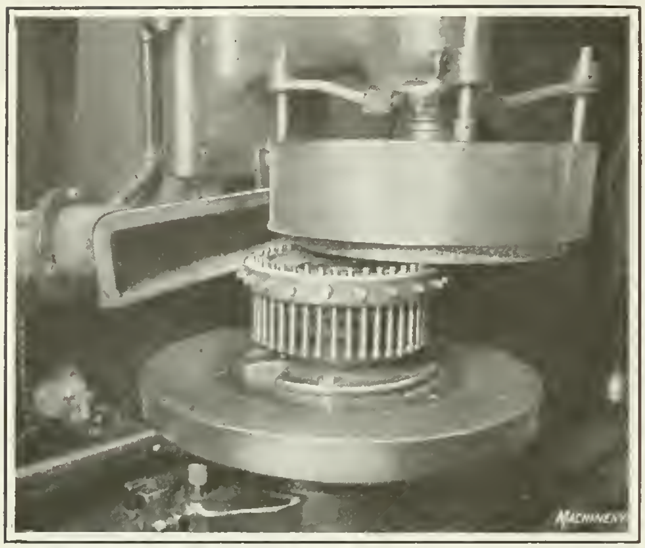


Fig. 15. Grinding Ends of Forty Micrometer Spindles simultaneously

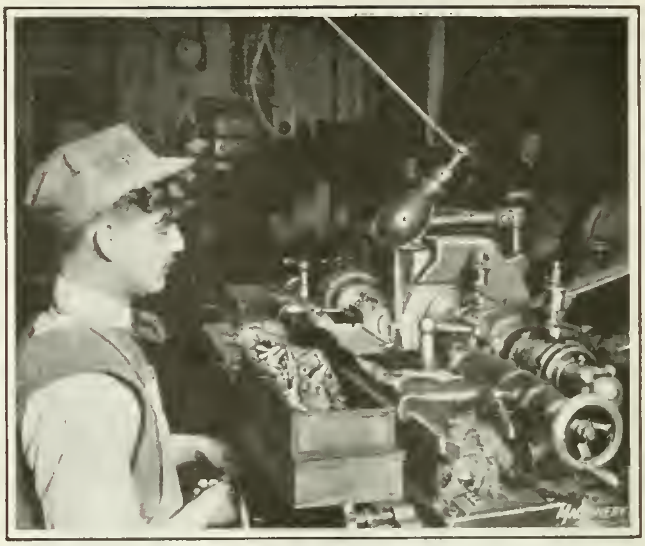


Fig. 16. Cylindrical Grinding Operation on Micrometer Barrel

vertical-spindle surface grinding machine (Fig. 15). The spindles are hard and the ends are rough. The rough-lapping operation on the ends is performed in the same rotary fixture shown.

Fig. 16 illustrates the cylindrical grinding of a micrometer barrel. From 0.012 to 0.015 inch of stock is removed in the grinding. A high degree of accuracy is required in this operation, in order that the graduations and figures which are placed on the sleeve later shall be uniform. The sides of micrometer frames are finish-ground on surface grinding machines, as shown in Fig. 17.

Twist Drill Grinding

Drills larger than 3/8 inch in diameter are ground most economically by special drill grinding machines, while those smaller than 3/8 inch in diameter are sometimes hand-ground. Fig. 18 shows a method of grinding a twist drill in a machine manufactured by the Washburn Shops of the Worcester Polytechnic Institute. The essential points in connection with drill grinding are:

1. The two cutting lips should be kept of equal length.
2. The cutting edges should be kept as straight as possible.
3. The cutting lips should form equal angles with the axis of the drill. The angle commonly used is 59 degrees.
4. There should be only just enough lip clearance back of the cutting edges.

The web of a twist drill is made thicker at the shank than at the point. The thicker it is the more thrust is required to feed the drill into the metal. This excessive thrust may cause a deflection in the drill press resulting in inaccuracy of work and loss of power in the transmission. Many experiments have been made with drills before and after the point has been thinned. In one such test, where a 2 13/16-inch drill with a web 11/32 inch thick was being used, it required two and one-half times more pressure to feed the drill before than after the web had been correctly thinned.

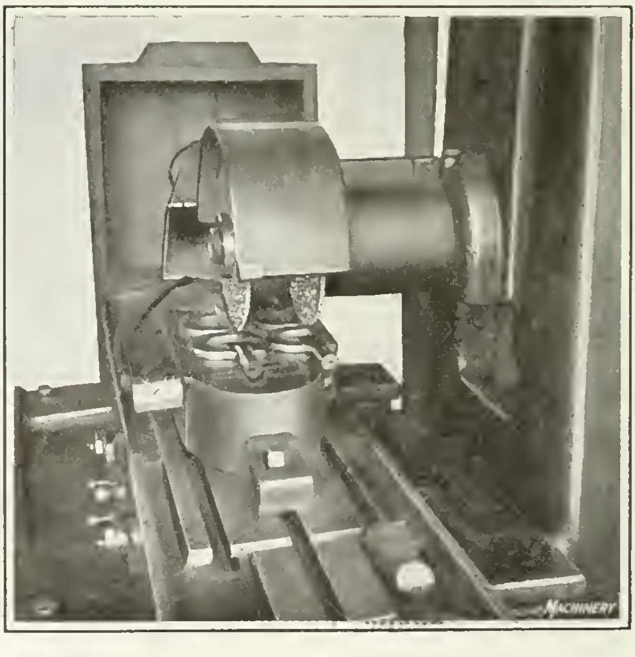


Fig. 17. Finish-grinding the Sides of Micrometer Frames

When thinning the point of a drill, it is essential to preserve the true center of the drill, and regardless of whether the web of the drill is exactly central or not, the distance from the outer end of each cutting edge to the termination near the center should be precisely the same. Sometimes, in the case of cheaper makes, a drill is not perfect when new, hence the importance of grinding the cutting edges the same length.

Care should be taken not to weaken the web by extending the ground portion too far up the flutes. The cutting edges should not be hollowed out by the point thinning. No attempt should be made to give "rake" to the cutting edges near the center, for this part of the drill revolves at such a slow cutting speed that the rake is not important. Point thinning must be done with a round-face wheel, to which the drill should be presented so that the grinding begins on the curved portion of the flute. It may then be rotated by hand until the proper point is obtained. The "point thinning" of small drills is a delicate and difficult operation, and is not advisable on drills below about 3/4 inch in diameter.

Wheels for Drill Grinding

Wheels for drill grinding should be fairly soft and open so that they will not clog, or burn the work. To avoid burning when grinding dry, the work should bear very lightly against the wheel. The surface being ground should be carefully watched in order to detect any drawing of the temper. Wheels furnished for various twist drill grinding machines are all of aluminous abrasive and include silicate 46-M; elastic 36-4; vitrified, 46-K, L and M.

Grinding of Taps

Needless waste can be avoided by regrinding dull taps. The methods employed may be listed as follows: (1) Squaring the end of the tap on the face of an ordinary tool grinding wheel; (2) Grinding the relief or chamfer, giving radial clearance or relief; (3) Grinding the flutes.

As a general rule, taps should be resharpened after having tapped 500 holes. The length of time that taps may be used before becoming dull, however, may vary widely, as it depends upon the kind of work on which the tap is used and also upon the quality of the tap.

The relief of the tap becomes dull first, and usually the only sharpening necessary is that of the relief. The tap is held lightly against the face of the grinding wheel, which should turn toward the cutting edge of the tool as shown in Fig. 19. The radial relief is obtained by turning the tool slightly in the hand, so that a little more will be ground off the back of the teeth than off the cutting edge. The chamfer is usually ground four or five teeth back. If the cutting edges of the teeth become dull, nicked or burred, it is necessary to grind in the flutes with a properly formed wheel.

The various makes of tool and cutter-grinding machines provide means for holding taps for flute grinding. As the cutting edge is very thin, extreme caution must be exercised not to change the temper of the steel. This danger of ruining the tap is practically eliminated by very light pressure and the use of a cool cutting wheel. A broken tooth does not render a tap useless; if all pieces of the tooth are carefully ground out, leaving no jagged edges to tear the thread, the efficiency of the tap as a threading tool is reduced but slightly.

Grinding Blanking and Forming Dies

The various classes of die grinding may be grouped under the following heads: Cylindrical, internal, surface, groove or form, and miscellaneous.

Cylindrical grinding is confined almost entirely to the grinding of punches, both straight and tapered. A universal or small cylindrical grinding machine is generally used and the grinding may be done wet or dry. Internal grinding is done on blanking and forming dies where an accurate internal surface is desired. The object of this form of internal grinding is to produce a clearance or to remove any irregularities caused by the shrinkage of dies after hardening.

Surface grinding of dies may be done either on horizontal- or vertical-spindle surface grinding machines. Much of the heavier surface work is done by means of flexible shaft machines or floor and bench stands equipped with surface grinding attachments. Grooving and form grinding of dies are special operations applicable to particular jobs.

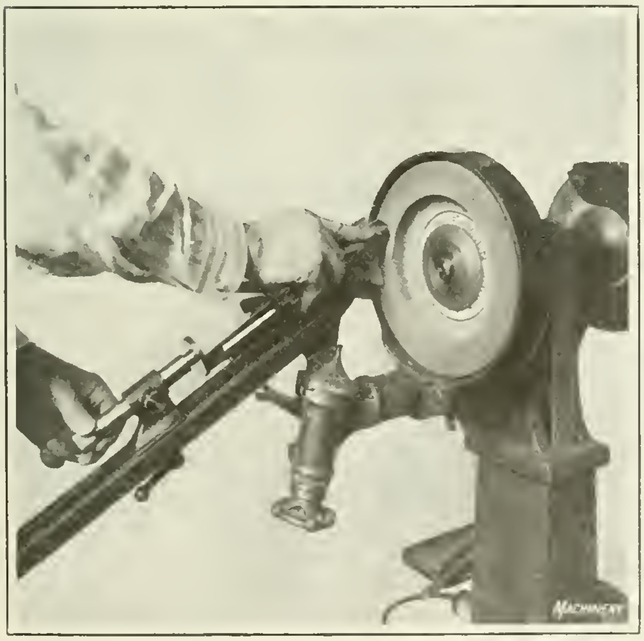


Fig. 18. Typical Example of Twist Drill Grinding

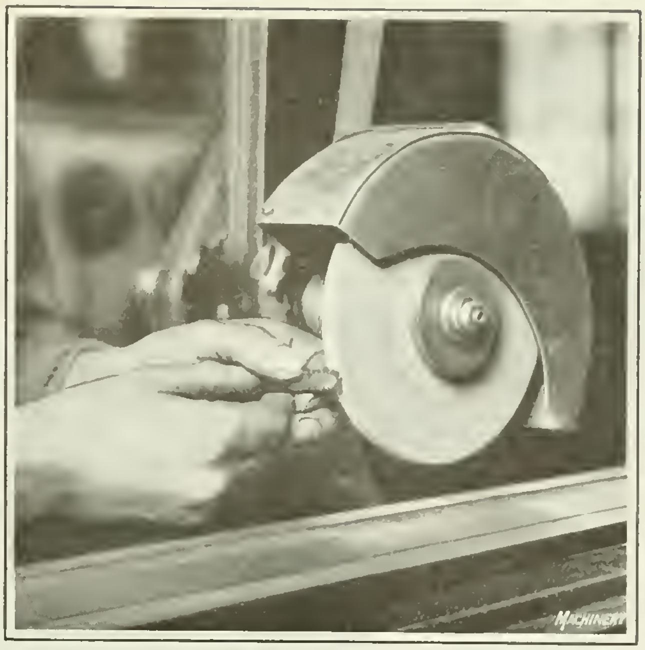


Fig. 19. Grinding the Relief of a Tap by Hand

The field of the small flexible shaft machine and the portable electric grinding machine in die grinding is almost unlimited. Small specially shaped wheels are used for all classes of irregular stamping, blanking or drop-forging patterns, and also on threading dies. Small portable machines are used for some of this work, but the flexible type is more adaptable to the varying kinds of work.

The spring die chaser or thread chaser has all of the elements of a tap turned inside out. The throat or chamfer of the die is ground by the use of a small cone-shaped wheel. The cutting edges or faces of the spring die are ground by dish wheels.

Grinding Lathe and Planer Tools

Lathe and planer tools are ground both by the freehand method and by automatic tool grinding machines. The machine method is safer and more satisfactory, unless the operator has exceptional skill. It has been found that machine grinding saves the workman's time, reduces the time lathes and planers stand idle while tools are being ground, gives the correct grinding angles, increases the life of the tool, increases production, raises the quality of the work, and permits a smaller investment in high-speed steels. Although the question is still open to considerable debate, most authorities favor wet grinding of lathe and planer tools. When grinding wet, a stream of water sufficient to take up the heat as fast as it is generated must flow at low velocity directly upon the nose of the tool. Five gallons a minute is good practice. A little water is worse than no water at all, as it is often the direct cause of surface cracks. Grinding should not be done too forcibly, as the water is thus kept away temporarily from the work surface so that when the tool is released the cool water strikes the hot metal causing it to surface-crack.

Arbor Grinding

The general practice among manufacturers is to harden arbors all over. For very accurate work, however, an arbor having hardened ends and a soft body is considered preferable, because there is less tendency toward distortion as a result of internal stresses. The cylindrical parts of arbors are rough-ground, and the arbors should be allowed to "season" before the finish-grinding operation. The "seasoning" is necessary on account of the stresses which are caused by the hardening operation.

LINE-REAMING

By CASPER J. DORER, Chief Tool Designer, White Sewing Machine Co., Cleveland, Ohio

Line-reaming to obtain accurate alignment of bearings is a subject of frequent discussion. Many tool designers believe that the part to be line-reamed should be held or clamped rigidly in place while the reamer is passed through the holes. Others contend that it is better to allow either the work or the tool to float, or to allow both the work and the tool to float. Each of these methods doubtless has its respective merits which particularly recommend it for use under certain conditions that should always be considered.

The fixture shown in the accompanying illustrations is of the type that allows both the work and the reamer to float. This fixture has been the means of eliminating much of the trouble previously experienced in reaming the holes in the part shown at *A*, Fig. 1. It represents a complete departure in design from that previously employed. Production has been greatly increased by its use, and no difficulty is experienced in holding the work within the required limits of accuracy.

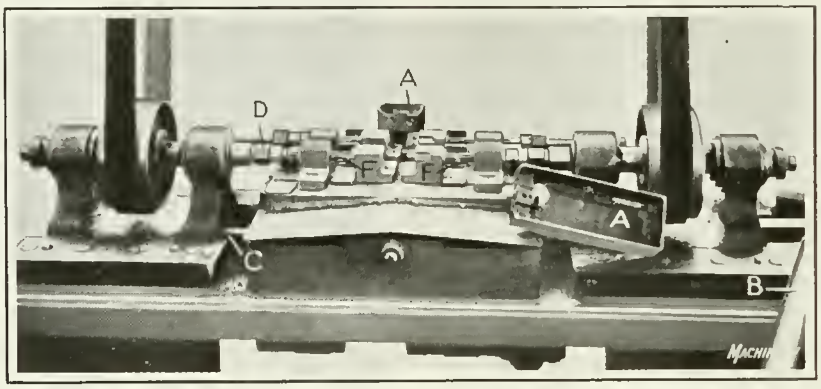


Fig. 1. Line-reaming Fixture employed on Two-spindle Machine

The work consists of reaming two holes in each end of the box-shaped casting *A*. The opposite holes in this casting are required to be in alignment within limits of plus or minus 0.001 inch. The machine on which the fixture is mounted has two opposed spindles which are fed inward by means of a hand-lever *B* and rack *C*. The reamers are held in chucks *D* by pins which pass through the chuck and reamer shank at right angles to the axis of the spindle. The driving pin in one of these chucks is shown at *E*, Fig. 2. A clearance of 1/64 inch is allowed between the shank of the reamer and the hole in the chuck, to permit the reamer to float freely.

The reamers *F* are constructed with pilots or bearing surfaces at each side of the cutting portion. These pilots are fluted to provide clearance for chips and are made a running fit in bushings *G* and *H*. The teeth are end-cutting, being taper ground for about 1/4 inch. The forward pilot of each reamer is about 0.003 inch smaller than the size of the drilled hole in the work. The pilot or shank at the rear of the cutting teeth is about 0.002 inch larger than the teeth of the reamer. Both pilots of each reamer are supported in their respective bushings before the teeth begin to cut.

The casting, which is represented by the dot-and-dash lines at *P*, Fig. 2, is drilled from 0.010 to 0.012 inch under size to allow for finish reaming. The work is laid on the fixture and is loosely located by means of the L-shaped blocks *K* and the heads of bushings *H*. When the reamers pass through the holes the work is lifted slightly from its position on the L-shaped blocks and drawn away from the vertical sides of these blocks, thus causing the piece to float completely while the hole is being reamed. As a result of this floating action, no strains are developed in the casting during the reaming operation. The four bushings that support the two reamers are, of course, in accurate alignment.

After line-reaming one set of holes, the second set, which is of smaller diameter, is reamed in the same manner by inserting smaller reamers in the spindles and moving the fixture forward so that bushings *J* come into alignment with the spindles of the machine. Set-screws *L* serve as stops for aligning the fixture with the spindles. These adjusting screws are locked in place by lock-nuts *M*. The fixture is slotted to receive the locking nuts or studs *N*, which clamp the fixture in place after it has been adjusted for reaming either the large or small holes. The sheet-iron aprons *R* keep the chips and dust from falling on the bearing surfaces of the fixture. With this fixture one operator can ream 350 pairs of holes per hour.

* * *

PRODUCTIVE AND NON-PRODUCTIVE LABOR

Every man and woman necessary to the conduct of a business, whether carried on the office or shop payrolls, is productive so far as results are concerned. In the past it has been the custom to divide labor into productive and non-productive classes, but this classification seems to be entirely erroneous. The so-called "non-productive" man is just as essential to the success of the enterprise and to the manufacture of the product as the productive man. If he is not, his services should be dispensed with. A better classification that has been proposed by a man prominent in the industry, is "direct" and "indirect" labor, the direct labor being engaged in specific operations on the product, while indirect labor is that which cannot be so classified. By so dividing labor costs, it is possible to charge overhead in the proper proportion.

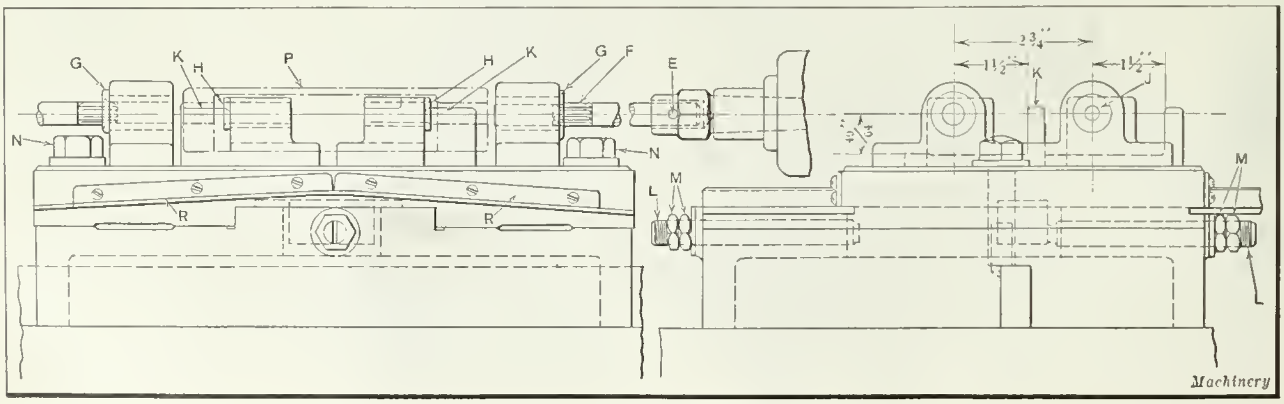
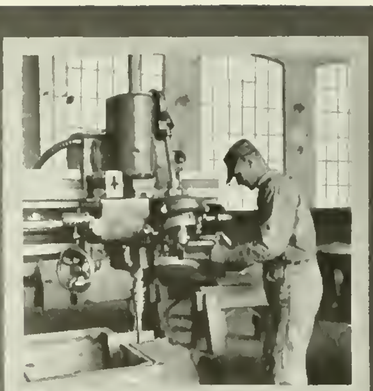


Fig. 2. Front and End Views of Line-reaming Fixture shown in Fig. 1

Letters on Practical Subjects



AIR CHUCK FOR IRREGULAR CASTING

The special chuck developed in the plant of the Delco Light Co., Dayton, Ohio, for holding an irregular shaped casting is shown in the illustration. The irregular shape of the part is shown by the four views in the upper left hand corner. It would be difficult to hold this work in a plain chuck without crushing the walls or distorting the part. The special chuck overcomes these difficulties satisfactorily, and has been in use for some time on a 1½-inch Acme hand screw machine.

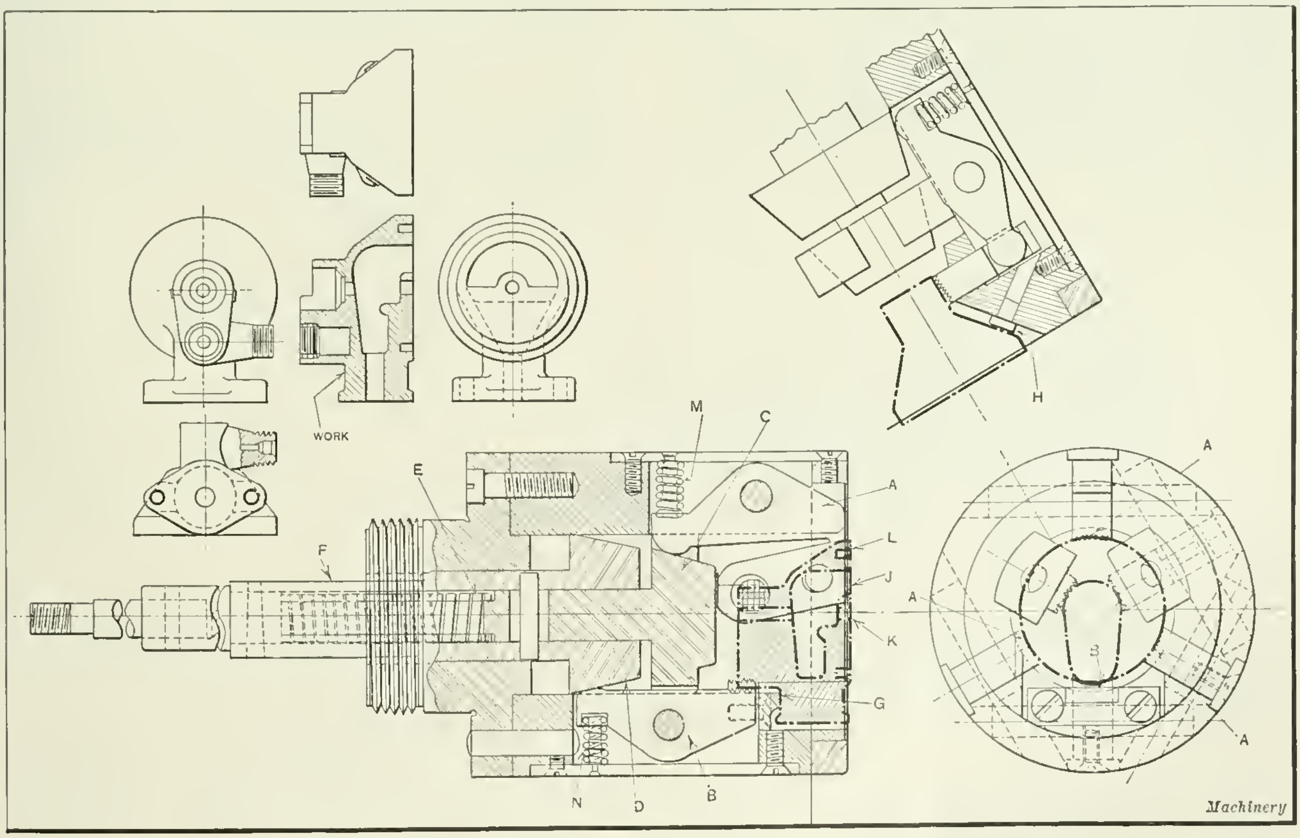
One set of three jaws *A* holds the casting by the outer rim, and another set of jaws *B* holds the elliptical shaped part. The two upper jaws of the latter set are fixed, and the lower one acts as a clamp. These clamping jaws are moved in toward the center by means of lever arms which are actuated by two cones *C* and *D*. The shaft of the rear cone *D* is bored out to form a recess in which is placed a spring *E* that fits over the plunger of the forward cone *C*. When the air pressure is turned on, the rear cone and its shaft move forward, causing clamping jaw *B* to grip the casting against the upper jaws. At the same time the front cone moves forward causing clamps *A* around the outer edge of the casting to close in.

As this takes place the spring *E* is compressed. The spring is designed to exert about half the pressure exerted by the air on the end of the rear cone shaft *F*. This equalizes the pressure on the jaws so that the casting is held firmly in place. Springs *M* and *N* are used to force the jaws outward when the air is released. When the casting is placed in the chuck by the operator, it is pushed back against stops *G* and *H*. The operations performed on the work when it is held in the chuck in the position indicated by the heavy dot-and-dash lines are facing surface *J*, drilling and reaming hole *K*, and counterboring recess *L*.

Dayton, Ohio. **Edward H. Tingley**

DRILL FOR WOODEN BLOCKS

In the plant of a specialty manufacturer, large quantities of small wooden blocks were being drilled in an automatic machine at the rate of seventy-five per minute. The blocks were of very dry beech wood. The dryness of the wood and the fact that the hole was required to be quite near the end of the piece made it difficult to prevent many of the pieces from splitting during the drilling operation. While an ordinary lip bit such as carpenters use would do the work without excessive splitting, it would not finish the bottom of the hole to the desired shape. The hole was cut half way



Air-operated Chuck with Two Sets of Jaws for holding an Irregular-shaped Casting through at the sides and the countersunk shape at the bottom was required to be clean cut with no wood splitting.

After trying all the specially designed bits and drills obtainable, the manufacturer decided that an ordinary twist drill gave the best average service, although his rejections of split blocks was still considerable. Quite by accident he noticed an illustration of a drill designed to cut marble, which is described and illustrated on page 1116 of MACHINERY'S HANDBOOK. Experiments with a drill of this type proved very successful. At a speed of 3200 revolutions per minute this drill is now producing the holes in the wooden blocks with a maximum rejection of only 1 per cent.

Middletown, N. Y. DONALD A. HAMPSON

CALCULATING DIAMETER AT INTERSECTION OF TWO TAPERS

When two tapers are formed on a piece of work as shown in Fig. 1 or Fig. 2, it is sometimes necessary to determine the length of each taper and the diameter at the point where the two tapers join. This problem may involve the conditions shown in Fig. 1 or those shown in Fig. 2. Referring to Fig. 1, it will be noticed that the section having the larger taper is at the top, while in Fig. 2 the section having the larger taper is at the bottom. Considering the problem as presented in Fig. 1, let

R = radius at large end of piece;
r = radius at small end of piece;
a = angle of taper at large end;
b = angle of taper at small end; and
H = height of piece.

The problem is to find the length J of the tapered section at the large end, and the radius x at the intersection of the two tapers. From Fig. 1 we see that

$$D = H \tan b \text{ and } F = D + r - R$$

$$f = 90 \text{ degrees} - b \text{ and } g = 90 \text{ degrees} - a$$

In the small diagram in the upper right-hand corner, km = 1 inch. Now as angle lkm = angle b as shown in the large diagram, and angle nkm = angle a; it follows that the geometrical figure $LKMN$ is similar to the small geometrical figure $lkmn$. Therefore, according to trigonometry, we have

$$T = \cot f \text{ and } S = \cot g$$

Therefore,

$$P = \cot f - \cot g$$

Now in the two similar geometrical figures we have

$$F:J::P:1$$

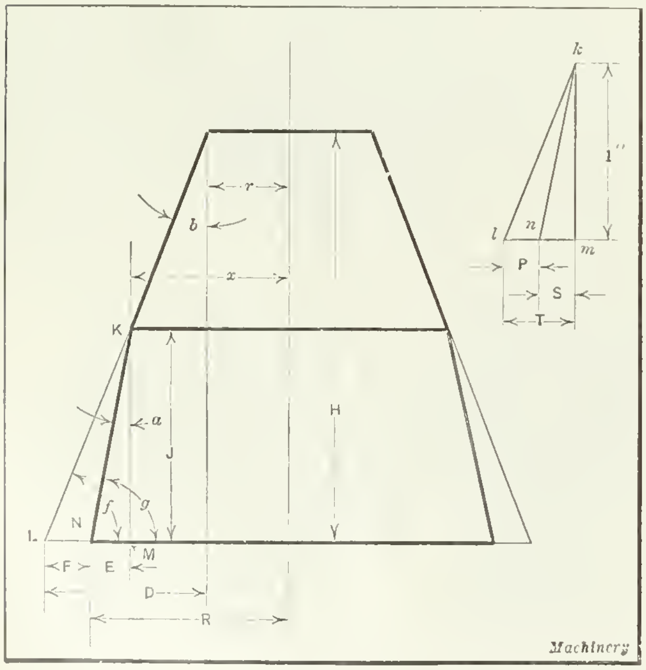


Fig. 1. Diagram used in calculating Diameter at Intersection of Two Tapers

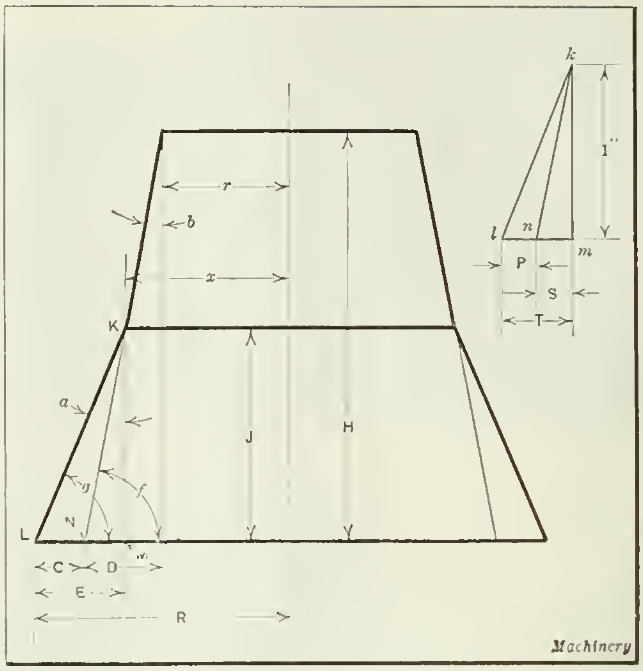


Fig. 2. Diagram showing Problem Similar to that presented in Fig. 1

Thus,

$$PJ = F \text{ and } J = \frac{F}{P} = \frac{D + r - R}{\cot f - \cot g}$$

By trigonometry $E = J \tan a$, and by subtraction $x = R - E$ and $2x$ = diameter at the intersection of the two tapers.

Referring to Fig. 2 illustrating the case in which the large taper is at the bottom end of the piece, let

R = radius at large end of piece;
r = radius at small end of piece;
a = angle of large taper;
b = angle of small taper; and
H = height of piece.

The problem is to find the height J of the tapered section at the large end, and the radius x at the intersection of the two tapers. In the illustration Fig. 2,

$$D = H \tan b \text{ and } C = R - D - r$$

Also,

$$f = 90 \text{ degrees} - b \quad \text{and} \quad g = 90 \text{ degrees} - a$$

Referring to the small triangle in the upper right-hand corner, angle lkm = angle a in the larger figure, and angle nkm = angle b.

According to trigonometry

$$T = \cot g \text{ and } S = \cot f$$

Therefore,

$$P = \cot g - \cot f$$

Considering the two similar geometrical figures, we have

$$C:J::P:1$$

Thus,

$$PJ = C \text{ and } J = \frac{C}{P} = \frac{R - D - r}{\cot g - \cot f}$$

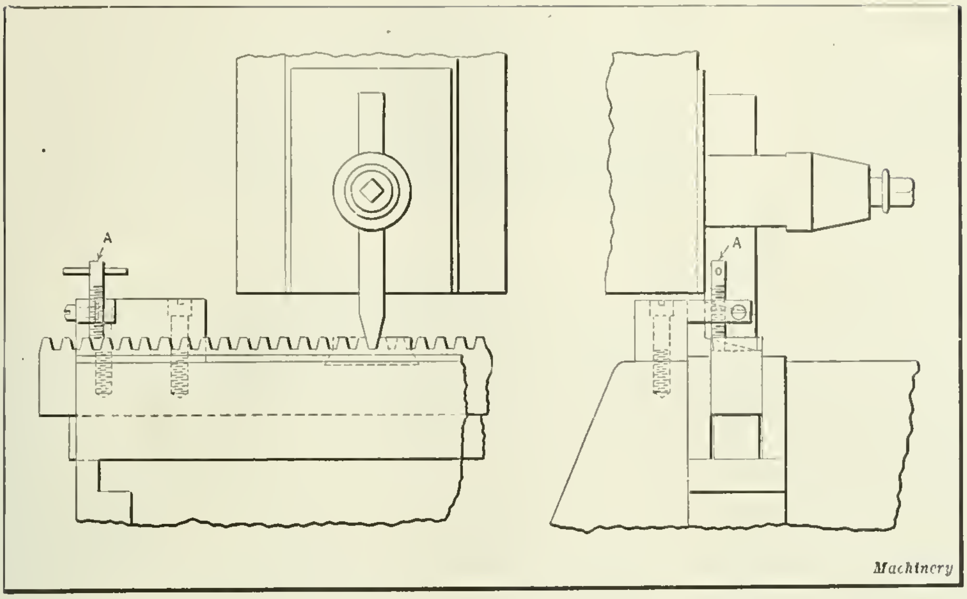
Therefore,

$E = J \tan a$ and $x = R - E$, and $2x$ = the diameter at the intersection of the two tapered sections.

Flint, Mich. W. G. HOLMES

REPLACING BROKEN RACK TEETH

In repairing machine shop equipment, it is often necessary to dovetail a piece into a rack in order to replace broken teeth. The simple fixture shown herewith can be attached to a shaper vise for cutting the teeth in the dovetailed piece. With this device the cutting can be done by an apprentice. In cutting the teeth, a tool is first selected of the proper shape and adjusted to fit the rack tooth space next to the dovetailed piece. The vise jaws are then opened and the



Fixture used in cutting Rack Teeth when replacing a Broken Section

rack moved along one tooth, the point of screw *A* serving as an indexing or spacing pin.

The first tooth space in the inserted piece is then cut to the proper depth as determined when setting the tool in the tooth space next to the patch. This operation is repeated until all the new teeth are cut. A similar method can be used in repairing gears that are too large to be cut in a milling machine, the gears being mounted on a stud attached to the shaper platen. This method will often obviate the necessity of sending a gear outside the plant to be recut or of ordering a new one and thereby forcing a productive machine to remain idle for an indefinite length of time.

Roslindale, Boston, Mass. CHARLES H. JACKSON

MOLD FOR RESERVOIR HAVING A LARGE CORED CHAMBER

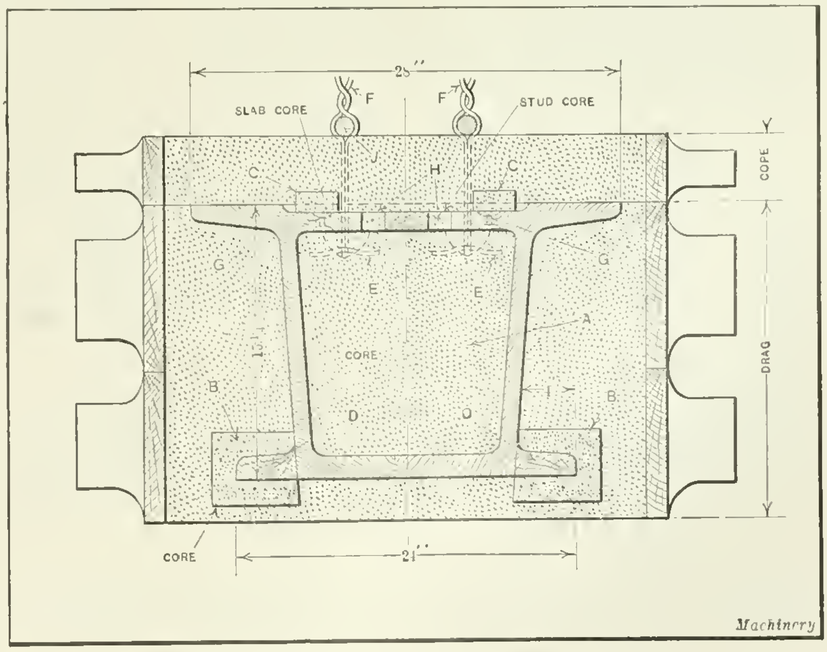
In the accompanying illustration is shown a cross-sectional view of the pattern and mold used in the production of a casting having a large cored chamber which serves as a water reservoir. The body of the reservoir is practically square in section and slightly tapering. The large flanged end of the casting is actually the base, but from the illustration it will be noted that the mold is constructed so that the reservoir is cast in an inverted position. The pieces forming the top flange of the pattern are loosely attached, while the bottom flange is made solid with the body of the pattern. The method of supporting the heavy core *A*, the making of the flange cores *B*, and the provision of proper means of carrying off the gases from the core are points of particular interest.

The pattern was intended to be molded in green sand, using a dry sand core *A* for the chamber. As the top flange was quite wide, dry sand cores *B* were made and placed in the mold as shown. No core-box was made for this purpose, a substitute being formed by placing one of the flanges on an iron core-drying plate with a temporary box built around the flange. The walls of a core of this kind may be made any convenient thickness. In foundry practice, such a core is referred to as a "ram-up-core."

In molding, the pattern was first placed on the bottom board with the large flange in contact with the board. Sand was then shoveled into the flask up to the flange cores *B*. The flanges were then placed in the cores and assembled in their original position on the body pattern, and the filling in of the sand continued up to the top of the drag flask. The drag flask was then turned over and made ready for the cope. Before filling the cope with sand, the dry sand slab cores *C* were placed on the pattern in the position shown. The purpose of these cores will be explained later. After going through the usual process of sand-filling, ramming, venting, gating, etc., the cope flask was lifted and the pattern drawn out, the flanges *D* (one at each side) being drawn in and up through the mold. This leaves cores *B* properly located.

In making the core *A*, four anchor wires *E* were embedded in the core about two inches below the top or cope-face. Sand was dug out above these wires and a pocket formed, as shown by the dotted lines. Wires *F* were fastened to the anchor wires, and core *A* was lowered down into the mold. Chaplets *G* were placed on the top of core *A* as illustrated. To provide means for carrying off the gases, four equally spaced 2-inch stud cores *H* were placed on top of core *A*. In closing the mold, the four wires *F* were passed up through the sand of the cope and the latter member lowered into contact with the drag by means of the protruding ends of the wires *F*. Core *A* was then carefully raised until the chaplets *G* came up against the slab cores *C* in the cope. The end of the wires *F* was next wrapped around and securely fastened to the bars *J*, which were placed across the sides of the flask. The vents for core *A* were then made through the stud cores *H*. It will be evident that the slab cores *C* were rammed up in the cope mold in order to provide a firm backing for the chaplets *G*. If placed in contact with green sand, these chaplets would have been worthless. The sand that formed core *A* was shaken and worked out of the casting through the holes left by studs *G*. When the casting reached the machine shop, the four 2-inch holes were tapped and plugged, thus completing the job.

Kenosha, Wis. M. E. DUGGAN

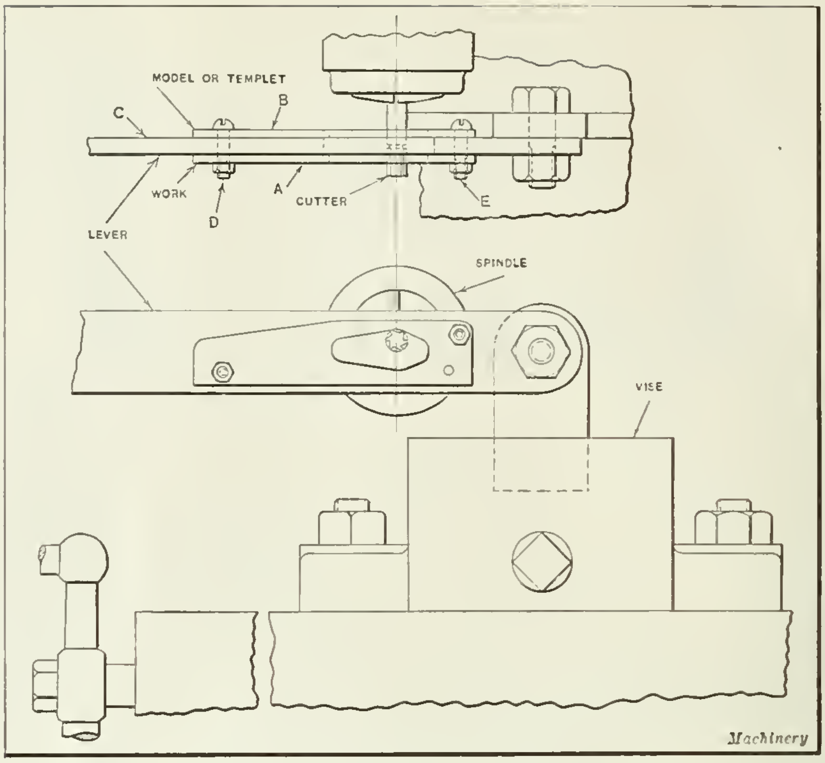


Sectional View of Pattern and Mold for a Large Cored Chamber

MILLING PROFILE OF SMALL INTERNAL CAMS

In model or experimental work on mechanisms such as are employed in typewriters and adding machines it is often necessary to produce say, twenty to sixty pieces, which must be interchangeable. Parts of this kind are frequently designed with small irregular shaped openings which serve as internal cams. The profile of these openings could, of course, be kept uniform by employing accurate dies, but where only a small number of parts is required the making of suitable dies would be too expensive. The following method of finishing cam profiles in duplicate parts is simple and accurate. Various adaptations of the method for milling curved surfaces, irregular slots, etc., may be employed to advantage.

The work shown at *A* in the illustration is made from rolled stock, ⅛ inch thick. Counterbores are first employed in order to remove most of the stock from the slot. The profile is then finished by attaching an accurate casehardened model or templet *B* to the lever *C* by means of screws *D* and *E*. These screws also pass through holes in the work, which is secured to the opposite side of lever *C*. The screws are made a tight fit in the three parts, which they hold together so that the parts are kept in proper alignment.



Milling Machine Set-up for milling Internal Cams

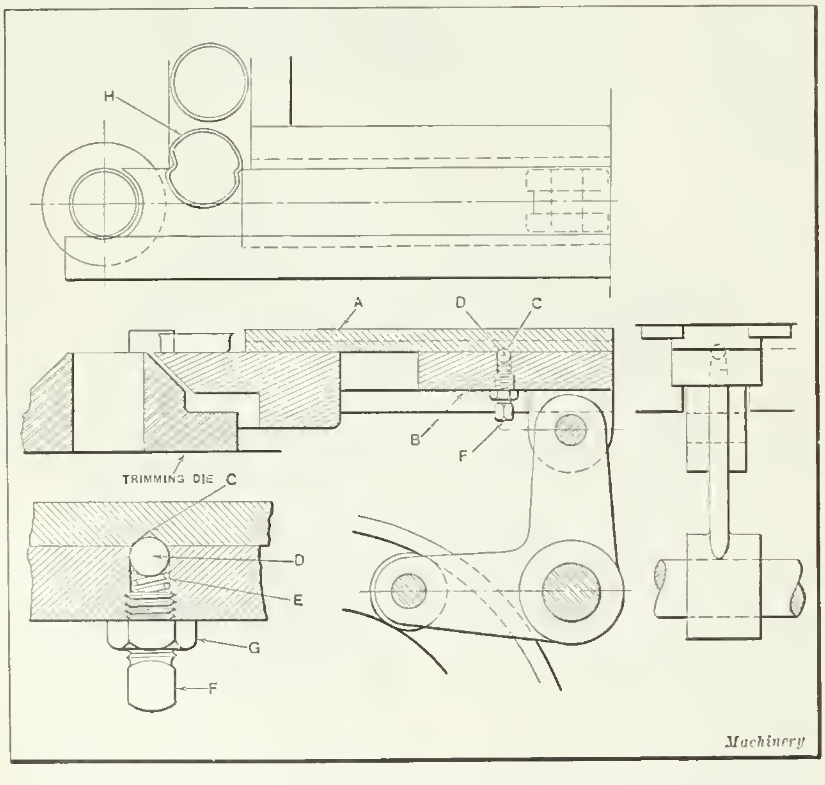
Two end-mills are used for the job, the teeth of one being ground a few thousandths inch smaller than the shank, while the other is ground straight; that is, the shank is ground to exactly the same diameter as the cutting part. The radius of the cutter is, of course, smaller than any radius in the profile of the opening to be machined. The smaller cutter is used to rough out all the pieces. This leaves, say, 0.004 inch at each side of the slot to be removed with the straight or finishing cutter. The templet bears on the shank of the cutters. The milling machine is fed with one hand, while the other hand holds the lever *C* which is raised or lowered so that the cutter will follow the outline of the templet. The profile of the work is thus quickly machined to exactly duplicate that of the templet.

Detroit, Mich. Charles S. Culver

SLIP DRIVE FOR PRESS FEED-SLIDE

The jamming of work in the feed-slide of an automatically fed press delays production and often causes considerable trouble. If the slide is positively driven, some part of the press or feeding mechanism is usually broken. A "slip-driven" slide designed to prevent trouble of this nature is shown in the accompanying illustration. This drive was applied to a trimming press which had been subject to frequent breakage due to the jamming of work in the regular feed-slide. The slip-driven slide effectively eliminated all breakage due to jamming, and the clicking noise made by the device when a piece of work was caught served as a signal to attract the operator's attention.

The feed-slide is made up of two parts, namely, the upper slide *A* and the lower slide *B*. A hole was drilled and tapped in the lower slide, as shown in the enlarged view in the lower left-hand corner of the illustration, and the upper slide was countersunk at *C*, the hole through the lower slide, being used as a means of locating or guiding the countersink. The ball *D* was placed in the hole in the lower slide, and backed up with a compression spring *E* and an adjusting screw *F*. When the required pressure has been exerted on ball *D* by the proper adjustment of screw *F*, lock-nut *G* is tightened, thus securing the adjustment. If the work being fed into the die becomes jammed, as shown at *H*, the upper part *A* of the slide stops, while the lower part *B* continues its forward movement, the ball *D* being depressed. On the return stroke the ball snaps back into the countersunk



Slip Driving Device for Press Feed-slide cavity *C* in the upper slide, and unless the slide is cleared it will snap out again on the forward stroke. This makes the clicking sound that attracts the operator's attention. As the machine on which this device was used operated at a speed of over 100 revolutions per minute, the increase in production and the saving in expense for repairs resulting from the use of the slip drive feature can readily be appreciated.

Brooklyn, N. Y. S. A. McDonald

COPPERING STEEL WIRE PARTS

A certain manufacturer who uses quantities of wire springs has adopted a simple method in connection with copper-plating the wire. The springs are made of steel wire which is not furnished the manufacturer copper-coated, on account of the abrasion that would be caused by the forming machines. After the springs come from the forming machines, they are dumped into a tumbling barrel of the upright type. A quantity of fine, clean, white sand is also put in the barrel, which is revolved for thirty-five minutes. The sand removes all oil from the springs, and prepares a good surface for the copper solution to attack. Following the plating, the springs are put into another barrel where they are cleaned and polished with sawdust. This cleaning and polishing requires but a few minutes. This process gives satisfactory results, and it is simple and inexpensive.

Middletown, N. Y. Donald A. Hampson

DETERMINING THE DIAMETER AT THE END OF A TAPERED ROD

In July Machinery, page 910, there appeared an article entitled "Determining the Diameter at the End of a Tapered Rod." The solution of the problem as contained in that article does not appear to be correct. Apparently it is assumed that *N* (marked *N'* in the accompanying diagram) is the same as the other dimension marked *N* in the diagram previously published. If this assumption is incorrect, then the problem cannot be solved by the method described. The following solution is offered, in connection with which the accompanying exaggerated diagram may be referred to.

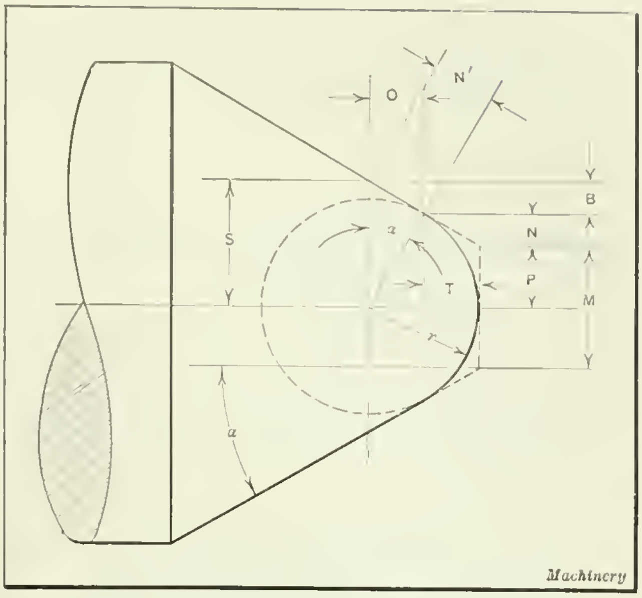


Diagram for finding the Diameter at the Tapered End of a Rod having a Rounded End

The known values are the angle of taper *a* at the end of the rod, and the radius *r* at the rounded end. It is required to find *M*, the original diameter at the end of the piece before rounding the end. By trigonometry,

$$N' = r \tan a; \quad S = \frac{r}{\cos a}$$

$$B = N' \sin a = (r \tan a) \sin a$$

$$O = N' \cos a = (r \tan a) \cos a$$

$$T = r - O = r - (r \tan a) \cos a$$

$$N = T \tan a = r - (r \tan a) \cos a \tan a$$

$$P = S - (B + N)$$

Substituting in the above equation, we have

$$P = \frac{r}{\cos a} - [(r \tan a) \sin a] + [r - (r \tan a) \cos a \tan a]$$

$$= \frac{r}{\cos a} - (r \tan a \sin a) + (r - r \tan a \sin a)$$

$$= \frac{r}{\cos a} - 2 r \tan a \sin a + r$$

$$= r \left(\frac{1}{\cos a} - 2 \tan a \sin a + 1 \right)$$

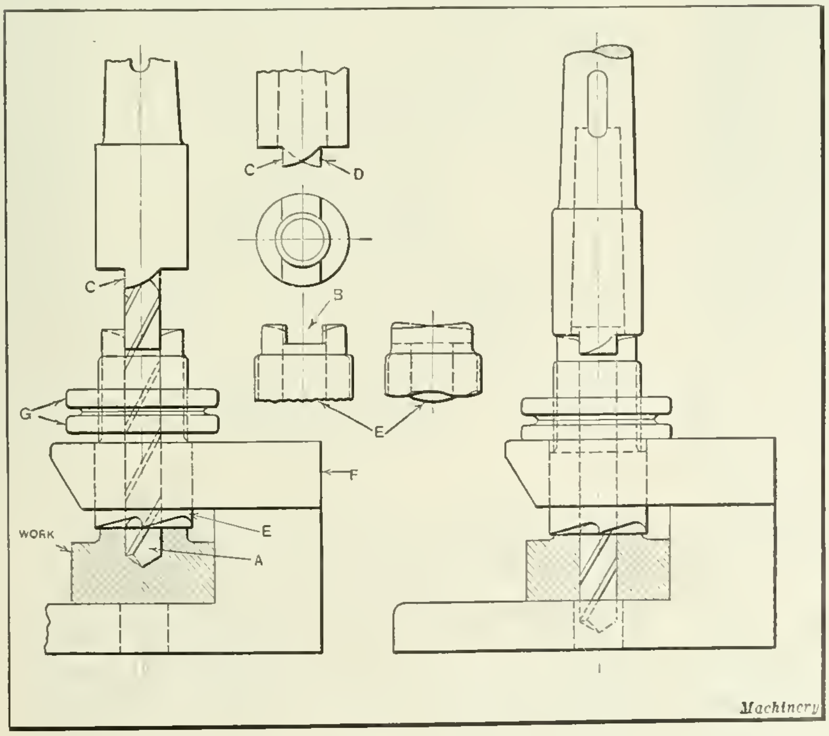
Then,

$$M = 2 r \left(\frac{1}{\cos a} - 2 \tan a \sin a + 1 \right)$$

Brooklyn, N. Y. Charles H. Buethe

COMBINATION SPOT-FACING TOOL AND DRILL BUSHING

A combination spot-facing tool and drill bushing, such as here illustrated, will enable work ordinarily requiring two operations to be done in one operation, in half the time previously taken. The drill *A* passes through the spot-facing tool *E* which thus serves as a bushing. After the drilling operation has been completed, the operator continues the downward feed of the drill spindle, which results in the engagement of the two teeth *C* and *D* of the drill shank in a corresponding slot *B* in the upper end of the spot-facing tool *E*. Tool *E* is thus revolved in the jig plate *F* and further downward movement of the drilling machine spindle results in facing off the

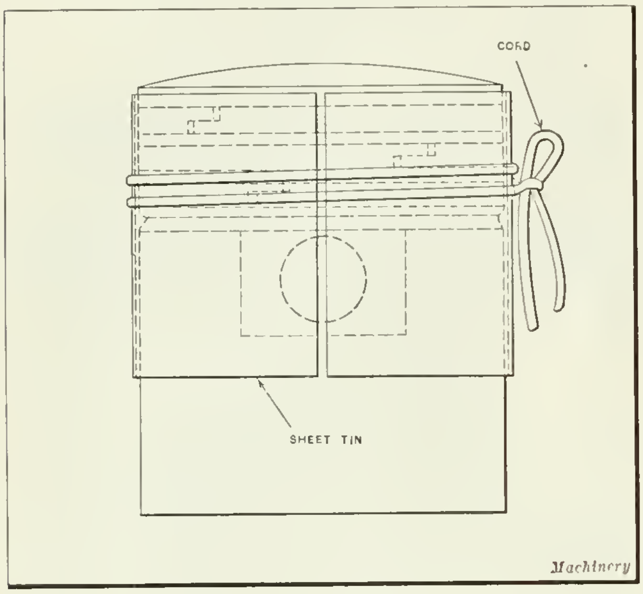


Combination Spot-facing Tool and Drill Bushing for drilling and facing in One Operation work. The adjustable lock-nuts *G* coming in contact with the jig plate *F* serve as a stop. The view at the right of the illustration shows clearly the positions of the drill shank, the drill, and the spot-facing tool at the end of the downward feed.

Detroit, Mich. CHARLES S. CULVER

METHOD OF ASSEMBLING PISTONS IN CYLINDERS

The writer read with interest the description of a device for assembling pistons in cylinders which appeared on page 825 of June MACHINERY. The method described appears to be a very good one, the only criticism being that different sizes of pistons would require separate sleeves. This fact, however, would hardly need to be considered except where a great variety of engines are assembled, as in garages or repair shops handling general repair work.



Piston ready for assembling in Cylinder

A method that the writer has found very satisfactory is as follows: Cut a piece of stiff tin such as used for canned goods to a length that will nearly but not quite encircle the piston. The width of this piece should be about two-thirds the height of the piston. The tin is wrapped carefully around the piston and rings after they have been cleaned and oiled ready to be assembled in the cylinder. A heavy cord is passed around the tin a couple of times and pulled tight in order to compress the rings. The string is tied in place with a single bow-knot as shown in the accompanying illustration.

As the piston is slid into the cylinder, the tin and string slide off at the lower end of the piston and are easily removed from the connecting-rod. This method keeps the piston clean and simplifies the work of assembling. The cost of the device is practically nil, and one piece of tin can be used for several sizes of pistons.

Hoosick, N. Y. WALTER CANTELO

SPREADING TOOL FOR SPLIT COTTER-PINS

Spreading split cotter-pins with a screwdriver is a slow method and one that is often responsible for minor injuries, due to the point of the screwdriver slipping from the work. In one plant the danger of injury from this source was eliminated and production increased by the use of a cotter-pin spreader made from a discarded belt punch. To adapt the belt punch for use as a cotter-pin spreader, the original cutter was removed and a V-shaped spreader inserted in its place. A small groove was also cut in the opposite jaw to prevent the cotter-pin from turning while the ends were being spread or opened.

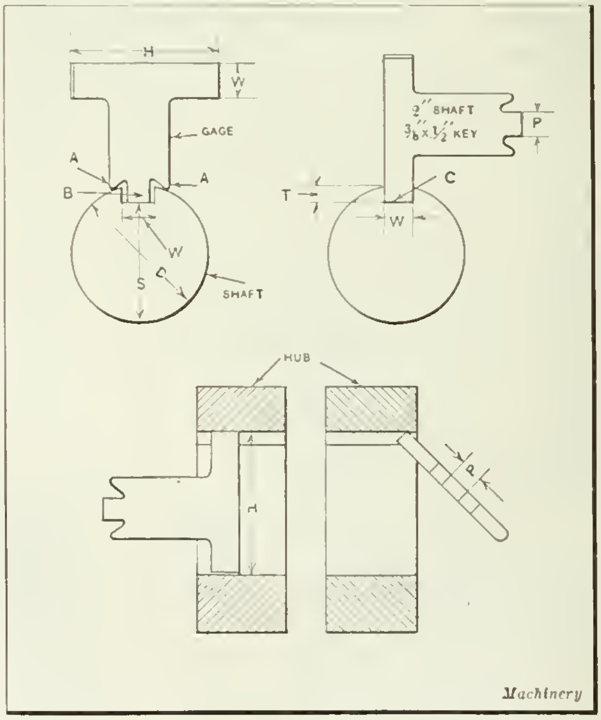
In the shop where the writer saw this cotter-pin spreader in use, the workman first inserted all the pins in the assembly, and then spread them with the tool. The time required for the spreading operation was thus cut to a fraction of that previously required, and a better job was obtained. A tool made as described is not limited to one size of pin, but can be used for a fairly wide range of sizes. The writer has seen the tool in use on pins ranging in size from 1/8 by 3/4 inch to 1/4 by 1 inch.

DeKalb, Ill. JOHN J. BORKENHAGEN

KEYWAY GAGE

When much keyway cutting in shafts and hubs is to be done on the shaper, a gage such as the one illustrated will be found useful. It is designed to gage the depth *T* and width *W* of the keyway in the shaft, and also the depth and width of the keyseat in the hub to which the shaft is to be keyed. In the two upper views, the gage is shown in position for gaging the depth and the width, respectively, of the shaft keyway. When the depth of the keyway is correct, as indicated in the view at the left, both ends *A* of the gage and the lower end of the gaging member *B* will be in contact with the work. The width *P* of the end *B* should be made slightly narrower than the width of the keyway.

For gaging the depth of the keyway in the hub, the dimension *H* should be such that the gage will be a good fit between the surface of the work at the bottom of the keyseat and the finished surface of the hole diametrically opposite when the keyseat is cut to the correct depth. The end *C* of the gage is used to gage the width of the keyway in both the shaft and the hub, as indicated in the illustration by the upper and lower views at the right. The gage is made of flat steel, the thickness of which depends upon the size of the keyway. The dimensions required in making a gage for standard keyways for shafts of different sizes may be obtained by the use of the tables given in MACHINERY'S HANDBOOK on page 501.



Gaging Depth of Keyway in Shaft and Hub

Philadelphia, Pa. PAUL H. BYER

Questions and Answers on Practical Subjects

TOOLMAKER'S PROBLEM

H. B. G.—Referring to the accompanying illustration, will you please show how to find the diameter X of a plug P which will be tangent to the two finished surfaces AB and BG of the work and at the same time be tangent to a straightedge placed on the ground surface AF?

A.—The known elements are $AB = \frac{1}{2}$ inch and the angular measurement 11½ degrees, as shown. Referring to the diagram,

$$AB = \tfrac{1}{2} \text{ or } 0.5 \qquad \text{and} \qquad AB = AE + EB$$

Also,

$$EAD = 90 \text{ deg.} + 11 \text{ deg. } 30 \text{ min.} = 101 \text{ deg. } 30 \text{ min.}$$

Therefore,

$$CAE = \tfrac{1}{2}\, EAD = 50 \text{ degrees } 45 \text{ minutes}$$

and

$$ACE = 180 \text{ deg.} - (90 \text{ deg.} + 50 \text{ deg. } 45 \text{ min.}) = 39 \text{ deg. } 15 \text{ min.}$$

Also

$$EBC = 45 \text{ degrees} \qquad \text{and} \qquad ECB = 45 \text{ degrees}$$

Now

$$AE = r \times \tan ACE \qquad \text{and} \qquad EB = r \times \tan ECB$$

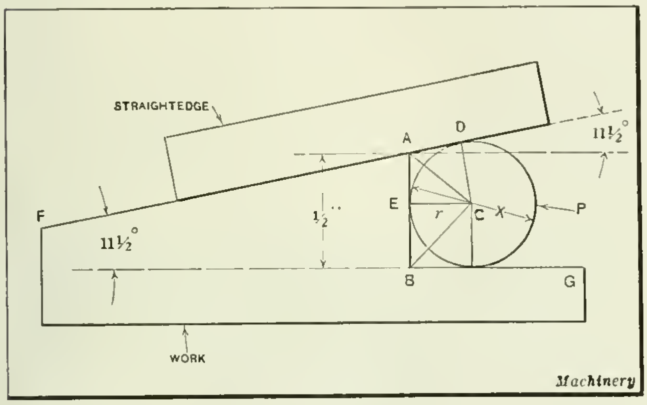


Diagram used in solving Toolmaker's Problem

As $AE + EB = AB$, we have

$$AB = r \times \tan 45 \text{ deg.} + r \times \tan 39 \text{ deg. } 15 \text{ min.}$$

or

$$AB = r \times 1 + r \times \tan 39 \text{ degrees } 15 \text{ minutes} = r\,(1 + \tan 39 \text{ degrees } 15 \text{ minutes})$$

Now as $AB = 0.5$ we have the equation,

$$0.5 = r\,(1 + \tan 39 \text{ degrees } 15 \text{ minutes})$$

Hence

$$r = \frac{0.5}{1 + \tan 39 \text{ degrees } 15 \text{ minutes}}$$

As the tangent of 39 degrees 15 minutes = 0.81703, we have

$$r = \frac{0.5}{1.81703} = 0.27517 \text{ inch}$$

$$X = 2r \text{ or } 0.5503 \text{ inch}$$

LOCAL CASEHARDENING

F. A. D.—We have some steel spindles that require casehardening only on two short bearing surfaces. What are the commercial methods of local hardening?

A.—There are several methods of local hardening. One is to paint the work with enamel where it is to be hardened, and to copper-plate the parts that are to be left soft. When the work is heated, the enamel burns away and the surface then absorbs the carbon. The copper coating, however, has no affinity for the carbon. Experiments have shown that a layer of electrolytically deposited copper, from 0.001 to 0.002 inch thick, is suitable. If desired, the entire surface can be copper-plated and the plating ground off where the hardening is to be done. Another method is to cover the parts that are to remain soft with a bushing or with ordinary tire tape; still another is to use fireclay for the protective covering.

"HOT TOP" IN STEEL MANUFACTURE

A. W. P.—What is "hot top" in steel manufacture?

A.—In the manufacture of steel, the molten metal from the crucible, converter, or electric furnace is poured into ingot molds. The impurities which float on the top of the molten metal are carried to the top of the mold, which is fashioned with a temporary "hot top" made of some refractory material. By this means the top of the ingot containing the impurities can be sheared off after the ingot is cold.

HARDENING DROP-FORGING DIES

J. R. de J.—In heat-treating shops, what is meant by "checking down"?

A.—Drop-forging and other similar dies which have irregularly shaped sections in which the metal is brought to a thin edge or ridge, present certain difficulties in quenching after heating, which are overcome by what is known as "checking" or "checking down." This consists simply of cooling the sections in which the metal is comparatively thin before the entire die-block is quenched. The preliminary cooling is done by applying wet waste or a piece of soap to the thin sections to bring the red-hot metal to a dark red color. This prevents cracking when the dies are quenched in water, and is common practice in heat-treating departments where work of this kind is regularly handled.

STEEL FOR BENCH LATHE SPINDLES

B. A. B.—Of what kind of steel are machine spindles such as bench lathe spindles usually made?

A.—The service required of bench lathe spindles—high wearing qualities and ability to withstand bending strains—indicates that a casehardened machine steel will give better results than will tool steel, and this material is therefore used by several bench lathe manufacturers. Properly heat-treated tool steel is also often used with good results, but the comparatively soft core of casehardened machine steel and its glass-hard surface makes machine steel particularly suitable for this use.

SIZE OF DROP-HAMMER

H. E. F.—What is the smallest drop-hammer recommended for use in making 6-inch flat wrench forgings?

A.—One is not liable to err if an over-size drop-hammer is selected, but it is dangerous to use a hammer which is not heavy enough to cause the dies to be filled in a few blows. Where many blows are required, the forging loses much of its heat, and consequently a higher initial heat is required with the attendant liability of ruining the surface of the die impression; or reheating becomes necessary and a correspondingly greater amount of time is required to complete the operation. If the forging is to be produced in single-impression dies, an 800- to 1000-pound board drop-hammer should be suitable; if double-impression dies are used, a 1500- or 2000-pound board drop-hammer will be required.

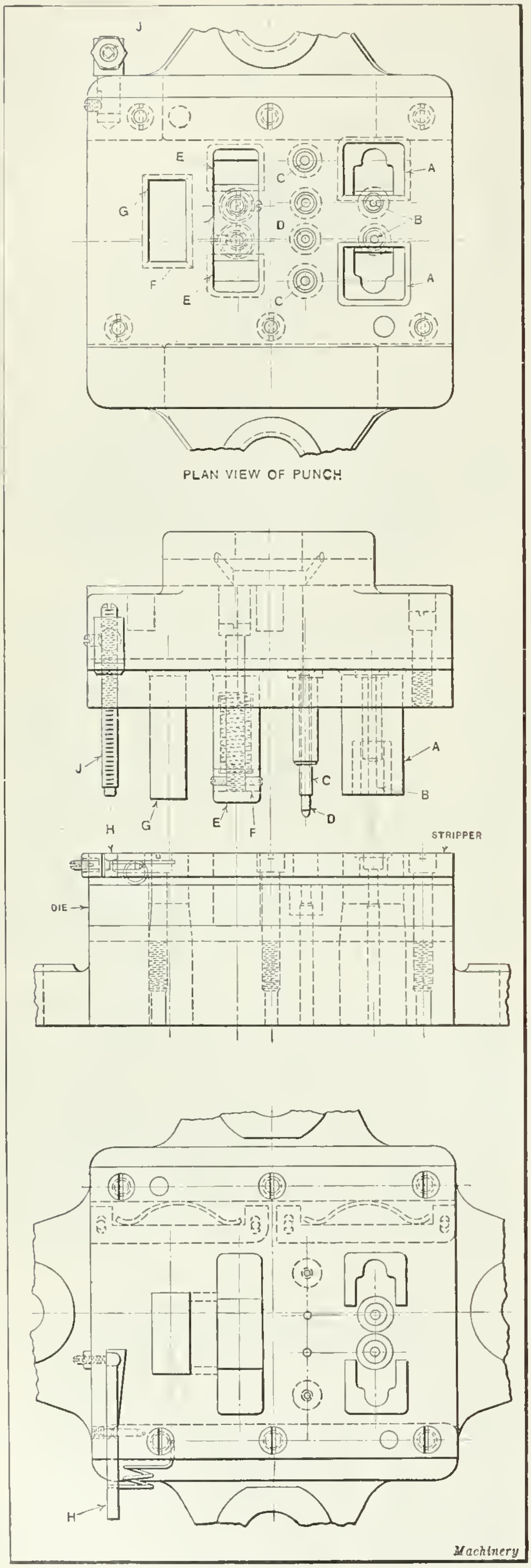


Fig. 1. Follow-die designed to produce the Bracket Support illustrated in Fig. 2

FOLLOW-DIE FOR PIERCING, BENDING AND BLANKING SMALL PARTS

By I. BERNARD BLACK

Dies of the follow type are rapidly gaining favor among manufacturers of small metal parts. In many instances, one die of this type is now used to pierce and blank work in one operation, which formerly required the use of several dies. Fig. 1 shows the general construction of the follow-die used to produce the part shown in the upper view of Fig. 2. This part is known as a bracket support, and is used in an electrical device, the nature of which requires that the part be of Norway iron. The stock is obtained in 10-foot lengths, 3 inches wide by 0.093 inch thick. It is fed to the press by means of a double roll feed. The speed of the press is 90 strokes a minute, and the gross production per hour is approximately 5000 finished pieces.

Referring to Fig. 2, it will be noted that the ends of the piece are bent at right angles to the central section. The provision of the bending punches *E*, Fig. 1, is a feature of particular interest in view of the fact that follow-dies are generally used for work that requires only piercing and blanking operations. The die lay-out is shown in Fig. 2. It will be noticed that this lay-out provides for four distinct stations. About 95 feet of stock is required for 1000 pieces.

At the first station the stock is blanked out at each side to form the rounded sections of the bent-up ends shown in the view of the finished piece. The part blanked out in this operation is shown in cross-section at *A*. The two holes *B* are also pierced at the first station. At the second station the two outside holes *C* are pierced, the stock being located by pilots *D* which enter the holes pierced in the first position. At the third station, the two ears or ends are bent down, and at the fourth station the piece is blanked out.

The construction of the punch and die is shown in Fig. 1. In the lower view is a plan of the die, and directly above is an elevation view of both punch and die. Part *A* is the punch which blanks out the part of the stock indicated by the cross-section *A* in the lower view of Fig. 2. Punches *B*

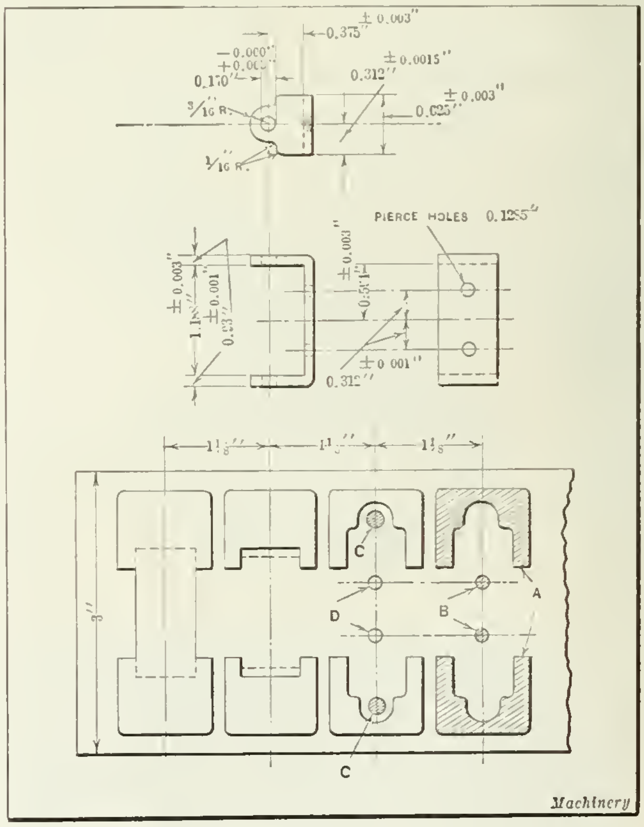


Fig. 2. Bracket Support and Lay-out of Die by which it is blanked, pierced, and bent

pierce the two central holes, the holes in the ends of the stock being punched in the second position by punches *C*. In this position the stock is located by pilots *D* which enter the central holes. The punches *F* that bend down the ends or ears are provided with steps designed to strike the outer points of the ears before the bending operation actually begins. It will be noted that a spring-actuated pad *F* is provided in the third position. This pad prevents the metal from being drawn or pulled to one side, and thus assists in obtaining a clean bend. The pieces fall through the die into a receptacle as they are blanked by punch *G*. A stop *H* locates the work after each feeding movement. The trip *J* which actuates stop *H* is mounted in a block attached to the punch-head.

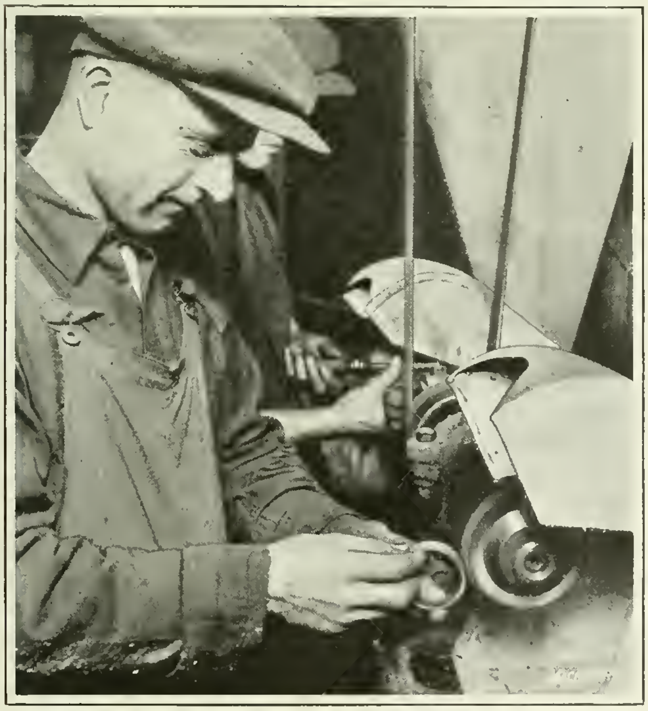
* * *

BUFFING AND POLISHING RADIO PARTS

Nearly all the brass fastenings on radio instruments, such as springs, crystal cups, and parts used in crystal mounting, are nickel-plated and are polished before and buffed after being plated. Such parts require a bright nickel-plated finish. One of the buffing operations illustrated is finishing a DeForest crystal cup; this is being done on the farther wheel. These brass cups, after being polished and nickel-plated, are buffed, as shown, on sewed cotton buffs to which Vienna lime is frequently applied. The cups are slipped over a plain holder, like a shouldered spindle, which is also used in the polishing operation preceding nickel-plating.

Buffing a Bezel Ring

The other operation shown is buffing a bezel ring which forms a peek-hole in a receiving set panel. The ring is similar in design to a dial gage case, and is also nickel-plated. The wheel is frequently dressed with a lime composition in cake form, the commercial name of which is "Acme White."



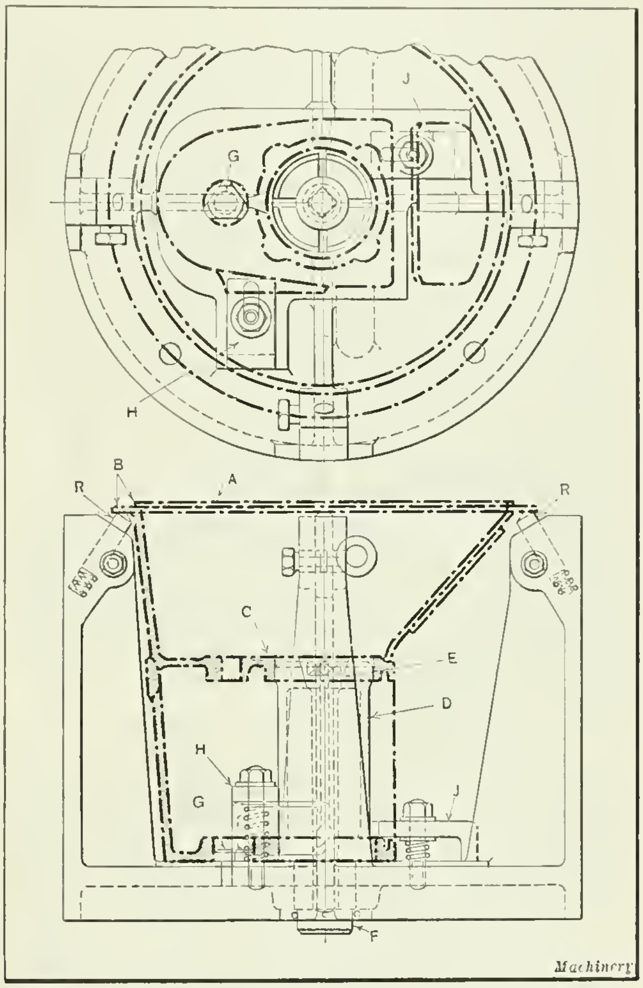
Buffing a Crystal Cup and a Bezel Ring used on Radio Instruments

All the buffs used in the buffing of these parts are made from sewed cotton plies, and have a soft open face which does not destroy the contour of the work, most of which is small. In order to obtain the best results, such work should be pressed into the face of the wheel while it is being buffed, and a wheel of sufficient flexibility on the face must be used to insure that the contour of the work will not be changed or destroyed.

FIXTURE FOR FACING AND TURNING TRANSMISSION CASE FLANGE

By WILLIAM OWEN

The fixture illustrated was designed for use on a 36-inch Bullard vertical boring machine, to hold the transmission case *A*, shown in dot-and-dash lines, while turning the surfaces *B* and the front bearing retainer face *C*. The body of the fixture is of rigid construction. It carries one large expanding plug *D*, which is actuated by the taper screw *E*. Screw *E* extends through the bottom of plug *D*. The plug *F* centers the fixture on the machine table.



Fixture used in turning and facing Transmission Case Flange

The three-point plug *G* holds the case from turning and locates it in the correct position for clamping. In loading the fixture, the case is slipped down over the large plug *D* and the small plug *G*. The clamps *H* and *J* are then brought into action, pulling the rear face of the case down tight on the fixture, after which the plug *D* is expanded by screw *E*. The four spring stops *R* are released and locked so as to hold the flange rigid under the cutting strain. This fixture is accurate, and can be easily loaded and unloaded. It has given excellent results when used for work done on a production basis.

* * *

A comprehensive course in employment management will become one of the regular features of the Technical Institute of Charlottenburg, Germany, beginning this fall. This course will cover methods for testing the suitability of apprentices and workers for the trade or occupation in which they wish to engage. It will also deal with time and motion study, taking into account both psychological and technical facts, and will cover all developments that have been made during recent years in regard to what might be termed scientific management in its broader sense.

Standardization of T-Slots

By H. CADWALLADER, Jr., President, Standard Shop Equipment Co., Inc., Philadelphia, Pa.

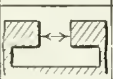
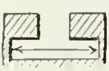
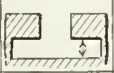
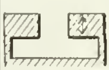
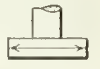
Designers of machine tools and special machinery often find difficulties in the designing of so simple a detail as a T-slot. This is due to the lack of uniform data obtainable from the experience of others, combined with the practical considerations that are likely to vary with each problem of design. The usual point of view has been to consider this method only from the standpoint of the particular machine involved. This lack of standardization causes considerable annoyance when endeavoring to set a precedent for future designs, especially when several machines may be found in the same shop with slots of different dimensions, though supposedly for the same diameter bolt. However, something has been done to correct this prevalent condition in the past, and it looks now as though the entire problem is in the proper hands for its permanent solution.

This year (1922) the National Machine Tool Builders Association at its convention held in Atlantic City, appointed committees in the lathe, planer, boring mill, drilling machine, and milling machine divisions, to report on the standardization of T-slots. These committees will work with the American Society of Mechanical Engineers and their findings will be governed by the question of practicability as applied both to design and application in the shop. Reports of these committees will have widespread distribution and should go far toward solving the problem. Ernest F. DuBrul, general manager of the association, brought the matter before the convention and called attention to the progress being made along kindred lines by the English Machine Tool Builders Association.

The Pioneer Work of Taylor and Barth

It may be well to consider the high spots of the past. The late Frederick W. Taylor saw the need of standardization of T-slots, but was limited in this work to the shops where the Taylor system of scientific management was being installed. He made no attempt at a world-wide standard, but worked rather to establish a standard for a given plant with the idea of curtailing to a minimum the number of changes necessary in that plant to aid in bringing about efficient production. Perhaps that method of inaugurating a general standardization was the best, because with it there was a chance to overcome its difficulties and to prove its possibilities. In those early days many machine tool builders actually had no slot standards of their own. Two or three types of tools built by the same manufacturer would have different sized slots for the same diameter bolt. Since then the number of machines and plants have multiplied so fast that general concentrated action is now imperative.

TABLE 1. PROPORTIONS OF T-SLOTS AND BOLT HEADS BASED ON EARLY BARTH FORMULAS

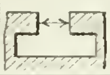
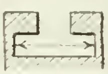
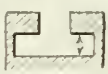
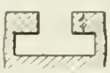
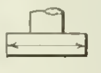
	$d + 1/32$	$2\,1/16\,d + 1/8$	$1\,1/16\,d + 1/16$	$H = 1\,1/2\,d$	BOLT HEAD = $2d$
BOLT DIAMETER d					
½	17/32	1 5/32	19/32	¾	1
⅝	21/32	1 13/32	23/32	15/16	1¼
¾	25/32	1 11/16	⅞	1⅛	1½
⅞	29/32	1 15/16	1	1 5/16	1¾
1	1 1/32	2 3/16	1⅛	1½	2

Machinery

Carl G. Barth was probably among the first to give this subject detailed study and investigation. Much credit is due Mr. Barth for his work on this subject, as it indicated to the users of machine tools the importance of consistency in T-slot sizes. Mr. Barth's early formulas, worked out at the Philadelphia plant of the Link-Belt Engineering Co. in 1903, are given in Table 1. Quite a number of firms, in ordering machine tools, specify that such tools be furnished with T-slots proportioned according to their T-slot standards. But this practice puts the "cart before the horse," since the buyers specify a standard instead of the manufacturers.

In designing T-slots, the amount of metal surrounding the slot is a practical point to consider. For dimension *H* (Table 1) on a machine such as a planer, where it is necessary to surface or true the machine table occasionally, it may be advisable to provide extra metal to allow for refinishing. This is particularly true of the heavier types of machine tools where heavy castings are liable to mutilate the table. The T-slot tables given on page 1087 of MACHINERY'S HANDBOOK are a good standard and represent dimensions used by a large proportion of machine tool builders. They have done much toward preventing new designs from going to extremes on certain dimensions and may be wisely followed where there are no available data on standards in the field in which the machine is being designed. Space does not permit giving all of the data available, but a more recent table of Mr. Barth's is well worth including (see Table 2).

TABLE 2. PROPORTIONS OF T-SLOTS AND BOLT HEADS BASED ON LATER BARTH FORMULAS

	d	$1\,3/4\,d + 5/32$	$5/8\,d + 7/64$	$H = 1\,1/2\,d$	BOLT HEAD = $1\,5/8\,d + 5/64$
BOLT DIAMETER d					
½	½	1 1/32	27/64	¾	57/64
⅝	⅝	1¼	½	15/16	1 3/32
¾	¾	1 15/32	37/64	1⅛	1 19/64
⅞	⅞	1 11/16	21/32	1 5/16	1½
1	1	1 29/32	47/64	1½	1 45/64

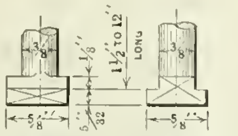
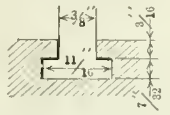
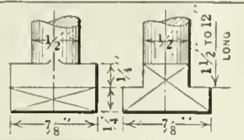
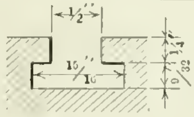
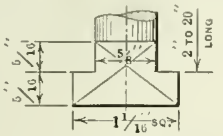
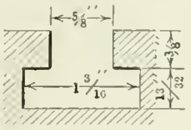
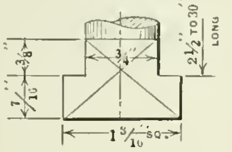
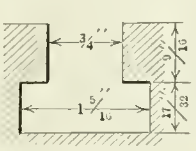
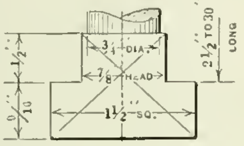
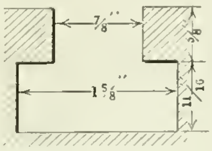
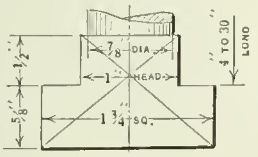
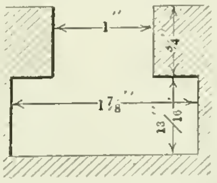
Machinery

Standards that are Widely Used

The Standard Shop Equipment Co., Inc. has adopted standards for T-slot bolts which are made to suit a large percentage of the machine tools now on the market (see Table 3). The relation of bolt head and slot sizes is such that there is an allowance of 1/16 inch on the width for the smaller bolts and ⅛ inch for the larger sizes. This allowance is chip space. There is also a proportionate chip clearance for the thickness of the bolt head. These bolt standards were adopted after much collating of information on present designs and sizes and are suitable for about 80 per cent of the machine tools manufactured. The amount that the bolt head is located below the surface of the machine table (dimension *H*) must be a more or less variable dimension because it must be greater in cases where the working surface must be machined occasionally to true it up.

Some common faults of present slot designs might be mentioned. Aside from the lack of standardization, most slots

TABLE 3. PROPORTIONS OF T-SLOT BOLTS AND T-SLOTS CONFORMING TO A COMMERCIAL STANDARD

Width of T-slot Head	Bolt Head Dimensions*	T-slot Dimensions*
3/8		
1/2		
5/8		
3/4		
7/8	 1/2" 9/16" 3/4 DIA. 7/8 HEAD 1 1/2" SQ. 2 1/2" TO 30 LONG	
1	 1/2" 5/8" 7/8 DIA. 1" HEAD 1 3/4" SQ. 4" TO 30 LONG	

Machinery

*The bolts listed are commercial sizes and the T-slots conform, either exactly or closely, to the proportions adopted by a large percentage of the machine tool builders.

are too large in the "width of head" dimension. The strength of the bolt head is its shearing strength at the shank; hence the wide head adds nothing to the strength of the bolt, and if extreme it causes the overhanging metal in the slot to break on account of the strain on the bolt causing the metal to be stressed more (as in a cantilever) with the increase in leverage. Bolt manufacturers claim that too much metal in the bolt head only tends to weaken the "head shearing" value because of the excessive distortion of the metal in forging the head.

It is believed that the committees appointed by the engineering societies will settle upon a standard for bolts with as small a width of head section as is practicable, giving due consideration to present slot dimensions and without making changes that are too radical and that will affect the majority of manufacturers. The committees' problem will not be to create an additional standard but to correct differences in those local standards now in use.

* * *

What is quoted as a rivet-cutting record was recently established in the tearing down of a standard freight car under ordinary yard conditions, when an operator recently cut out 1038 rivets in two hours and forty-six minutes. Heavy scale and rust, it is stated, made the cutting difficult, and it was necessary to work inside, outside, and under the car. In performing the work 384 cubic feet of oxygen and 83 cubic feet of acetylene were used.

INDUSTRIAL STANDARDIZATION IN GERMANY

The great strides now being made in Germany toward industrial standardization are referred to by Oscar R. Wikander, an engineer who has just returned from Germany where he represented the American Engineering Standards Committee in conferences concerning the international standardization of ball bearings. Mr. Wikander states that it appears that one of the main reasons why forward-looking Germans are forcing their standardization work to the extent at present being done is because they want to introduce German standards in other importing countries. Holland, Switzerland, Austria, and Sweden, and many other European countries follow the German lead very closely, and German deliveries of goods to France will no doubt be made, as far as possible, according to German standards, thereby introducing them into that country.

The German engineering standards committee, known as the "Normenausschuss," has already issued several hundred sheets of approved standards and about twice as many have been published as proposed standards. This enormous output of the German organization has led many to believe that it was merely a factory producing "paper standards," and that its work was not to be taken too seriously. Mr. Wikander states that a personal investigation convinced him that this is not the case and that the great output of standards is due to the enormous efforts put forth and to the enthusiasm of a great majority of interested parties. The reason for this enthusiasm is the general recognition of the great economic value of standardization and the very generally accepted opinion that a standardized industry will be one of the strongest factors in Germany's struggle for economic and financial reconstruction.

As an example of cooperation and standardization in manufacturing, it may be mentioned that a syndicate of one Swedish and nineteen German manufacturers are executing an order for 700 locomotives for Russia, all of the same design, every part being made interchangeable with the corresponding part in the other engines. One of these locomotives was assembled from parts made in twenty different shops with no more difficulty than a locomotive built complete in one shop. In case of future orders, it is expected that these will require interchangeability with the engines already built, and it is easy to see how the German manufacturers of locomotives will have a great advantage over those of other nations when competing on the basis of such specifications.

It has often been believed that the German standardization committee is autocratic in its methods and that it is not in close contact with the industries, but this is an erroneous opinion. The actual work of establishing standards is left to experts who are recognized leaders in the various industries, and the staff of the standardization committee merely coordinates and directs the work of the various committees. Many of the larger German manufacturers have standards departments of their own, with a number of engineers and draftsmen working permanently on national standards. Because of this cooperative spirit the German standards committee has come to play a more important role in the industrial life of the nation than was originally expected, and manufacturers now write to the committee for advice upon questions of the most intricate nature.

In his report to the American Engineering Standards Committee, Mr. Wikander concludes by saying that he hopes that American manufacturers will realize the enormous economic importance of industrial standardization and take steps to eliminate waste through duplication, through lack of system and coordination in sizes, and through failure to establish interchangeability of products where such interchangeability is desirable.

The Machine-building Industries

If the adverse influence of the railroad and coal strikes had not so materially affected conditions, there is every reason to believe that at this time a general industrial improvement could have been recorded. In practically all industries, including that of machine tools, business increased considerably during the spring months, and this improvement was quite definite up to the end of June. The rate of progress slowed down somewhat during the summer months, which is usual, and the uncertainty in all industries due to the coal and railroad strikes has also made itself felt in its reaction upon the machine tool industry. Business is reported to be somewhat more active in Ohio and the middle western states than in the East; and in spite of the temporary falling off it is considerably better throughout the country than in 1921. There is every indication that as soon as the strikes are definitely settled, there will be a marked improvement in the industries in general, including the machine tool and the machine-building industries as a whole.

In the spring, railroad buying had begun to a considerable extent and lists were being prepared by railroad shop executives that promised a fair amount of business during the remainder of the year. Then came the coal strike which slowed things down materially, followed by the railroad strike which put a still heavier brake upon the wheels of industrial improvements. The railroads have again been set back, and their ability to buy and thus greatly help maintain other industries in active condition has been impaired.

Advanced prices for machine tools are to be expected. As mentioned in August Machinery, some manufacturers have already advanced prices while others are contemplating an increase within the near future. The coal strike has considerably advanced the prices of all kinds of materials used in machine tool building, and this will naturally be reflected in the price changes; but more important is the fact that prices were reduced during the last eighteen months to levels often below cost of production. Keen competition and the efforts to unload large stocks were responsible for this. Now that demand is better, prices will return to a normal level.

The Iron and Steel Industry

Prospects in the machine tool industry can always be judged with fair certainty from current conditions in the iron and steel industry. Business steadily improved in this basic field during the first six months of the year, and normal conditions were close at hand when the effect of the strikes began to be felt. These effects are now quite pronounced. The price of coke is rising rapidly, and the scarcity of coal has forced may shut-downs of blast furnaces and mills. The railroad strike during the last two months seems to have affected the steel industry more than the coal strike did during a period of five months. When coal could be moved, there was enough coming from non-union mines to supply the most urgent needs, but the railroad strike has placed a different aspect on the whole situation. The mills have fallen behind in orders and deliveries are slow. The prices of all iron and steel products are continuing to increase. By the middle of August, at least fifty blast furnaces had been banked or blown out during the preceding four weeks due to coal shortage, and it is expected that there will be many more shut-downs. Pig iron is from $8 to $9 above the price of a year ago. Nevertheless, the United States Steel Corporation early in August operated at 70 per cent capacity, and a speedy settlement of the strikes might make it possible to nearly maintain this rate.

The situation is the more deplorable since without strikes the immediate outlook undoubtedly would have been bright and employment in all industries more general with the condition of labor as a whole greatly improved. The strikes have retarded the industrial readjustment that was taking place, and the loss of workers' wages and of railroad and mine operators' revenue are but a small part of the total loss the country as a whole, including labor of all classes, is sustaining through the slowing down of the industries.

The Automobile Industry

The only industry that in spite of all difficulties seems to hold its own is the automobile industry. It is true that the strikes have affected production in the Detroit district and that August will show a decrease from the high records of the last four months, but this would have taken place to some extent anyway on account of the falling off of the seasonal demand. To some points, cars can no longer be shipped by rail because of freight congestion. They are shipped by boat as far as possible from Detroit, and are then driven to their destinations.

Complete figures of the Department of Commerce for the production of passenger cars show that 261,963 were produced in June, in addition to 25,912 trucks. This was an increase of about 32,000 cars and trucks over May, the increase being due both to greater domestic demand and greater exports. During July operations were at about 90 per cent of the June schedules, except that the Ford plants did not curtail production. The output in June of the Ford plants was nearly 142,000 cars, nearly equalled in July, and with August schedules also maintained.

It is estimated that there are now 10,863,000 cars in use in this country—an increase of 1,428,000 in the last year. There have been announcements of new models from nearly all the companies, with further price reductions. The indications are that the slowing down in sales for the next six months will be less than usual at this season of the year.

General Industrial Conditions

The agricultural machinery and implement business which was very seriously affected by the business depression from which we are emerging, shows a marked improvement. Production, particularly of threshing machines, has been increasing and employment in the entire agricultural machinery and implement industry shows an increase during recent months.

Pump manufacturers state that their business is much better than it was a year ago, and that production has been increasing at a satisfactory rate. A steady reduction of the number of people out of work was reported up to the end of June. There is a scarcity of labor in the skilled trades, and in some of the smaller towns the point has now been reached where there is no unemployment.

"If a satisfactory settlement of the present labor difficulties can be reached in the near future," says the Department of Commerce, "there is every reason to believe that business will continue on its present level or even increase in volume. The failure to re-establish European economic equilibrium may continue to limit our foreign trade in that direction, but domestic conditions as well as those in many other parts of the world are favorable to further expansion."

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Landis Roll Grinding Machine. Landis Tool Co., Waynesboro, Pa. 65
Van Dorn Electric Radial-arm Drill. Van Dorn Electric Tool Co., Cleveland, Ohio 66
Cleveland Automatic Double-end Threading Machine. Cleveland Automatic Machine Co., Cleveland, Ohio 67
Pratt & Whitney "Super-Micrometer." Pratt & Whitney Co., Hartford, Conn. 68
Power Clamping Device for Dreses Radial Drilling Machines. Dreses Machine Tool Co., 227-239 West McMicken Ave., Cincinnati, Ohio 69
Oilgear High-speed Broaching Machine. Oilgear Co., 60-64 27th St., Milwaukee, Wis. 70
Reeves Centerless Grinder. Reeves Pulley Co., Columbus, Ind. .. 71
Ames Dial Gage Universal Attachment. B. C. Ames Co., Waltham, Mass. 71
United States Lathe Grinding Attachment. United States Electrical Tool Co., 6th Ave. and Mount Hope St., Cincinnati, Ohio 72
Hendey Plain-geared Engine Lathe. Hendey Machine Co., Torrington, Conn. 72
Hammond Wall Drill. Hammond Mfg. Co., Cleveland, Ohio .. 72
Cleveland Electric Recording Pyrometer. Cleveland Instrument Co., 1988 E. 66th St., Cleveland, Ohio 73
Wood's Improved Friction Clutch. T. B. Wood's Sons Co., Chambersburg, Pa. 73
Becker Cherrying Attachment. Becker Milling Machine Co., 677 Cambridge St., Worcester, Mass. 73
Diamond Pulley Grinding Machine. Diamond Machine Co., 9 Codding St., Providence, R. I. 74
Cincinnati Geared-head Lathes. Cincinnati Lathe & Tool Co., 3207-11 North St., Oakley, Cincinnati, Ohio 74
U. S. Welding and Heating Transformer. U. S. Electric Welder Co., 327-328 Permanent Bldg., Cleveland, Ohio 75
Starrett One-inch Micrometer Caliper. L. S. Starrett Co., Athol, Mass. 75
Hydraulic Flanging Press. Hydraulic Press Mfg. Co., 84-88 Lincoln Ave., Mount Gilead, Ohio 75
Greenfield Pipe Wrench. Greenfield Tap & Die Corporation, Greenfield, Mass. 78
Edlund Adjustable Boring Head. Edlund Machinery Co., Inc., Box 57, Cortland, N. Y. 78

Landis Roll Grinding Machine

A special feature of the Landis roll grinding machine is an attachment which provides for grinding rolls concave, convex, tapered, or straight. The machine is self-contained, separate motors being employed for driving the different units. The movements of all machine members are controlled through handwheels, levers, and push-button switches on the operator's platform. This platform moves with the wheel-head carriage as it travels along the rear of the machine.

MILL rolls of all types used in hot- or cold-rolling may be finished in a heavy-duty roll grinding machine built in a number of sizes by the Landis Tool Co., Waynesboro, Pa. The machine illustrated has a swing of 40 inches and takes rolls up to 14 feet in length. Other standard sizes have a swing of 20 or 30 inches, and all sizes are built to any required length. The machine is driven by three motors, one of which is direct-connected to the headstock for driving the work. The second motor drives the wheel-head, being mounted on a carriage which travels on a track running along the rear of the machine. The third motor drives the impeller pump which supplies water to the grinding wheel. The work-driving and wheel-head motors are both of 25 horsepower capacity, and the pump motor of 5 horsepower. In addition, a small reversible motor feeds the wheel-head toward and away from the work. The entire machine, both mechanically and electrically, is controlled from the operating platform on the wheel-head carriage. Starting and stopping of the motors is accomplished by means of push-button switches.

Construction of the Headstock and Tailstock

The relative positions of the headstock and its motor may be observed in Fig. 1. The headstock casting is bolted to the bed and is provided on the under side with teeth that are engaged by a ratchet in the direction of the thrust, thus eliminating endwise movement. Two speeds are furnished by the gears in the headstock which are thrown

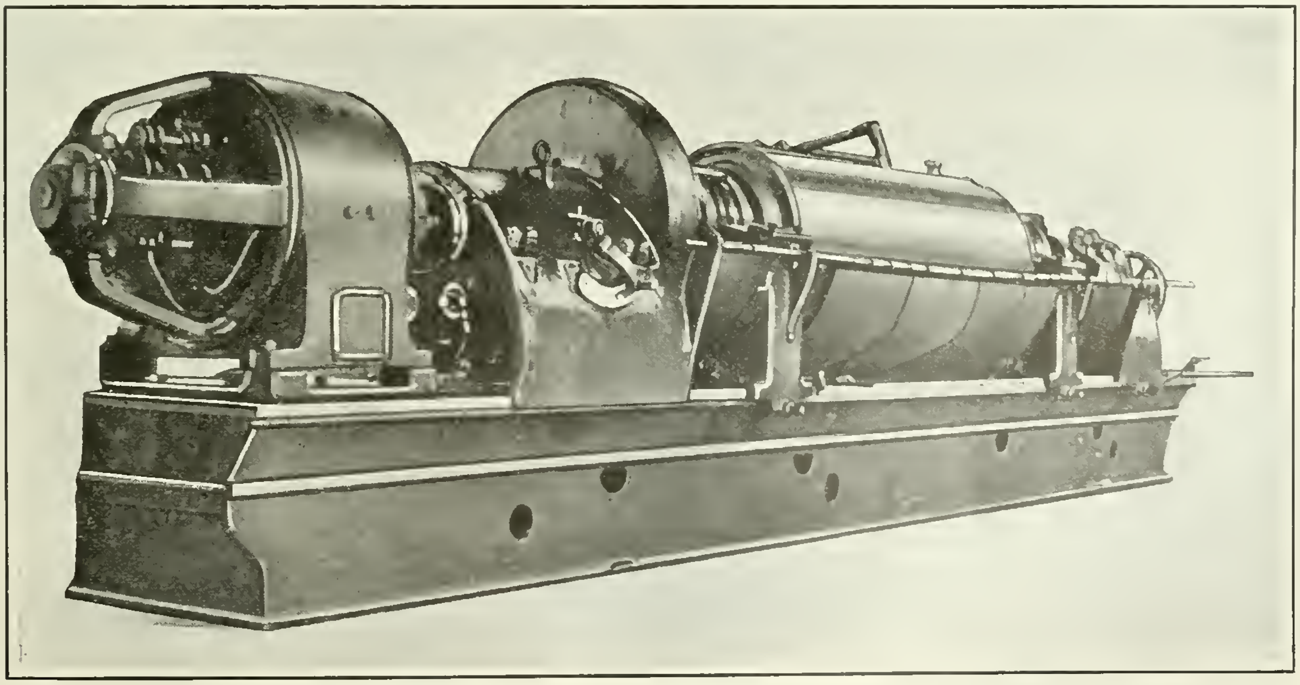


Fig. 1. Landis Heavy-duty Roll Grinding Machine which is controlled entirely from an Operator's Platform on the Wheel-head Carriage

into and out of engagement by means of the handle on the front of the headstock. Additional speed changes are secured from the motor, which is of the variable-speed type. The equalizing drive on former Landis roll grinding machines is also furnished on this machine. By this drive power is transmitted directly from the motor to a flexible coupling keyed to a shaft in the headstock. This shaft, in turn, is geared to the faceplate.

The tailstock is also held to the bed by means of clamping bolts, and a ratchet and pawl take up the thrust. A latch prevents the pawl from disengaging while the machine is in operation. The shaft on which this pawl is mounted passes through the tailstock and provides a means of lifting the pawl when it is desired to move the tailstock along the bed. This positioning of the tailstock is accomplished through a pinion that engages a rack on the front of the bed. The tailstock spindle is advanced and withdrawn by rotating the end handwheel seen in Fig. 2, which functions through a pair of gears. The handle on top of the tailstock is employed to lock the spindle in position after making a setting.

The roll supports are of a two-bearing type which permits grinding of the journals without changing the position of the roll. With this arrangement concentricity of the body and the journals is assured. This concentricity is particularly essential with rolls used in cold-rolling thin metal to close limits. The bearing block in the roll supports is made adjustable so as to accommodate journals of different diameters. One of the roll supports is shown disassembled in Fig. 3.

Wheel-head Features

The operating platform on the wheel-head is so located that the operator at all times has a clear view of the point of contact between the grinding wheel and the work. The wheel-spindle is driven from its motor by a belt which passes over three idler pulleys. One of these, strictly speaking, is not an idler but actually the driving pulley for the mechanism which traverses the wheel-head. This pulley furnishes power from its shaft, through a spider coupling, to the driving shaft of the traversing mechanism. This driving shaft has a worm mounted on it for revolving a worm-wheel on a shaft arranged crosswise of the machine. From the worm-wheel shaft the drive is transmitted through bevel gears to the vertical shaft of a gear-case, a reversing clutch being provided on the worm-wheel shaft. The gear-case provides three speeds, and this number may be doubled by means of back-gears on the clutch shaft. At the lower end of the vertical gear-case shaft is a worm which drives a worm-wheel set at an angle with the longitudinal center line of the bed. On the opposite end of the worm-wheel shaft is mounted a worm which meshes directly with a rack at the rear of the bed. This mechanism serves to traverse the wheel-carriage back and forth past the work.

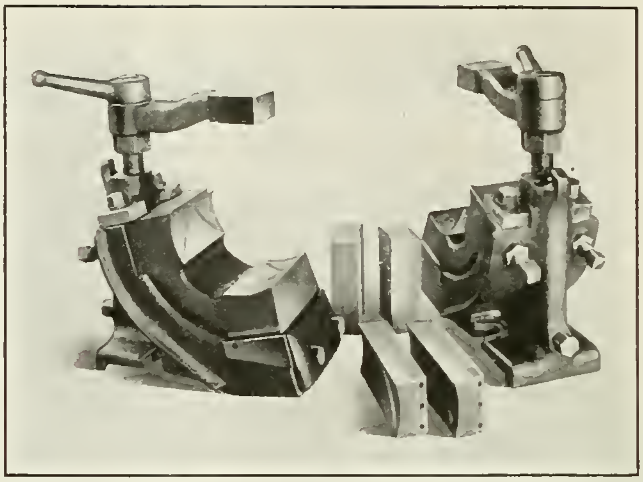


Fig. 3. Support in which the Journals of a Roll rest during an Operation

The wheel-carriage may also be moved by revolving the handwheel upon which the operator's hand is seen resting in Fig. 2. The handle beneath the handwheel is employed for throwing out the power clutch and for engaging the hand feed. The "spiral" below this handle is utilized for setting dogs which cause a reversal of the carriage movement at any desired point. By having a worm on the dogs and worm teeth on the spiral, it is possible to adjust the dogs very accurately. Two handles at the front of the operating platform control the traverse speeds, one of them being used for engaging and disengaging the back-gears, and the other, the gears in the gear-case. The wheel-head is fed by power toward the work and away from it, by a small reversible motor, as previously mentioned, which is operated by a switch that is close to a slow-motion handwheel. This handwheel is used to obtain a fine adjustment of the wheel-head.

A special feature of the machine is that it will grind rolls either concave, convex, straight, or tapered. This has been made possible by hinging the wheel-head on an auxiliary base that allows the wheel to be lifted to bring its center line above that of the work. This is accomplished by the manipulation of an eccentric shaft at the front of the wheel-head. The amount of concavity or convexity within a given length can be varied by means of simple gearing at the back of the machine, and this amount may easily be determined by reference to a chart that is furnished. This gearing is engaged and disengaged by a lever on the operating platform. Under typical operating conditions the machine illustrated has removed seven cubic inches of chilled iron per minute. The roll shown mounted on it weighed approximately 8 tons.

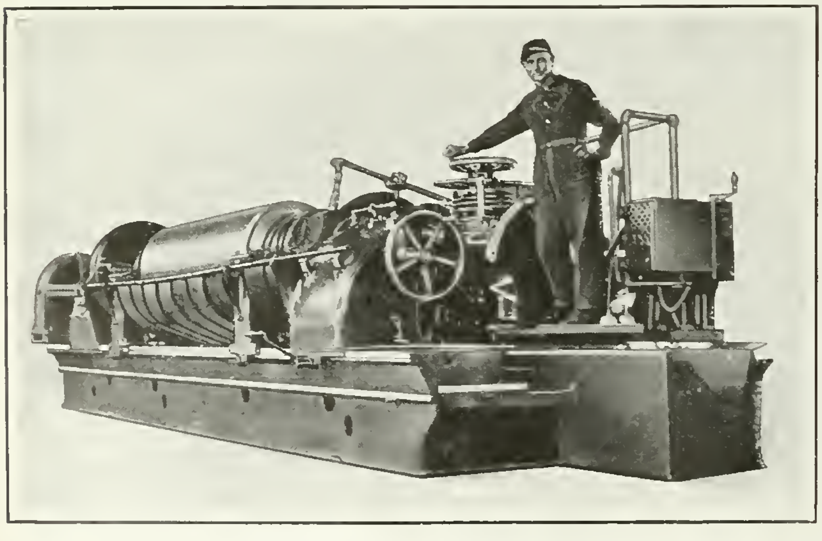
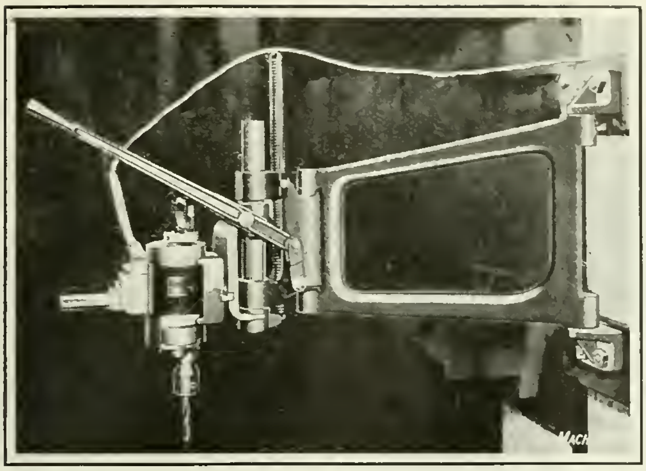


Fig. 2. View from the Tailstock End of the Roll Grinding Machine in which the Operator's Platform may also be seen

VAN DORN ELECTRIC RADIAL-ARM DRILL

A radial-arm drill intended primarily for use by millwrights and maintenance men, has been added to the line of products manufactured by the Van Dorn Electric Tool Co Cleveland, Ohio. It will be seen from the illustration that the equipment can be bolted to a wall or column by means of two pivot brackets. At the outer end of the main arm casting is another pivoted joint on which a short forearm swings. A portable electric drill is mounted on a sliding member at the



Van Dorn Millwrights' Radial-arm Drill

outer end of the forearm. This construction permits quick location of the drill when using the equipment.

The drill bracket or sliding member is raised and lowered by means of a long lever and a toggle-link mechanism. A secondary lifting arrangement is also provided in the form of a strong tension spring which is attached to the lower part of the drill bracket, and hung from an extension rod above the forearm. The drill can be quickly attached by simply unscrewing one handle and bolting the drill to an adapter plate on the forearm. The radial arm with the drill attached covers a radius of 31½ inches, and the auxiliary forearm provides a secondary radius of 10½ inches. The driving motor is of the universal type operating on either alternating or direct current. It is ventilated by means of an aluminum fan on the rotor shaft, and is equipped with ball bearings. A special drill chuck allows the use of drills up to ⅝ inch in diameter for drilling holes in iron and steel. The housing of the drill is made of aluminum and can be quickly disassembled for greasing or cleaning.

CLEVELAND AUTOMATIC DOUBLE-END THREADING MACHINE

Both ends of forged or rolled locomotive-boiler staybolts or similar parts may be simultaneously threaded in an automatic machine now being placed on the market by the Cleveland Automatic Machine Co., Cleveland, Ohio. With this machine the time required to thread a staybolt is only that necessary for threading the longer end. A magazine provides for continuous operation of the machine, which results in high production rates. Each staybolt is carried from the magazine, by means of a small vertical conveyor, down into line with the threading dies, where it is gripped for the operation. Threading both ends of the staybolt simultaneously necessitates gripping it at the center. The gripping jaws are of a floating design so that both staybolt end may be aligned with the dies even if the part that is gripped is out of true. The ends may be over 1/16 inch out of true in the rough and still be threaded in line with each other.

The gripping jaws are composed of an upper half *A*, Fig. 3, and a lower half which is not visible. Both halves pivot on a stud, and are opened and closed by means of a toggle mechanism operated by lever *B*. This lever is controlled by cam *C*, Fig. 2, which functions through lever *D* and a connecting bar. Fig. 3 shows the gripping mechanism with the jaws just closed. The slot in lever *B* is enlarged at the lower end to give a slight free movement which allows the jaw slide to shift forward or backward and the jaws to oscillate. This constitutes the floating feature of the jaws previously referred to.

In setting up a job, a master staybolt or long thread gage is inserted in one of the die-heads, which is then closed upon it. Next, by means of a fine adjustment, the other die-head is brought to a position where it may also be closed upon the gage. In this manner the die-heads are so set that a continuous-lead thread will be produced on the staybolt ends. The lead-screw is mounted back of the die-spindles and is driven directly from the left-hand die-head spindle through gearing. The die-head slides *E* and *F*, Fig. 1, are controlled by the lead-screw during the cutting stroke, but when the desired length of thread has been cut, the die-heads are opened by contacting with stops at the front of the machine, and the lead-screw nuts are tripped open by cams. The slides are then returned by the action of cams on drums *G* and *H*, Fig. 2.

When the return stroke is nearly completed and the die-heads are just clear of the work, the jaws open and move backward, ejecting the finished staybolt, which drops into a pan. Another staybolt is then lowered from the magazine into a position in line with the die-heads. The opening of the jaws, the ejecting of the finished staybolt, and the withdrawal of the slide upon which the jaws are mounted to allow another staybolt to be lowered from the magazine, all occur during the backward movement of the toggle mechanism operated by lever *B*, Fig. 3, as previously mentioned. The forward movement of this toggle mechanism advances the slide with the jaws open until they are in position to close on the staybolt, at the same time seating the staybolt in V-blocks just in front of the die-heads and thus aligning the staybolt with them. The jaws are then closed on the staybolt, a heavy spring cushion allowing for slight variations in the diameter of the portion gripped.

The pulley at the left-hand end of the machine in Fig. 1 drives a shaft which extends through the inside of the bed to the right-hand end. The die-head spindles are driven from this shaft through gears at each end of the bed. This long horizontal shaft also drives through spiral gearing, a transverse shaft at the right-hand end of the machine which, in turn, transmits power to the camshaft at the rear. Change-gears under cover *J*, Fig. 2, regulate the operation

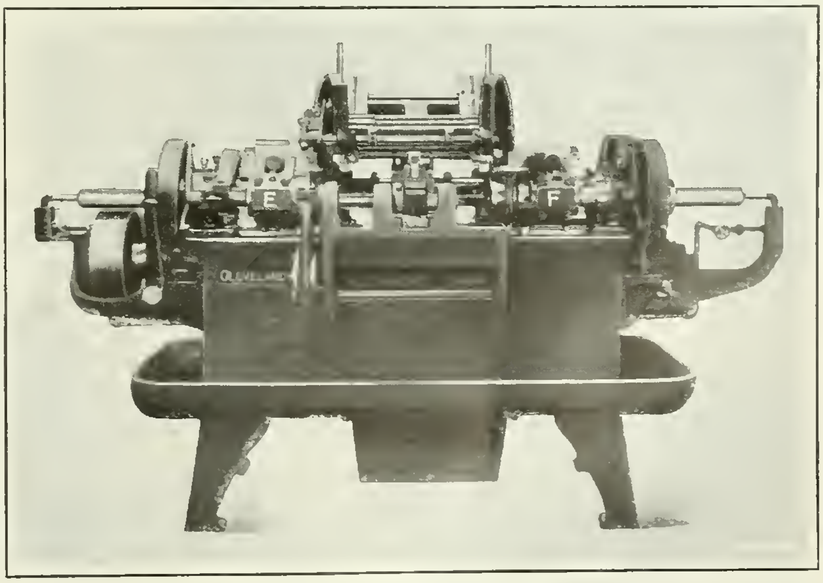


Fig. 1. Cleveland Automatic Double-end Threading Machine, which is especially designed for handling Locomotive-boiler Staybolts

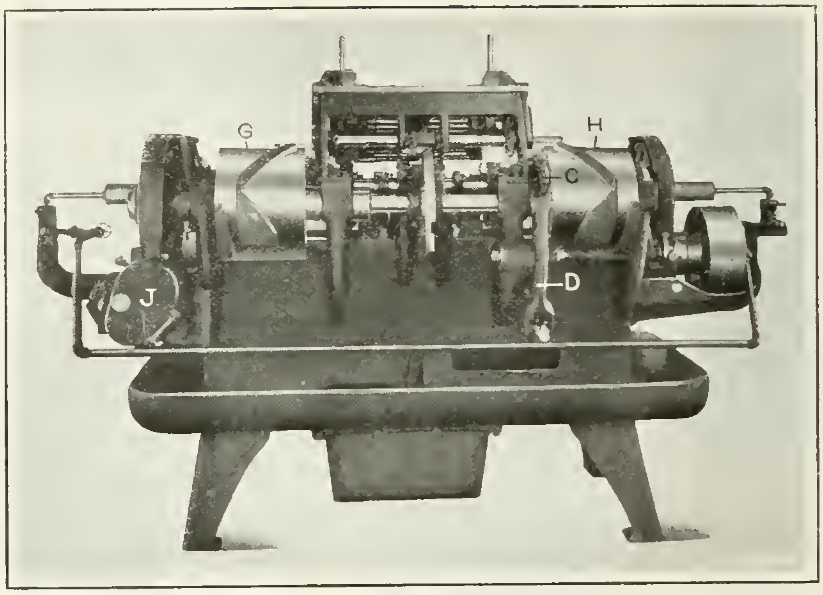


Fig. 2. Rear View of Cleveland Double-end Threading Machine, showing the Cam Drums for returning the Die-head Slides

of the camshaft to suit different lengths of threads. The machine is equipped with a safety pin which shears off when an attempt is made to machine staybolts that are too much out of shape. Cutting oil is pumped through both die-heads in a heavy stream to wash away chips, and cool and lubricate the chasers. The starting and stopping of the machine is controlled by a lever at the left-hand end which functions through a friction clutch. The die-head spindles can be quickly moved horizontally to locate them in the proper position when changing from one length of staybolt to another, and the magazine is also adjustable for this purpose.

The machine threads staybolts up to 1 5/16 inches in diameter and from 7 to 18 inches in length. The production time is from 35 to 60 seconds per staybolt, depending upon the diameter and length of the thread. One man can usually operate five of these machines, as the magazine requires filling only every forty to fifty-five minutes. Besides threading staybolts, this machine is also adapted for threading studs, pipe nipples, and tubing, and turning shaft ends. Such turning operations can be done by substituting the proper cutting tools in the die-head spindles and arranging the spindles for running at high speeds. Plain gripping jaws can also be furnished instead of the toggle design.

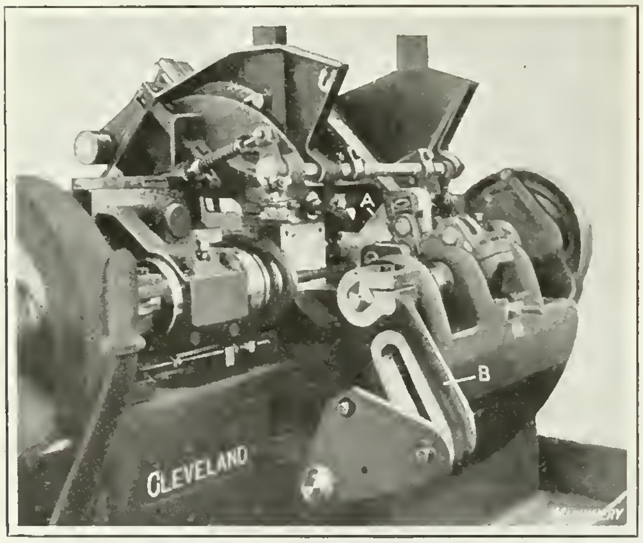


Fig. 3. Close-up View of Details at Front of Double-end Threading Machine

PRATT & WHITNEY "SUPER-MICROMETER"

Most workmen experienced in using micrometers on precision work can measure to within 0.0001 inch, assuming that an accurate micrometer is employed; nevertheless, variations in readings of from 0.0002 to 0.0004 inch are not uncommon. There are two chances for error; first, the micrometer, especially if owned by the workman and not checked periodically, may be slightly inaccurate. Second, the readings taken by different men are sure to vary more or less because of difference in contact pressure, vision, and judgment. In order to enable measurements within 0.0001 inch to be readily and repeatedly taken by different workmen without exercising particular care, the Pratt & Whitney Co., Hartford, Conn., has developed a "super-micrometer." It is intended for use in tool-rooms and machine shops, and accurate results are obtainable by men who have not previously used it.

From the general view of the "super-micrometer" shown in Fig. 1, it will be seen that the machine has a stationary micrometer headstock and a footstock which may be adjusted along a rigid cylindrical bed to permit the measurement of lengths up to 8 inches. The micrometer headstock has a threaded measuring spindle *A* passing through a nut in the hub of the 5-inch graduated disk *B*, which is a duralumin forging. The settings are made by the use of standard inch-blocks, which are lapped by a modification of the Hoke process and are stated to be accurate within five

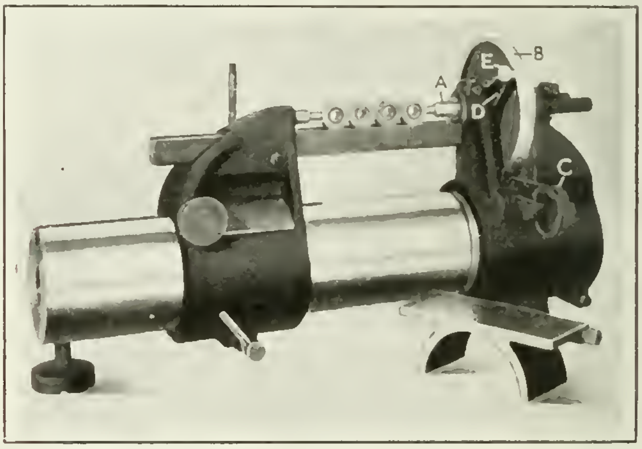


Fig. 1. Pratt & Whitney "Super-micrometer" designed for accurately measuring to 0.0001 Inch

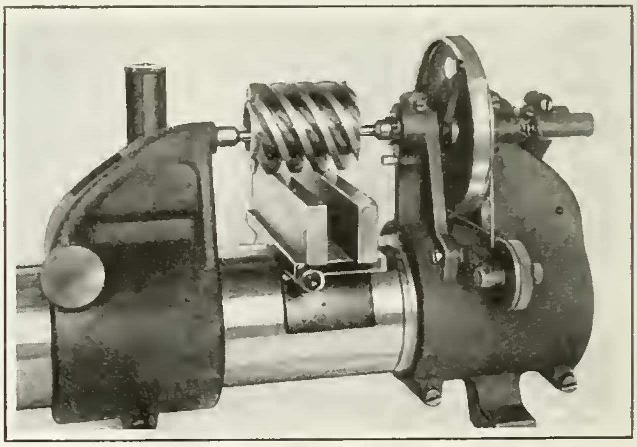


Fig. 2. Making Use of the Work-table in measuring the Length of a Part on the "Super-micrometer"

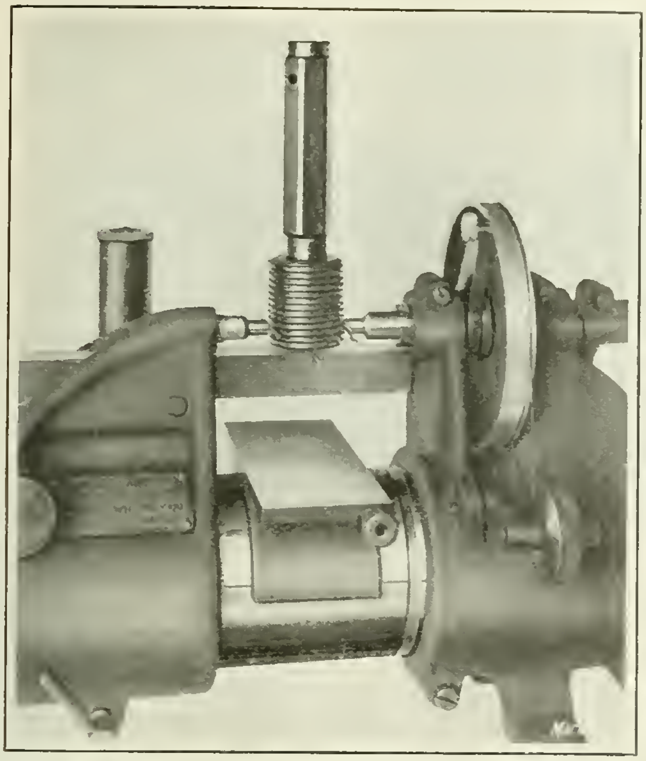


Fig. 3. Example in which the Part to be measured is held on the Square Bar employed in setting the Anvils

millionths inch. A square bar with a channel in one side provides for holding these blocks in place, as shown, while making the set-up.

The bar passes through the footstock and is mounted on a pin under the measuring spindle. The number of blocks used depends, of course, upon the measurement to be taken. In all cases the blocks take care of even inch measurements, while subdivisions of an inch are measured by means of the graduated spindle and disk. The spindle has an integral anvil and a working range of ½ inch with liberal over-travel each way. When the required number of inch-blocks are in place between the anvils and the spindle is set as required, the footstock is advanced by a rack and pinion mechanism to bring the anvil in contact with the blocks. The footstock is then clamped in position on the bed.

The measuring spindle is next removed from contact with the blocks by turning the graduated disk, and then again advanced into contact by turning handwheel *C*. This handwheel has two knurled steps, the smaller of which is used for quickly moving the spindle into contact and the larger for imparting the final slow movement to the point where slippage of the belt connecting the handwheel to the graduated disk, indicates that perfect contact is established. The belt insures the application of the same measuring pressure to the anvils each time. The graduated disk may be spun quite rapidly for setting up, but when taking a reading it must be brought up slowly until the belt slips. When contact has been secured, the zero arm *D* is set so that its zero line coincides with the zero mark on the graduated disk, the knurled knob *E* maintaining this setting. The inch-blocks are then removed and the work inserted in place.

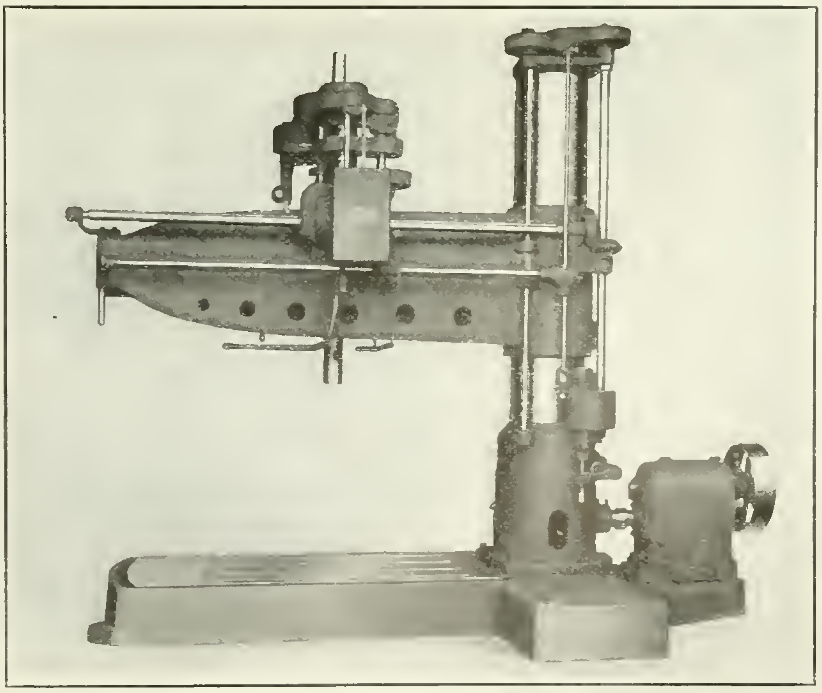
The work may be placed on the square bar used in setting the anvils; however, in this case the bar is inserted in the machine with the flat surface uppermost as illustrated in Fig. 3. The work-table shown in front of the machine in Fig. 1 is employed for supporting the work as illustrated in Fig. 2. Two of these tables are furnished. The height between the axes of the anvils and the top surface of this table is 3¼ inches.

The measuring spindle is mounted in split adjustable bearings located on each side of the graduated disk. Attached to the rear end of the spindle is an arm which straddles a fixed pin. This pin may be deflected slightly by means of adjusting screws, due to its being thinned down at the inner end. This arrangement serves to compensate for any exceedingly slight lead error in the screw, because as the arm moves along the pin when the latter is deflected, a slight turning movement is imparted to the spindle relative to the nut which offsets the amount of lead error that may exist in the screw. Springs on each side of the spindle at the rear end continually hold the side of the disk hub against the bearing, and thus eliminate errors due to endwise lost motion. Should the thread in the nut show appreciable wear, it may be taken up by tightening the steel collars around the hub of the index-wheel.

The spindle is graduated to 0.050 inch, which represents the amount that the spindle moves horizontally per turn of the disk. The disk has fifty main graduations with numbers indicating thousandths of an inch, and subdivisions reading directly to ten-thousandths of an inch. As the five hundred divisions on this 5-inch disk are not very closely spaced, it is easy to estimate subdivisions of the 0.0001-inch graduations. The footstock is held in alignment by a key engaging a keyway on the under side of the bed.

POWER CLAMPING DEVICE FOR DRESES RADIAL DRILLING MACHINES

Radial drilling machines built by the Dreses Machine Tool Co., 227-239 W. McMicken Ave., Cincinnati, Ohio, are now being equipped with a clamping device which receives power from the vertical driving shaft of the machines for clamping the column after the arm has been swung to bring the drill spindle into a new position. The device clamps the column without the operator having to change his position when drilling with the head near the outer end of the arm. A rear view of a machine equipped with this power clamping device is here illustrated. It will be



Dreses Radial Drilling Machine with Power Clamping Device for Column

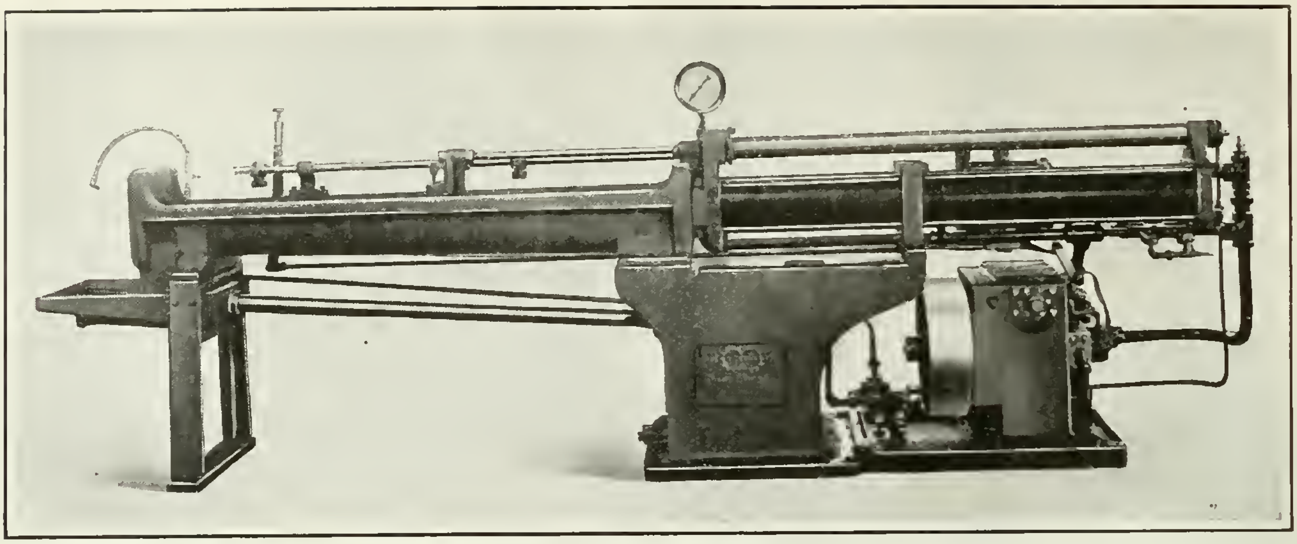


Fig. 1. Oilgear Broaching Machine with Cutting and Return Speeds ranging from 48 to 360 Inches per Minute

seen that the vertical driving shaft extends through a small oval box in back of the column. By means of a set of friction clutches in this box, the vertical screw which projects from the lower end of the box can be revolved either in a clockwise or in a counter-clockwise direction. On this screw is mounted a nut which is attached to a forked lever. The hub of this lever has a tapped hole, the threads of which engage those of the column binding screw.

The friction clutches are operated by a cam attached to a vertical splined shaft that extends to the top of the machine from the left-hand side of the oval box. This shaft is geared to a horizontal splined shaft that extends to the outer end of the column. The horizontal shaft is swiveled to throw the friction clutches into mesh, by means of levers and links which move along the arm with the drill head. The friction clutches are self-releasing. This power clamping device does not interfere with the use of the hand device.

OILGEAR HIGH-SPEED BROACHING MACHINE

Broaching at unusually high speeds, a practically unlimited choice of speeds within a given range, and an automatic control of the cutting and return speeds independently of each other, are the principal features of a hydraulic broaching machine recently developed by the Oilgear Co., 60-64 27th St., Milwaukee, Wis. Both the cutting and return speeds range from 48 to 360 inches per minute. A standard "Oilgear" variable-stroke pump, similar in design and operation to that used in variable-speed drives built by this company, delivers a steady flow of oil to a double-acting cylinder, the piston-rod of which is connected to a sliding head operating on the ways of a U-shaped trough. Fig. 2 shows a close-up view of the pumping apparatus.

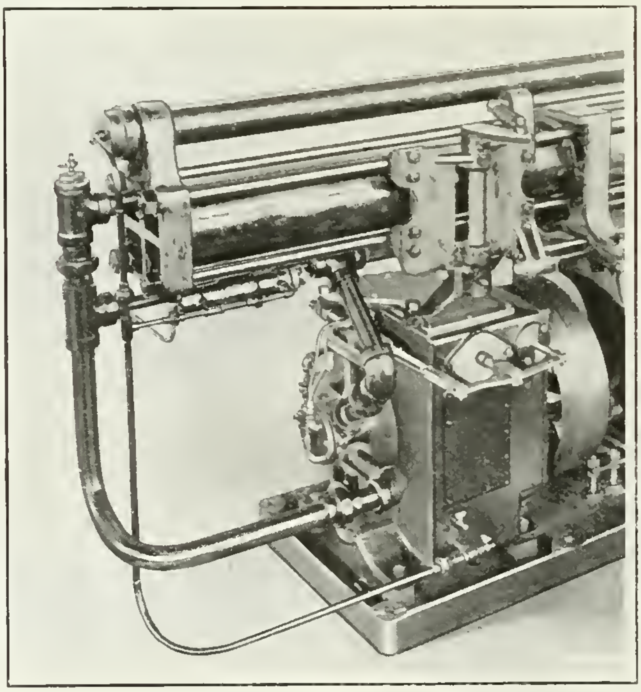


Fig. 2. Close-up View of the Oilgear Variable-stroke Pump employed in driving the Broaching Machine

The amount of oil delivered to the cylinder depends upon the length of pump stroke, which may be varied from zero to a maximum. As the speed of the piston travel depends upon the amount of oil pumped into the cylinder, this speed can be changed at will by merely changing the pump stroke. The fast operation of the machine is attributed mainly to this method of control. The cutting stroke is started without shock and the pull is steady. The slight variations in speed obtainable provide for selecting the correct speeds for different materials and different styles of broaches, the higher speeds being employed for light cutter-bar work, and the slower speeds for heavier jobs.

Automatic stops may be set for securing any desired length of cutting stroke, and this length will remain fixed. There is no danger of over-running, and consequently the broach will not be pulled beyond the reducing bushing and caught on the reverse stroke. Reversal at either end of the stroke is effected by simply pressing a push-button. In addition, the control may be set for automatic reversal. An emergency control lever enables the operator to stop the machine instantly at any point of the stroke.

Quick-acting relief valves prevent the pulling apart or the buckling of a broach under abnormal load conditions on either the cutting or return stroke. These valves, one of which is placed on the cutting end of the cylinder and the other on the return end, automatically relieve the pressure and stop the operation of the machine whenever the pressure reaches a predetermined point.

The machine can be driven by belt from a lineshaft or by a motor. When a motor drive is employed, the motor is mounted above the main cylinder on an adjustable support. The following example is given as being typical of the performance of this machine: In broaching four solid keys in a differential bevel gear made of 0.22 per cent carbon steel and having a 1¼-inch bore, 2 inches long, the cutting speed was 288 inches per minute and the return speed 312 inches per minute. The average cutting time for this part was 6½ seconds.

The principal specifications

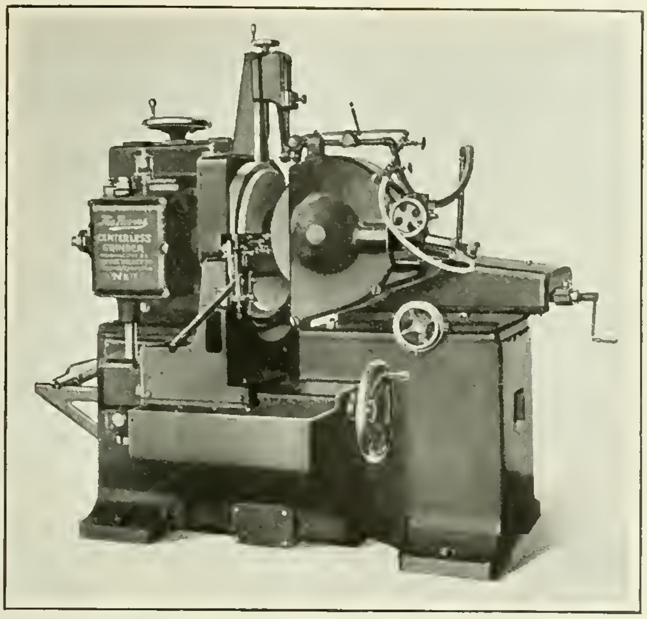


Fig. 1. Reeves Improved Centerless Grinding Machine, Suitable for grinding Shouldered, Tapered, or Straight Work

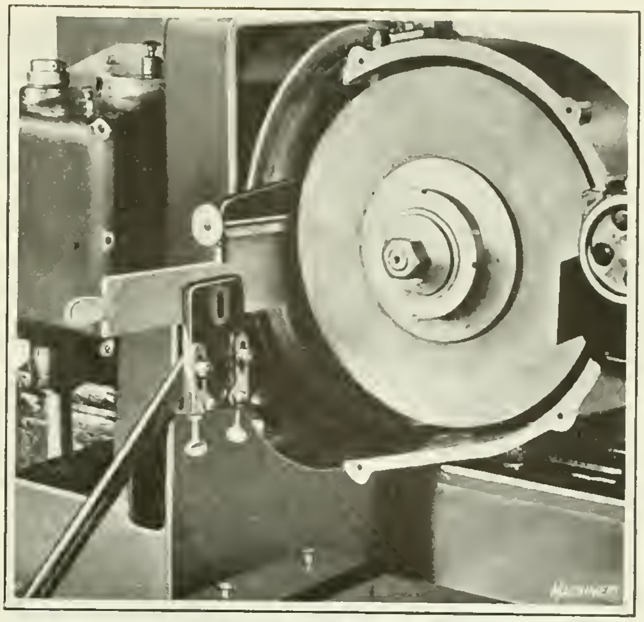


Fig. 2. Close-up View of the Reeves Centerless Grinding Machine, showing the Work-rest for Shouldered Parts

of this machine are as follows: Pulling capacity 16,000 pounds (equivalent to that required for a 2-inch square broach designed according to standard practice); maximum stroke, 56 inches; diameter of hole in faceplate, 5 inches; vertical adjustment of draw-head, 1⅝ inches above and 1⅝ inches below center; size of motor recommended for driving machine, 10 horsepower; approximate weight of machine, 2900 pounds; and floor space required, 16 feet by 26 inches.

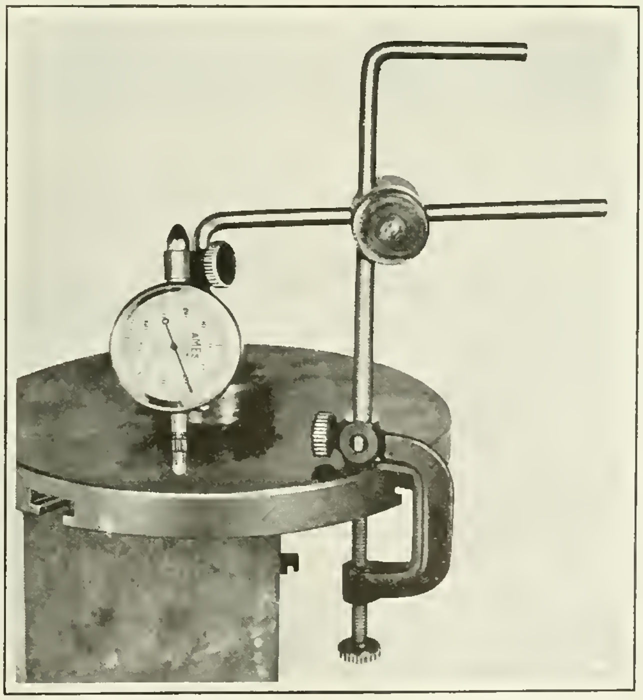
REEVES CENTERLESS GRINDER

A number of improvements have been made in the centerless grinding machine now being built by the Reeves Pulley Co., Columbus, Ind., which was described in June, 1919, MACHINERY, at the time that it was placed on the market by the Gardner Machine Co., Beloit, Wis. A general view of the redesigned machine is shown in Fig. 1. Among the most important of the improvements is a patented drop-in work-rest, which adapts the machine for grinding shouldered, taper, or straight work, including valve stems, shackle bolts, and similar parts. This work-rest consists of a steel bar having a hardened and ground edge which supports the work in a horizontal position between the two grinding wheels. On top of the bar there is an extended guide slotted to provide an opening just large enough to receive the work. On the sides of the bar are guide walls which hold the work in a straight line centrally between the two grinding wheels. A stop may be adjusted for grinding rolls of different lengths. This stop permits the rolls to extend in between the wheels just far enough to grind them without touching the shoulder.

A special feature of this rest is that it is mounted on rollers which permit it to be drawn forward, raised to allow the work to be entered lengthwise 5 inches or less above the grinding point, and lowered to the grinding position. Thus the piece is centered and ground its entire length and produced concentrically. This diamond dresser is adjustable for dressing the wheel to the necessary angle for grinding work to a taper. Provision is made for obtaining correct wheel balance, which is so essential in precision grinding. The balancing is accomplished without removing the wheel from the chuck by means of holes which are drilled around the chuck close to its periphery to receive balancing pins. These pins are placed in holes opposite the points where there are heavy spots in the grinding wheel and counterbalance them. Permanent balancing ways are regularly bolted to the base of the machine, and a tapered balancing arbor is furnished for the chuck.

AMES DIAL GAGE UNIVERSAL ATTACHMENT

A universal attachment intended for use in connection with "Junior" dial gage heads manufactured by the B. C. Ames Co., Waltham, Mass., is now being placed on the market by the same concern. From the illustration it will be seen that the attachment provides for holding the gage in every conceivable position in the vertical plans. The vertical rod may also be inserted in the horizontal holes of the clamp to hold the dial gage in various positions in the horizontal plane. The clamp provides means for attaching to a large variety of objects. This equipment is especially useful in checking the straightness of crankshafts, camshafts, and valve stems, the lift of valves and valve cams, the thickness of piston-rings, shims, bearing liners, etc., diameter of pistons, and accuracy of many other parts. The attachment may be furnished with the Ames cylinder gage outfit.

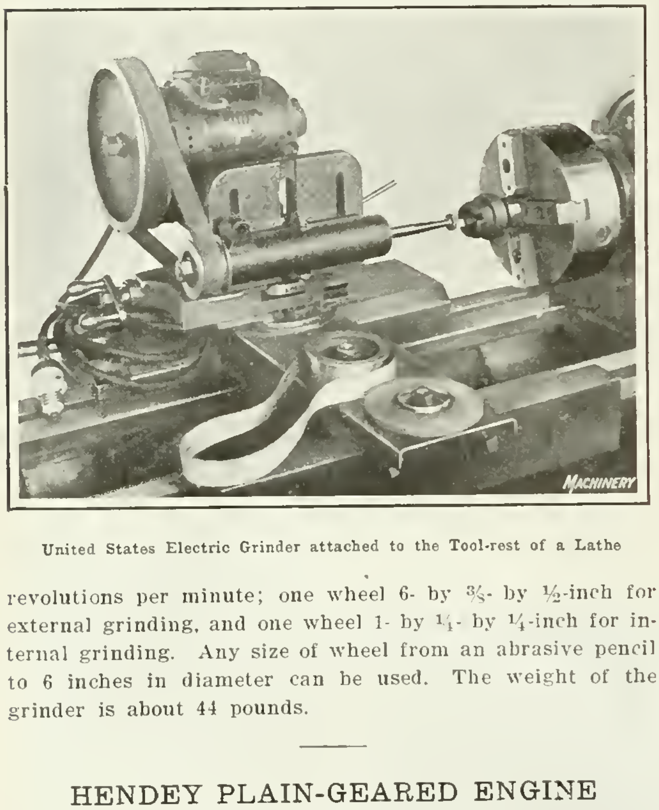


Ames "Junior" Universal Attachment for Use with Dial Gage Head

UNITED STATES LATHE GRINDING ATTACHMENT

An external and internal electric grinder which may be attached to lathes as shown in the accompanying illustration is a recent product of the United States Electrical Tool Co., 6th Ave. and Mount Hope St., Cincinnati, Ohio. This attachment may be applied to all lathes having a swing of 10 inches or more. The angle-plate of the grinder is bolted to the tool-rest of the lathe. The grinding spindle is mounted on the front of the angle-plate and may be clamped in various positions by means of two screws. It has a vertical adjustment of 4 inches and may be set at an angle for jobs requiring such a setting. The same spindle is used for both internal and external grinding.

The motor is mounted on the opposite side of the angle-plate from the spindle by means of a hinge pin. This pin allows the motor to be swung either toward the front or back to facilitate the changing of belts or to tighten them. The motor is of the universal type for operation on either direct or alternating current of 60 cycles or less. Both the motor and grinding spindle are fitted with ball bearings. Among the standard equipment are included three pulleys which give spindle speeds of 30,000, 16,500, 9500, and 5500 revolutions per minute; one wheel 6- by ⅜- by ½-inch for external grinding, and one wheel 1- by ¼- by ¼-inch for internal grinding. Any size of wheel from an abrasive pencil to 6 inches in diameter can be used. The weight of the grinder is about 44 pounds.

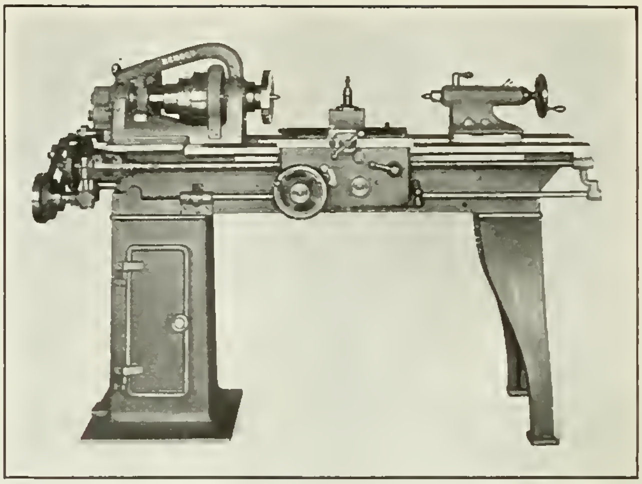


United States Electric Grinder attached to the Tool-rest of a Lathe

HENDEY PLAIN-GEARED ENGINE LATHE

For light manufacturing purposes and for use in technical and vocational institutions, the Hendey Machine Co., Torrington, Conn., has brought out the plain-geared 12-inch lathe here illustrated. The headstock, tailstock, carriage, apron, and lead-screw are of the Hendey standard design. The machine is driven from a two-speed countershaft. This countershaft and the headstock construction provide sixteen speeds for the spindle. Change-gears and a belt running over three-step cone pulleys at the headstock end of the bed supply the necessary number of feed changes for cutting threads from two to thirty-six per inch. The lead-screw is 1 inch in diameter and has six threads per inch.

A guard which encloses the feed belt and change-gears was removed from the machine at the time the photograph was taken. The starting, stopping, and reversing of feeds are controlled from the apron. The cross-feed screw is graduated to thousandths of an inch. The bed is regularly furnished in 4-, 5- and 6-foot lengths, but longer beds may be supplied. The cabinet leg has shelves and partitions for storage of the change-gears and other small parts. All attachments designed for the Hendey standard 12-inch lathe are applicable to this machine. Some of the principal dimensions are as follows: Diameter of hole through spindle, 15/16 inch; distance between centers, 27¼ inches; actual swing over bed, 12⅝ inches; and swing over carriage 7¼ inches.



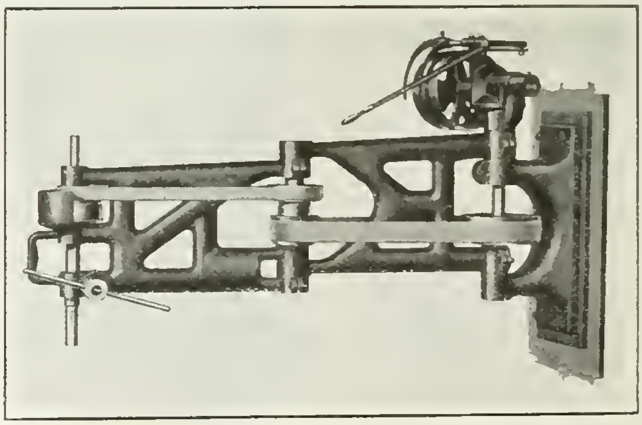
Hendey "Junior Model" 12-inch Engine Lathe

HAMMOND WALL OR POST BRACKET DRILL

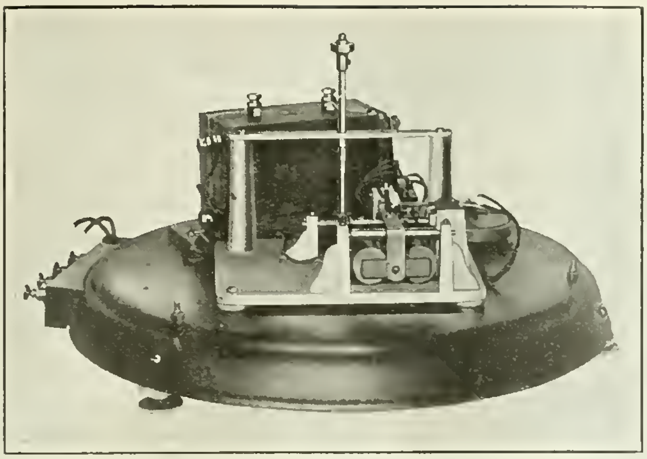
A bracket drill designed by the Hammond Mfg. Co., 6545 Carnegie Ave., Cleveland, Ohio, to be attached to a post or wall and used for light drilling operations on electrical parts or similar work is here illustrated. The equipment has a drilling radius of 42 inches. It is driven by means of a tight-and-loose pulley countershaft which transmits power through bevel gears to an upright shaft situated close to the base end of the bracket. This upright shaft, in turn, drives the spindle through pulleys and an intermediate shaft.

The countershaft yoke may be set in any position to suit an overhead drive, and is provided with a convenient belt shifter. By having the bracket arms swing on stationary sleeves, undue pressure on the driving shafts is eliminated. The spindle is equipped with a ball thrust bearing and a spring counterbalance. The quill of the spindle is made of steel and has bushed bearings and a rack cut from the solid.

Some of the principal specifications are as follows: Spindle traverse, 2½ inches; size of Morse taper hole in spindle, No. 2; drilling capacity in steel, ⅜ inch; speed of countershaft pulleys, 400 revolutions per minute; and spindle speeds, 500 and 1300 revolutions per minute.



Hammond Bracket Drill designed to be attached to a Post or Wall



Cleveland Electric Pyrometer for recording Temperatures up to 2500 Degrees F.

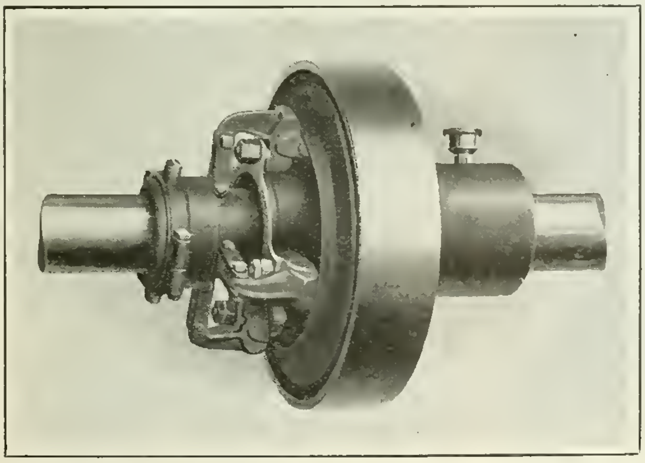
CLEVELAND ELECTRIC RECORDING PYROMETER

An electric pyrometer for recording temperatures from 0 to 2500 degrees F. in steel-treating furnaces, ceramic kilns, etc., is now being placed on the market by the Cleveland Instrument Co., 1988 E. 66th St., Cleveland, Ohio. This pyrometer is of a construction which permits any number to be operated by one master clock. The chart is 18 inches in diameter and scaled for either thermo-electric or resistance systems. The record is made by burning a small hole in the chart from the point of the galvanometer needle to the arc circle. The galvanometer is of the "Unipivot" suspension type in which the moving element or indicator is suspended by a phosphor-bronze member which is supported by one sapphire jewel and a steel pivot. The pivot supports only one-tenth of the weight of the moving element and thereby overcomes fragility. The relays are operated by 6-volt storage batteries.

WOOD'S IMPROVED FRICTION CLUTCH

An improved "Universal Giant" friction disk clutch manufactured by T. B. Wood's Sons Co., Chambersburg, Pa., has been especially designed to withstand severe shocks such as are produced in starting a machine, a battery of machines, or an entire plant. This clutch has a new type of fireproof friction lining which is called by the manufacturers "Non-burn." It is said that this lining has a considerably higher coefficient of friction than wood blocks and other materials previously used in the clutch and that the lining will not burn out.

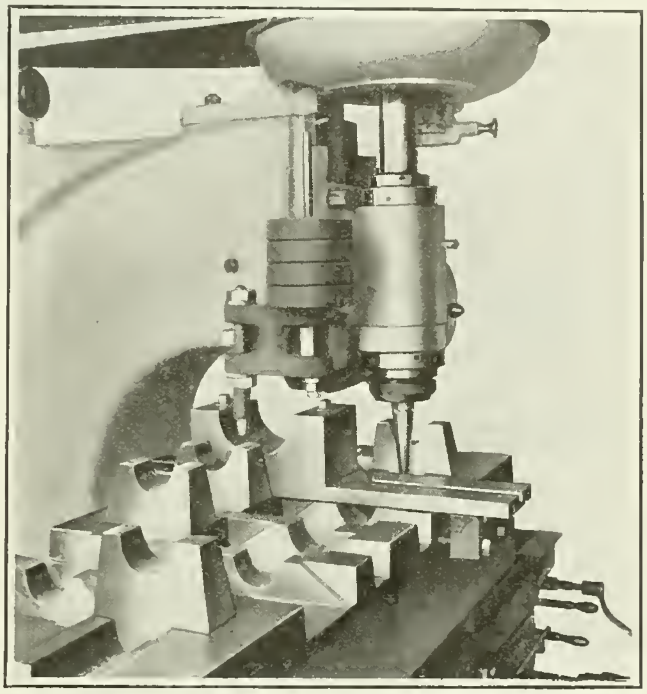
The clutch is of the floating disk type and may be furnished with one, two, or three disks. It is made in sizes having rated capacities of from 5½ to 480 horsepower at a speed of 100 revolutions per minute. This clutch is also still being made with wood blocks for installations in which the service does not require the improved type.



Wood's "Universal Giant" Friction Clutch which is provided with a Fireproof Lining

BECKER CHERRYING ATTACHMENT

Profiling in both the vertical and the horizontal plane on vertical milling machines built by the Becker Milling Machine Co., 677 Cambridge St., Worcester, Mass., has been made possible by means of a cherrying attachment lately developed by this concern. From the illustration it will be seen that a bracket provides for holding a vertical former-pin which can be adjusted up and down and locked in position by means of two nuts, the upper of which is graduated to thousandths of an inch. In an operation, this former-pin moves over a block having surfaces similar to those that are to be produced on the work. The cutter, of course, follows these movements. There are three holes in the bracket for the former-pin, which permits the positioning of the pin in line with the machine spindle or either 4 or 8 inches back of the spindle center. This allows more flexibility as to the location of the former-block.

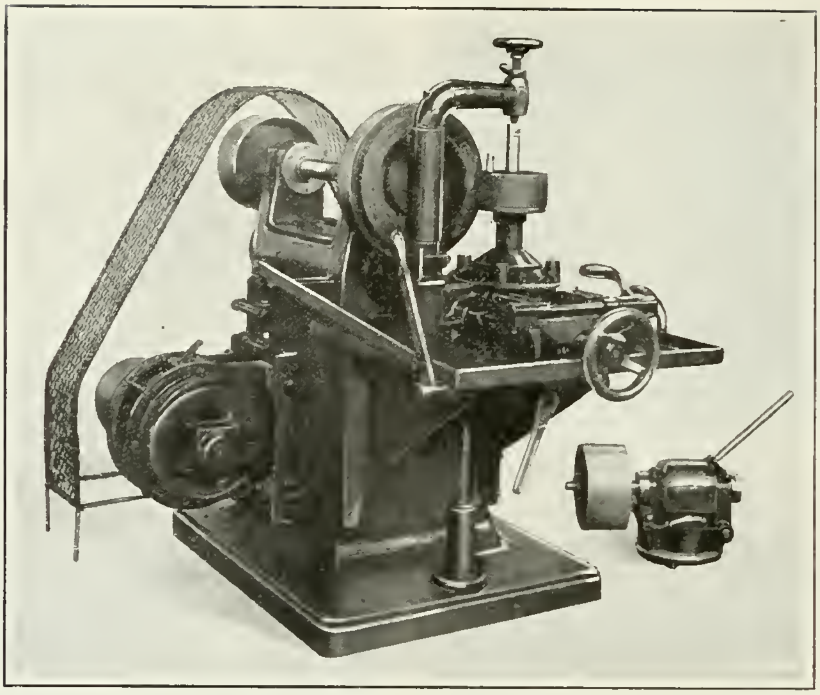


Attachment which adapts Becker Vertical Milling Machines for Profiling Operations

The former-block, as previously mentioned, is the same shape as the hole to be cherried, which in the majority of cases is semicircular. However, other shapes can be produced as, for example, an elliptical surface or an inclined surface having perhaps a fillet at one or both ends. The former blocks are designed to be attached to a plate and they may be moved lengthwise to any position on the plate and clamped by means of T-slots. The plate spans the work and is clamped to it on both sides, the clamping means being adjustable so that the plate may be clamped on blocks of various widths.

In order to illustrate the use of this attachment, it will be assumed that it is desired to cut a semicircular depression having blind ends. The operator first selects a two-lipped cutter with the same radius on the end as the allowable fillet at the blind end of the hole and having a taper corresponding to the customary draft on dies. The cutter is fastened in the machine spindle in the usual way, and a former-pin is selected with one end having the same size fillet as the cutter end. The pin is placed in one of the bracket holes and adjusted to the former-block, which has previously been clamped in position on the holding plate.

The machine is started, and with the former-block as a guide for the cutter, the operator starts at the top of one side of the former-block and by using the cross and vertical feeds, proceeds to the lowest point of the block. Then starting at the top of the other side of the block, he again proceeds to the lowest point, this time, of course, using the reverse cross feed. If it is necessary to take a second cut, the former-pin is adjusted vertically as many thousandths inch as required, and the cutting operation is repeated. Weights may be placed on the attachment to counterbalance the head. Patents are pending on the design of this attachment.



Diamond Grinding Machine for finishing Convex, Concave, and Flat Surfaces on Pulleys, Wheels, Rolls, etc.

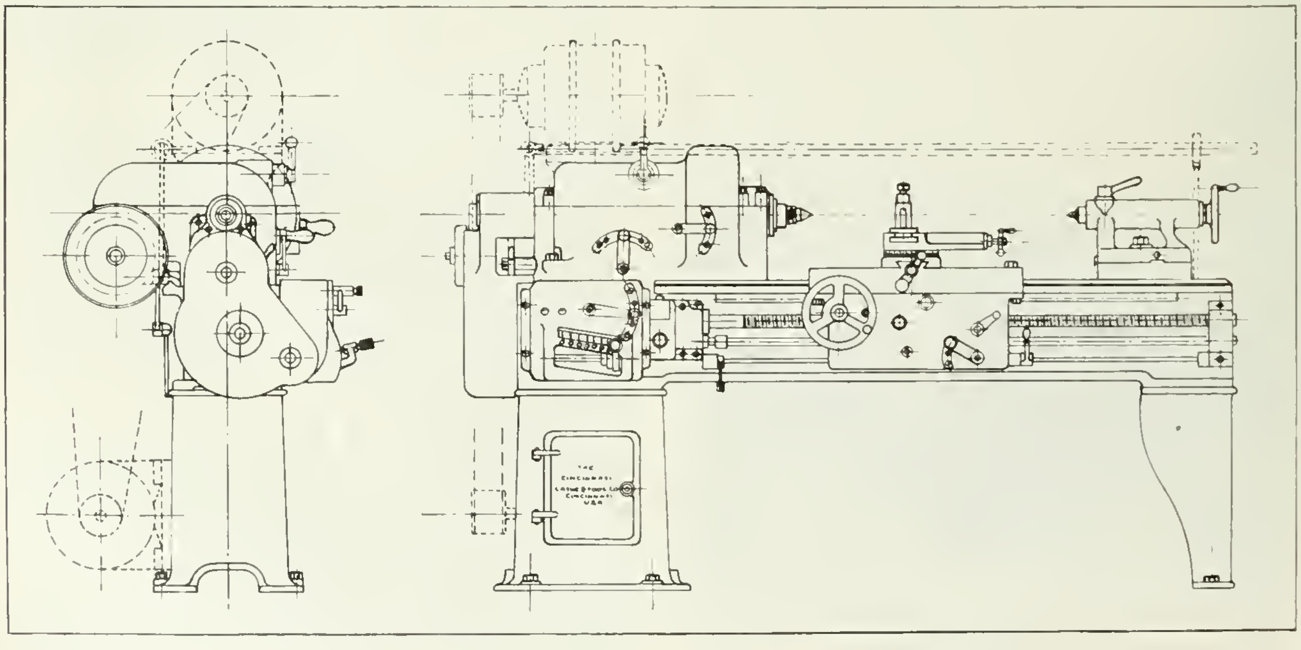
DIAMOND PULLEY-GRINDING MACHINE

Convex, concave, or flat surfaces can be quickly finished on such work as pulleys, wheels, and rollers by means of a grinding machine recently brought out by the Diamond Machine Co., 9 Codding St., Providence, R. I. The edges of the work can also be finished by the nse of the attachment shown to the right of the machine in the accompanying illustration. The principle upon which the design of the machine is based is the same as that employed in the Diamond pulley grinding fixture described in February, 1921, MACHINERY. The grinding is accomplished by rotating the pulley against the ring-wheel. If the pulley is brought against the inner edge of the wheel, the crown will have the same radius as the inside of the wheel, and if the pulley is rotated against the wheel face it will be ground flat. By bringing the pulley to the outer edge of the wheel, negative grinding or a concave face will result.

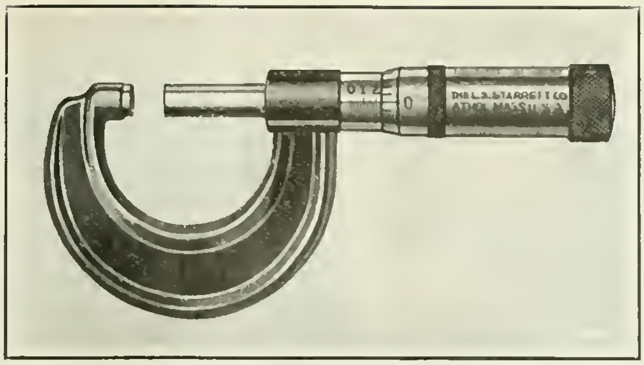
The grinding speed may be varied by changing back-gears. The spindle is equipped with ball bearings and runs at the rate of 1500 revolutions per minute. It is driven from the motor through a silent chain, the motor being of 10 horsepower capacity and running at 1800 revolutions per minute. The ring-wheel is 14 inches outside diameter and has a 1-inch face. The machine is equipped with three guards that adequately enclose the work during an operation, these guards having been removed at the time the photograph was taken. A vertical pump is supplied for wet grinding. The edge facing attachment can be put on the machine or removed in from two to three minutes. Its correct alignment with the machine is assured by dowels and large holding-down screws. The attachment weighs about 50 pounds. The machine has a capacity for work from 2 to 18 inches in diameter and 1 to 6 inches in face width. It weighs about 2000 pounds.

CINCINNATI GEARED-HEAD LATHES

A line of geared-head lathes made in sizes of from 16- to 30-inch swing and capable of developing a horsepower double that of other lathes of the same nominal size mannfactured by the Cincinnati Lathe & Tool Co., 3207-11 North St., Oakley, Cincinnati, Ohio, has been added to the line of machine



Cincinnati Geared-head Lathe which is built in Sizes of from 16 to 30 Inches Swing tools built by this concern. When the lathes are motor-driven, the motor is mounted either on the headstock or on the rear of the cabinet leg and connected to the machine by a chain or belt running over an idler pulley. When driven from a lineshaft through a single pulley, either a rod running along the top of the lathe as shown, or a handle on the front of the headstock, is furnished for starting and stopping. An apron control can also be supplied when desired.


Starrett One-inch Micrometer Caliper

These lathes are equipped with a power disk clutch and a brake having a neutral position in which the spindle is entirely disengaged from all gearing. This feature eliminates the flywheel effect of heavy gears on a spindle, and is a time-saver in centering irregular work in a chuck or in machining small parts in which the chucking time is a large factor. Twelve spindle speeds are quickly obtainable by manipulating the three handles on the front of the headstock. The 16-inch lathe has a spindle-speed range of from 13.5 to 400 revolutions per minute in geometrical progression. It is said that the spindle speeds can be changed throughout the entire range in twelve seconds.

U. S. WELDING AND HEATING TRANSFORMER

A transformer intended for use on welding and heating equipment subjected to extra hard service, and where a high power is necessary, is now being placed on the market in various sizes by the U. S. Electric Welder Co., 327-328 Permanent Bldg., Cleveland, Ohio. The illustration shows the transformer as manufactured for mounting vertically on a butt-welder. However, it is also made in a horizontal type for mounting on other types of equipment.

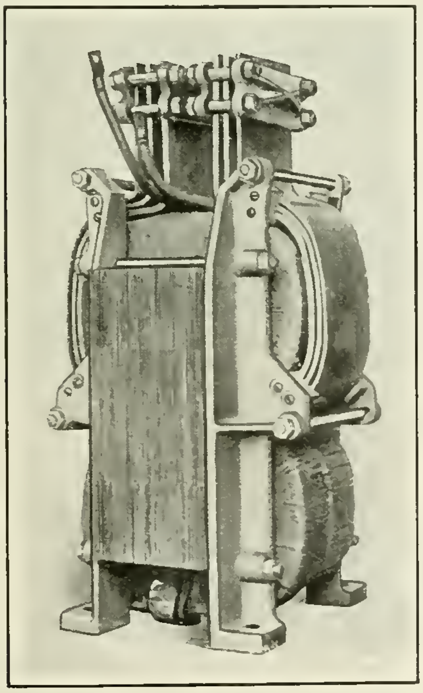
The support for the core and the primary and secondary coils is designed to prevent humming or shifting of these parts. The cooling surfaces in the primary and secondary coils are sufficiently large to insure that the temperature will be kept within safe limits during heavy overloads. It is stated that the temperature never rises above the room temperature more than 50 degrees C. The secondary coil is built up of heavy drawn copper bands which are securely insulated and supported. An internal automatic reactance prevents the current from reaching dangerous limits, eliminating breakdowns and increasing the welder's speed and power.

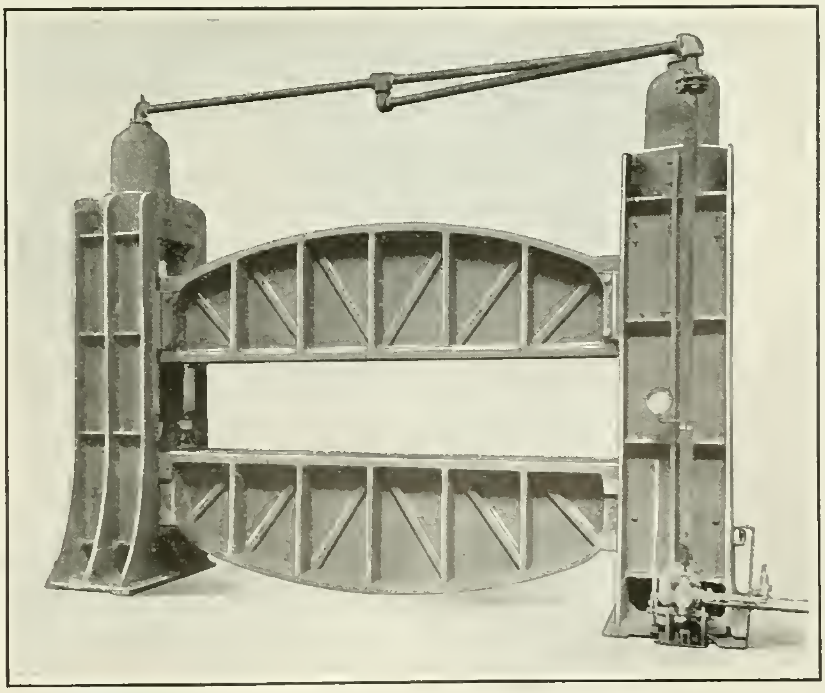
STARRETT ONE-INCH MICROMETER CALIPER

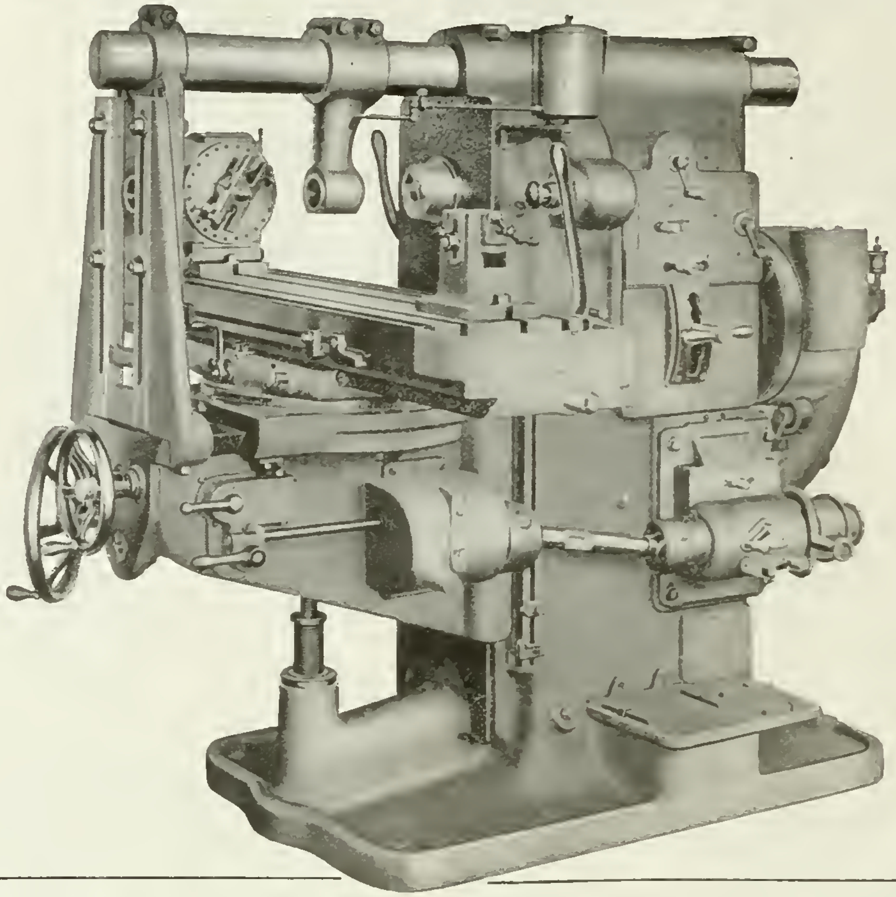
A No. 435 micrometer caliper which has just been added to the line of mechanics' tools manufactured by the L. S. Starrett Co., Athol, Mass., is shown in the accompanying illustration. This micrometer has a range of one inch. All its details have been proportioned to insure long life. The screw is 0.312 inch in diameter and the contact point 0.270 inch. The frame is a drop-forging and is coated with black enamel. Decimal equivalents are marked around the thimble.

HYDRAULIC FLANGING PRESS

A very large hydraulic press capable of exerting a pressure of 435 tons has been built by the Hydraulic Press Mfg. Co., 84-88 Lincoln Ave., Mount Gilead, Ohio, for flanging plates used in constructing Murphy car ends. This press will flange steel plates cold up to 5/16 inch thick by 10 feet long. It is equipped with two 20-inch rams, and two 5½-inch auxiliary cylinders are used for returning the platen after an operation. All movements of the press are controlled by a three-way poppet-type high-pressure valve which is operated by the manipulation of a single hand-lever. The cylinders, platens, housings, etc., are steel castings. The press has a stroke of 24 inches and a maximum distance between platens of 36 inches. The total weight is approximately 42 tons.


U. S. Electric Welding and Heating Transformer


Large Hydraulic Press for flanging Steel Plate Cold



BROWN & SHARPE
UNIVERSAL
MILLING MACHINES

Adaptable Machines for Accurate Work

When a new milling machine is added to the shop equipment, there is usually some definite job in view for it. It may be a lot of big, heavy castings, followed by another lot of the same kind. Or between jobs there may be a large fixture to mill.

Extremely accurate on large fixtures

As for fixtures—your toolmakers may have had difficulties with an occasional big fixture—heavy, bulky—demanding accurate work to close limits. The manner in which the larger Brown & Sharpe Universal Milling Machines handle such tasks reveals their essential strength and precision. They are accurate, handy, thoroughly capable machines.

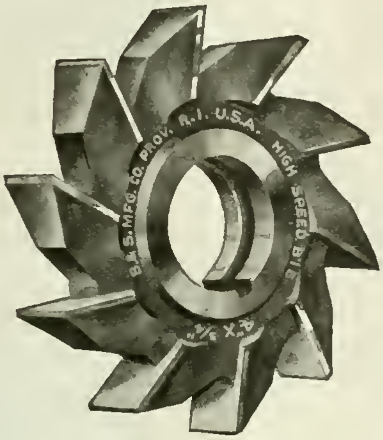
Always available for production work

If, when the fixture is finished, another production job is scheduled—there's the machine—put it to work. You'll find it has plenty of strength and stamina for all the work you can give it.

In our complete line is the machine for your work

Your problem may be quite different from the one outlined here. Whatever your problems are, send for our General Catalog listing our entire line, including six styles of milling machines covering a broad range of sizes. Become acquainted with the details and specifications of these machines. Ask for Catalog No. 137.

BROWN & SHARPE COARSE-TOOTH MILLING CUTTERS



The advantages of coarse-tooth cutters

Among the many types and styles of modern cutters, Brown & Sharpe Coarse-Tooth Milling Cutters possess advantages which deserve consideration.

Take heavy cuts at small power cost

Two distinct economies are secured by this coarse-tooth design. A larger amount of metal is removed per unit of time and the power consumed is less per unit of metal removed. Taking heavier cuts at reduced power cost means money saved on every job.

No vibration or chatter

This coarse-tooth construction enables every tooth to remove a proportionately large amount of material. These substantial cuts eliminate vibration and chatter, producing a surface noticeably free from chatter marks. Finishing a surface in a single deep cut is customary practice with coarse-tooth cutters.

The wide spaces between teeth allow the cutting edges to be well backed up. This added support gives each tooth a strength greater in proportion than the increase in work of which each tooth is capable. This means that although each tooth removes a larger chip there is still a surplus of strength to meet an emergency. These cutters take deep, rapid cuts without danger of failing.

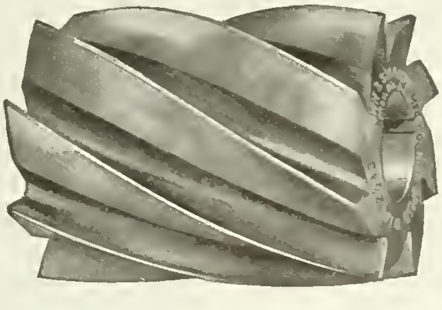
An effective angle of rake

An increased spiral angle

The angle of rake is sufficiently acute to give a sharp cutting edge without diminishing tooth strength. This rake gives the teeth a freer cutting action, which rids the cutter of any tendency to push or drag. The resulting decrease in friction leaves the teeth cooler—and a cool cutter does more work with fewer sharpenings. The increased spiral angle on wide cutters gives them a shearing action with portions of several teeth cutting at the same time. Freedom from chatter and "banging" of the teeth is the result. The cutting action becomes continuous.

Proved reliability

With these features in mind, consider the milling jobs where you can use Coarse-Tooth Cutters to advantage. They will increase production and lower operating costs. Insist on the name BROWN & SHARPE. It is a guarantee of cutter quality.



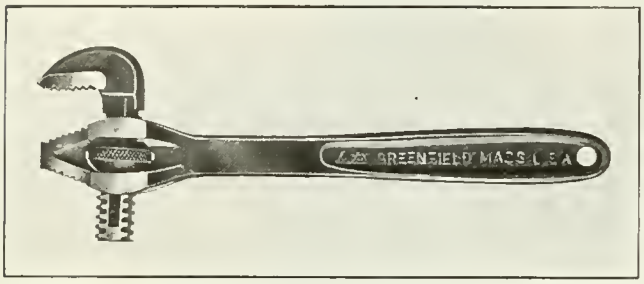
Send for Catalog No. 28 describing our cutters

BROWN & SHARPE MFG. CO.

Providence, R. I., U. S. A.

GREENFIELD PIPE WRENCH

A pipe wrench of simple construction, having the end opening common to machinists' wrenches, has recently been placed on the market by the Greenfield Tap & Die Corporation, Greenfield, Mass., under the trade name of "Little Giant." This wrench consists of three parts, a combined handle and jaw, a movable jaw, and a steel adjusting nut.



Greenfield "Little Giant" Pipe Wrench the Design of which permits its Use in Close Quarters

The combined handle and jaw and the movable jaw are drop-forgings, and all three parts are heat-treated.

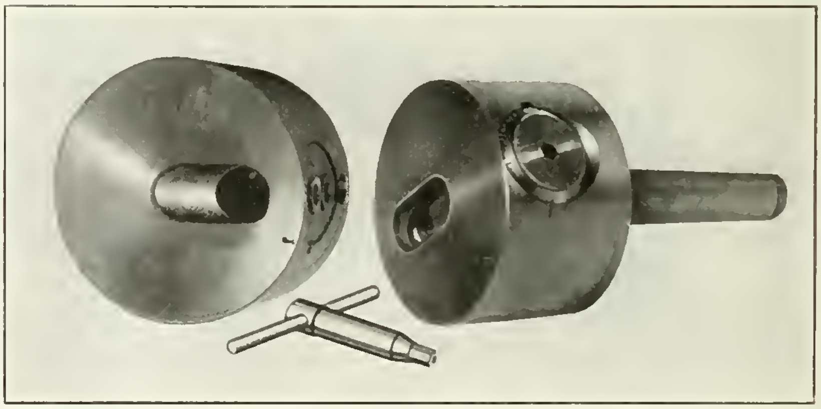
Both the main and the movable jaws have teeth which grip the pipe. The main jaw has teeth on both sides, and the movable jaw can be reversed so that it is possible to grip work between it and either of the sets of teeth on the main jaw. This design considerably lengthens the life of the wrench. On the larger sizes, the main jaw is provided with two additional sets of teeth on the part where it joins the handle.

The wrench is manufactured in 8-, 10-, 14-, 18- and 24-inch sizes. It is claimed that the 14-inch wrench has repeatedly stood stresses in excess of 4700 inch-pounds without slipping or bending. The Army and Navy specifications for a wrench of this size only require that it withstand a stress of 2800 inch-pounds.

EDLUND ADJUSTABLE BORING HEAD

An adjustable boring head designed for both tool-room and manufacturing purposes has been placed on the market by the Edlund Machinery Co., Inc., Box 57, Cortland, N. Y. The body of the head carries a round plunger into which the boring-bar is secured. The position of the boring-bar relative to the axis of the head is adjusted by means of a feed-screw. A stiff spring provides for taking up any wear of the feed-screw and thus eliminates backlash. The feed-screw is fitted with a dial which is movable relative to the screw, so that it is always possible to start turning the screw with the dial positioned with its zero gradnation opposite the scribed line of the head. A long taper key locks the plunger in position. The head is simple in construction and all moving parts are hardened and ground.

This tool is being manufactured in four sizes; the No. 0 size takes a ¼-inch boring-bar, may be offset ¼ inch from the center, and will bore holes from ¼ to ¾ inch diameter; the No. 1 size takes a ½-inch boring-bar, may be offset ½ inch from the center, and bores holes from ½ to 1½ inches in diameter; the No. 2 size takes a ¾-inch boring-bar, may be offset ⅝ inch from the center, and bores holes from ¾ to 2 inches in diameter; and the largest size (the No. 3) takes a 1¼-inch boring-bar, may be offset 1¼ inches from the center, and will bore holes from 1¼ to 3¾ inches in diameter.



Edlund Adjustable Boring Head made in a Number of Sizes for Tool-room and Manufacturing Use

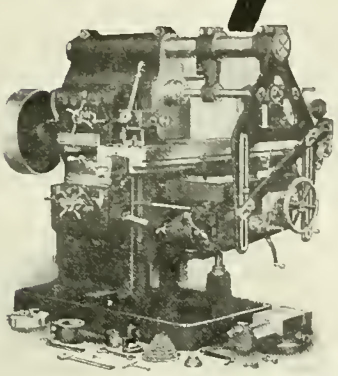
NEW MACHINERY AND TOOLS NOTES

Profiling and Milling Machine: Robbins Machine Co., 42 Lagrange St., Worcester, Mass. A vertical-spindle profiling and milling machine which differs considerably from customary design. The cross-feed screw is operated through helical gears from a handwheel in the same plane as the traverse handle. This design enables the operator to feed the table both crosswise and lengthwise simultaneously. The lengthwise traverse of the table is 12 inches, and the cross movement 7 inches. The knee may be moved 6 inches vertically, and the spindle 2¾ inches.

Welding Machine: General Welding & Equipment Co., 74 Brookline Ave., Boston, Mass. An automatic welding machine on which the torch is mounted at one end of a connecting-rod that receives motion through a crankpin at the other end. The welding rod passes through the center of the torch and is fed by gravity. The torch will travel in an egg-shaped path of which the proportions may be changed, and, in addition, the entire machine may receive motion at right angles to the mean of the motion imparted to the connecting-rod. An additional torch which precedes the welding torch and preheats the metal, is supplied for heavy welds.

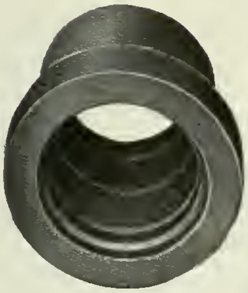
Electric Nut-, Screw-, and Stud-setter: Elecdrive Mfg. Co., Inc., Drawer 34, Syracuse, N. Y. An electric tool for setting nuts, cap-screws, wood-screws, and studs. The spindle of the tool can be driven in both clockwise and counter-clockwise directions to permit it to be used for screwing left-hand nuts and unscrewing right-hand ones. It is manufactured in both portable and stationary types. The portable tool resembles an electric drill and operates from an electric light socket supplying either direct or alternating current. The stationary type is intended for connection to a power line. A special feature provides for the slow setting of nuts or screws, obviating the stripping of threads, straining of bolts or injury to the tool. Nuts may be picked up from the bench with the tool running at full speed.

Polishing and Buffing Lathes: Mitchell Engineering Co., Springfield, Ohio. A line of polishing and buffing lathes of which the No. 5 has two independent spindles. With this construction the stopping of one spindle for changing wheels or for other causes does not interfere with the operation of the second spindle. Either or both spindles may be removed with their bearings by releasing clamps and may be readily replaced without disturbing the alignment. The No. 5 machine may be driven by a motor mounted in the base connected to the spindles by belt. The No. 6 machine has a single spindle arranged for carrying a wheel on each end. The distance between the wheels on the No. 5 machine is 57 inches, and the diameter of the flanges is 4 inches. The approximate weight of the machine is 950 pounds.

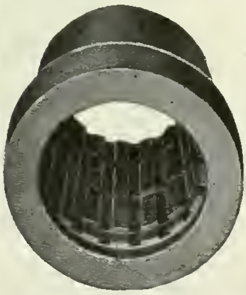


Good design in a vital spot—

—The main spindle bearing of the Cincinnati Milling Machine



The box machined, inside and out, with three circumferential dovetail grooves, on the inside.

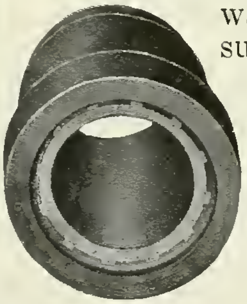


Showing the axial dovetail grooves.

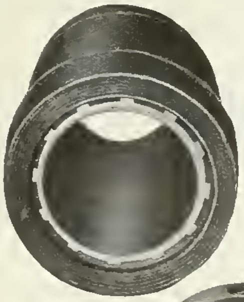
The main spindle bearing is the very heart of the miller. We recognized this when we developed our special design many years ago.

Because of its proved excellence we are using it today.

It consists of a cast iron box with a special composition lining, composed of 90% tin and no lead. But its value is not entirely in this unusual material. The way we make it has much to do with its success.



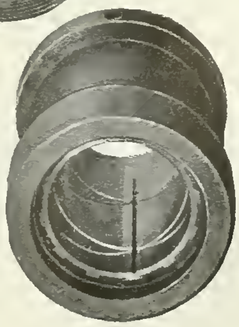
The bearing metal cast in place



The bearing metal thoroughly compressed and forced into the grooves, rendering it dense and homogeneous. It becomes an integral part of the cast iron box and will not work loose.

This bearing has proved so very satisfactory that we believe it to be unsurpassed.

We submit it as another example of Cincinnati Miller excellence.



The finished bearing. It is bored, accurately reamed, oil grooved and then ground on the outside concentric with the bearing.

Ask for our New Book, "Tool Room Methods"

Cincinnati Milling Machine Co.

Cincinnati, Ohio

TENDENCIES IN GRINDING MACHINE DESIGN

Machine tool design constantly tends toward the elimination of overhead driving belts. In grinding machines, especially, recourse has been made to several methods of power transmission for driving the headstock spindle. Among these methods are included a drum supported by pedestals, and arrangements of gears and shafts. In some designs a constant-speed motor is mounted on the headstock, and the spindle is driven either through cones and clutches or trains of gears.

What appears to be the ideal plan for driving the headstock spindle is to embody a variable-speed motor in the headstock casting. A headstock of such a design is now in the experimental stage at the works of the Norton Co., Worcester, Mass. The photographs here reproduced were taken from drawings of a 14-inch headstock in which is placed a 2-horsepower variable-speed direct-current motor. The motor speed variation is 3 to 1. In the event that this drive proves particularly satisfactory, it will probably be used by builders of grinding machines in general.

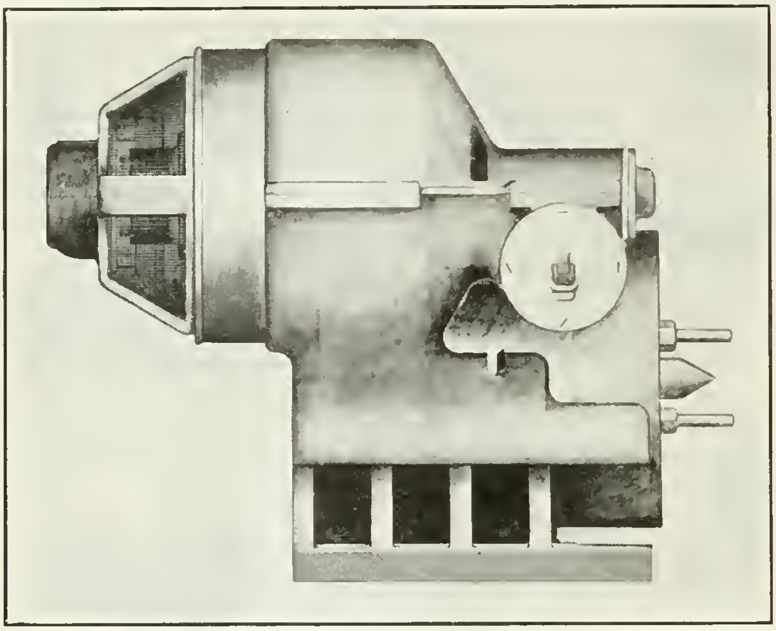


Fig. 1. Headstock Design for Grinding Machines in which a Variable-speed Motor is embodied in the Headstock Casting

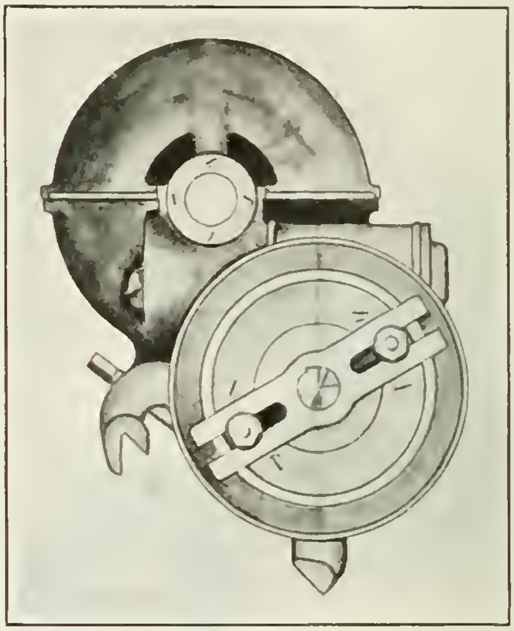


Fig. 2. End View of the Grinding Machine Headstock illustrated in Fig. 1

* * *

NEW APPLICATION OF OXY-ACETYLENE CUTTING

A machine which has created considerable interest during its development in England is the Godfrey oxy-acetylene cutting machine. In its present state it is a very efficient machine, working with an oxy-acetylene cutting blow-pipe in place of an edge tool. All cutting movements and the supply of oxygen in the correct proportions to suit the rate of feed are automatically controlled. In the latest model the oxygen is preheated prior to its passage through the blow-pipe, and this not only provides much cleaner cuts, but also speeds up the rate at which the blow-pipe can be fed. It is now possible to cut through ¾-inch mild steel plate at 17 inches per minute. One of the uses to which this machine is being put is the cutting of locomotive motion links. Links have been cut for the Midland Railway, 2½ inches thick, with a total length of cut of 80 inches. The time taken was 14 minutes, 23 seconds, giving an average cutting speed of 5.55 inches per minute. The oxygen consumed was 38 cubic feet. The finish of the cut surface is said to be remarkable for its regularity; in fact, only on the running surface is it necessary to apply any other finishing operation.

PERSONALS

A. M. Lindsley, chief engineer of the Alvord Reamer & Tool Co., Millersburg, Pa., has been placed in charge of the advertising department of that company. He will continue his duties as chief engineer, coordinating the work of the two departments. Previous to his association with the Alvord Reamer & Tool Co., Mr. Lindsley was connected with the Cincinnati Milling Machine Co., Cincinnati.

William H. Lolley, special representative for the Standard Parts Co., Cleveland, Ohio, sailed for Europe, August 1. Mr. Lolley will negotiate with German and French interests for the manufacture and sale of Bock taper roller bearings on the Continent. He will also visit the British Bock Bearings, Ltd., which was organized last year for the manufacture and sale of Bock bearings in the British Isles and possessions.

A. T. Doud, Philadelphia, Pa., has acquired the Precision & Thread Grinder Mfg. Co., located at 1 S. 21st St., Philadelphia. Mr. Doud is a graduate in mechanical engineering of Purdue University. He was formerly mechanical engineer for the Hale & Kilburn Co., of Philadelphia; general superintendent of the Speakman Co., Wilmington, Del., and works manager of the Diehl Mfg. Co., Elizabeth, N. J. During the war he was general manager of the Hero Mfg. Co., Philadelphia. Since the war he has been manager of manufacturing for the American Tube & Stamping Co., Bridgeport, Conn.

Henry Harnischfeger, president of the Pawling & Harnischfeger Co., Milwaukee, Wis., recently returned from a six months' tour around the world, during which he visited Japan, China, the Philippine Islands, India, and several of the European countries. The object of the trip was to investigate the business conditions and trade possibilities in the Far East, particularly in Japan, China, and India, where the Pawling & Harnischfeger Co. has branches. Mr. Harnischfeger was much impressed by the possibilities in the Far East, and believes that there is a good market there for labor-saving machinery of all kinds.

* * *

The production of automobiles reached the highest peak in the history of the industry in June, when 261,963 passenger cars were completed in addition to 25,912 trucks. It is not expected that the production rate for the month of June will continue for the remainder of the year. Should it do so, it would mean a production of over 2,500,000 cars for 1922, which is, without doubt, a much higher figure than may be expected. If the production reaches 2,000,000 passenger cars for the year, and 250,000 trucks, the automobile industry will have to consider that it has had a very active year.

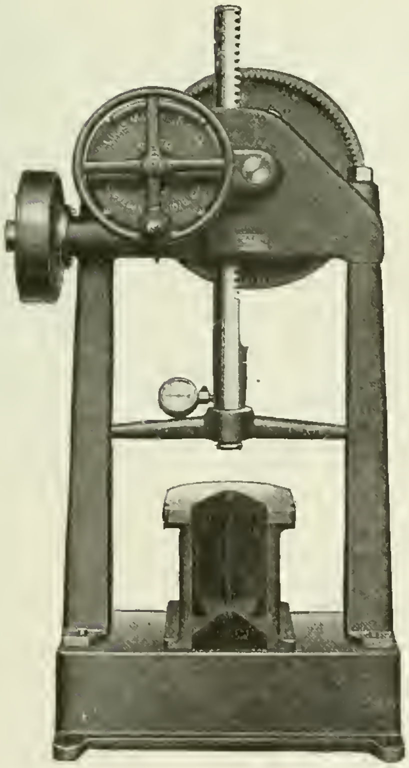
Take Us Into Your Confidence!

We frequently run across some peculiar job that can be done on the

LUCAS
Power Forcing Press

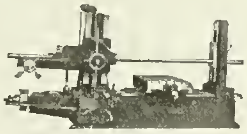
better than on any other machine.

If you have any jobs requiring pressure
Let us look them over, maybe we can help.



Illustrated Circular
Tells the Whole Story

WE ALSO MAKE THE
"PRECISION"



BORING, DRILLING AND MILLING MACHINE

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

TRADE NOTES

Associated Engineers, Inc., Milwaukee, Wis., announces that the organization has removed to larger quarters at 373 Broadway, Milwaukee.

Herberts Machinery & Supply Co., Los Angeles, Cal., has recently taken over the exclusive selling rights of the machines built by the Gisholt Machine Co., Madison, Wis., for the states of Arizona, California, and Nevada.

Scheid Engineering Corporation, 90 West St., New York City, has been appointed metropolitan and export representative for the Franklin Moore Co., Winsted, Conn., manufacturer of material handling machinery for industrial plants.

National Tool Co., Cleveland, Ohio, has taken over the "Save-All" chuck business formerly conducted by J. C. Dufresne, Waltham, Mass. Mr. Dufresne will remain with the National Tool Co. as manager of the "Save-All" chuck business.

Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago, Ill., announces that the company's New York office for Stewart industrial furnaces has been removed from 350 Broadway to 16 Reade St. The office, as before, is in charge of J. W. Lazear.

Van Dresser Bros., 1157 Concord Ave., Detroit, Mich., manufacturers of cylinder reboring equipment, announce that the sales and distribution of Van Dresser cylinder reboring tools will in the future be handled directly by Van Dresser Bros. at their Detroit address.

Wisconsin Electric Co., 2551 16th St., Racine, Wis., manufacturer of "Dumore" electrical tools and appliances, has appointed E. S. McGonegal resident sales representative in the metropolitan New York and northern New Jersey districts, with offices at 27 Warren St., New York City.

Milwaukee Machinery Co., Milwaukee, Wis., has moved from 124 Second St. to new quarters at 93 W. Water St. The new location will be used for offices as well as for a display room, and machine tools, electrical equipment and woodworking machinery will constantly be on exhibition.

Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., has appointed Samuel W. Hay's Sons, 1410 Keenan Bldg., Pittsburg, Pa., exclusive representatives of the company for the sale of Diamant standard punch and die sets in the territory covered by the counties of Allegheny, Westmoreland, Washington, Armstrong, Indiana, Cambria, Somerset, Fayette, and Beaver in the state of Pennsylvania.

Mitchell Engineering Co., Springfield, Ohio, announces that it has recently been incorporated for the manufacture of a line of polishing and buffing lathes. The products are the design of R. C. Mitchell, who for a number of years was designer and factory manager for the Webster & Perks Tool Co. of the same city. P. A. Schaefer, vice-president and general manager of the new company, was formerly in charge of sales and advertising for the Webster & Perks Tool Co.

Air Reduction Sales Co., 342 Madison Ave., New York City, announces that the company has under way a program of plant expansion of considerable magnitude. Sites have been purchased for an Airco acetylene plant at Birmingham, Ala.; an oxygen plant at Milwaukee, Wis.; and an acetylene plant and a calorene plant at Pittsburg, Pa. Construction of the plant at Birmingham has already begun, and plans are well under way for the erection of the plants at Milwaukee and Pittsburg. In addition to these new plant installations, the company's facilities for producing oxygen from the air will be enlarged in Buffalo and Minneapolis. The estimated cost of the proposed additions is over half a million dollars.

Valabhdas Runchordas & Co., 70 Apollo St., Bombay, India, announce that they are in the market for lathes, milling machines, shapers, drilling machines and other machine tools for small machine shops. They are also in the market for electric motors from 1 to 10 horsepower for machine tool and woodworking machinery drives. In addition, they are interested in machinery for manufacturing phonograph horns at a production rate of about 500 a month, together with machinery for spraying or painting such horns as well as machinery for sheet-metal toys, with machinery for painting or spraying. They are also in the market for machinery for making phonograph needles and sewing needles, and for making sheet-metal boxes for phonograph needles.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., has been acquired by A. T. Doud of Philadelphia, who will act as president and treasurer of the company. F. V. Doud is secretary, and C. A. White, secretary of the Leeds & Northrup Co., will serve with the officers mentioned on the board of directors. F. Rodger Imhoff, former sales manager of the company, will be associated with the new organization as consulting engineer. The company will continue to manufacture its multi-graduated precision grinder; its thread lead variator for obtaining precision lead from the ordinary lathe lead-screw; its gage-block for testing lead-screws and for setting and testing the lead variator; and its permanent alignment wheel truing head for use on precision grinders, which is also applicable as a truing device on any grinding machine where it is necessary to shape the wheel face.

* * *

OBITUARIES

FRANK BURR SMITH

Frank Burr Smith, works manager of the Bullard Machine Tool Co., Bridgeport, Conn., died August 16, at Grace Hospital, New Haven, Conn., from an acute attack of appendicitis. Mr. Smith was fifty years old. He was born at Mohican Springs Farm, Fairfield, Conn., in 1872, and obtained his early education in the public and high schools of Bridgeport. In 1890, he entered the employ of the Bullard Machine Tool Co. at their old Broad Street plant as a machinist apprentice. Upon the completion of his apprenticeship he was connected with the engineering department, but he soon had to go to Colorado on account of bronchial trouble. Upon his return to the East he was connected with a number of firms including the Atlantic Iron Works of Boston and the Laird Gold Production Co., with whom he served as mechanical engineer. In 1903 he entered the employ of the De LaVergne Machine Co. as erection and installation engineer.

In 1911 he returned to the Bullard Machine Tool Co. and represented this company in a sales capacity in Chicago, Cleveland, and Philadelphia. The last year of his sales work he spent in England, but returned in 1915 to Bridgeport and became manager of the employment and industrial relations department at the Broad Street plant of the Bullard Machine Tool Co. His efforts in this capacity were largely responsible for the harmony that prevailed in the Bullard organization during the entire period of intense activity following 1915. When all manufacturing of the Bullard company was transferred in 1920 to the new plant at Black Rock, Mr. Smith was made works manager and continued in this capacity until his death. He is survived by his wife and a brother, Hubert C. Smith, of Milford, Conn.

COLEMAN SELLERS, JR.

Coleman Sellers, Jr., president of William Sellers & Co., Inc., Philadelphia, Pa., died August 15, after an illness of several months, at the age of seventy. Mr. Sellers graduated from the University of Pennsylvania, and in 1873 began work with the Sellers firm. After serving an apprenticeship in the shops of this company for several years, he entered the drafting-room, of which he soon became the head. He was appointed assistant manager in 1887, becoming at the same time a director. In 1902 he was made engineer of the company, and in 1905 president, an office which he held continuously until his death.

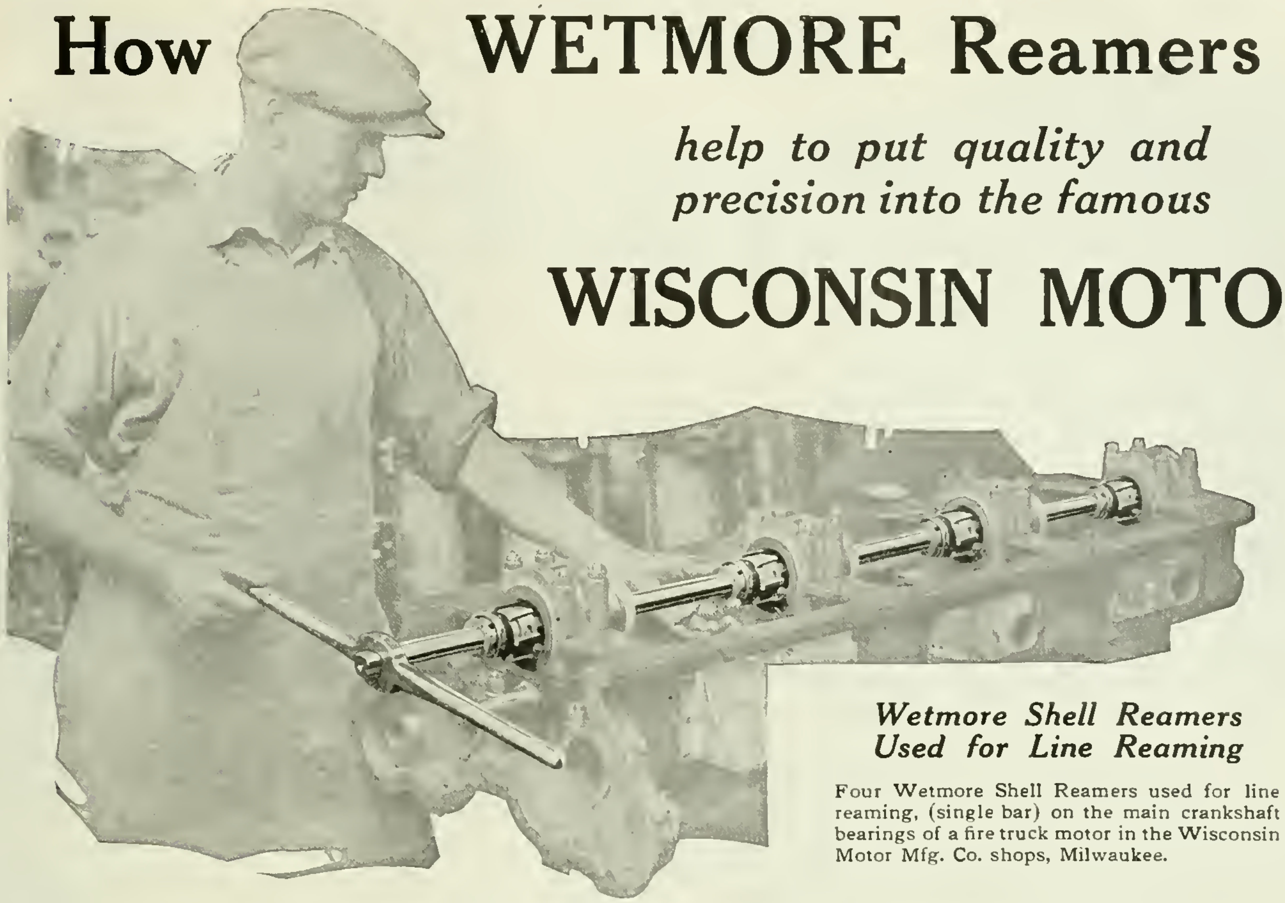
Mr. Sellers came from a family that in four preceding generations had given many evidences of unusual mechanical and engineering ability. His father, Coleman Sellers, was well known as one of the most brilliant mechanical engineers of his time. Mr. Sellers, like his father, had many interests besides those in mechanical and engineering lines —scientific, literary and educational, and was active in the civic life of Philadelphia. He played an important part in the affairs of the Franklin Institute, and was vice-president of the institute at the time of his death. In 1907 he was appointed a member of the Board of Commissioners of Navigation of Pennsylvania. He took special interest in the work of the American Philosophical Society, the American Society of Mechanical Engineers, the American Society of Naval Architects and Marine Engineers, and the Engineers Club of Philadelphia, of which he was one of the founders. He was president of the Philadelphia Chamber of Commerce from 1909 to 1913. He also served as chairman of the local Draft Board during the early stages of the war, and devoted so much time and energy to this work that it is believed that it seriously impaired his health and contributed not a little to his subsequent illness.

Mr. Sellers was known as a kind and considerate man, and as one had an especial sympathy for the young men of his profession—those just stepping upon the lower rounds of the ladder which he had so successfully climbed.

How WETMORE Reamers

help to put quality and precision into the famous

WISCONSIN MOTOR



Wetmore Shell Reamers Used for Line Reaming

Four Wetmore Shell Reamers used for line reaming, (single bar) on the main crankshaft bearings of a fire truck motor in the Wisconsin Motor Mfg. Co. shops, Milwaukee.

AFTER severe tests, in competition with other reamers, production officials of the Wisconsin Motor Mfg. Co., unhesitatingly endorse Wetmore Expanding Reamers. Not only do they excel in *durability*, but they insure greater *accuracy* and speed—guaranteed, straight round holes—than have been obtained by reamers costing almost twice as much.

You, too, will find that Wetmore Reamers give greater precision, longer life and lower reaming costs. Here are some of the features that are making Wetmore Reamers standard equipment in hundreds of America's largest and best shops:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering, and scoring of the reamer while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

Let us send you a complimentary copy of our 1922 Handbook—a valuable reference book on precision tools. Write for it on your business letterhead. Sent free, postpaid.

Wetmore Reamer Company

60-64 27th Street Milwaukee, Wis.

Manufacturers of Expanding Reamers and Cylinder Reaming Sets, Arbors, Blades, and Thread Gages.

REPRESENTATIVES:

Mr. W. R. Wyatt,
50 Church Street,
New York, N. Y.

Devlin Supply Co.,
2220-22 Chestnut St.,
Philadelphia, Pa.

Mr. E. E. Ehrenfeld,
444 Little Building,
Boston, Mass.

Wyman-Taylor-Ward Co.,
403 Real Estate Exch. Bldg.,
Detroit, Mich.

Doermann-Roehrer Co.,
318 East Third St.,
Cincinnati, Ohio.

James T. Winterling Co.,
209 Alpine Ave.,
Pittsburgh, Pa.

Kemp Machinery Co.,
215 N. Calvert Street,
Baltimore, Md.

The W. Bingham Co.,
Cleveland, Ohio.

Sword Bros. Co.,
625-629 Seventh St.,
Rockford, Ill.

The E. A. Kinsey Co.,
Indianapolis, Ind.

The R. C. Neal Co.,
76 Pearl St.,
Buffalo, N. Y.

Western Iron Stores Co.,
Milwaukee, Wis.

R. H. Jones Co.,
Minneapolis, Minn.

A. E. Chadwick Co.,
549 W. Washington Blvd.,
Chicago, Ill.

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

COMING EVENTS

September 4-9—Annual meeting of the American Chemical Society at Pittsburg, Pa. Further information may be obtained from R. S. Clark, office of the secretary, Carnegie Institute of Technology, Pittsburg, Pa.

September 11-15—Sixteenth annual convention and fourth annual exhibition of the Association of Iron and Steel Electrical Engineers at Cleveland Public Hall, Cleveland, Ohio. John F. Kelly, secretary, Empire Bldg., Pittsburg, Pa.

September 11-16—Eighth national exposition of chemical industries in the Grand Central Palace, New York City. Managers, Charles F. Roth and Fred W. Payne, Grand Central Palace, 46th St. and Lexington Ave., New York City.

September 21-23—Second annual machine tool exhibition in the Mason Laboratory, New Haven, Conn., under the joint auspices of the New Haven branch of the American Society of Mechanical Engineers and the Department of Mechanical Engineering, Yale University. H. R. Westcott, Westcott & Mapes, Inc., 207 Orange St., New Haven, Conn., is chairman of the exhibition committee.

October 2-7—Annual convention and exposition of the American Society for Steel Treating in Detroit, Mich., General Motors Bldg. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

October 25-27—Third annual meeting of the American Trade Association Executives at the Inn, Buckhill Falls, Pa.

October 26-27—Automotive production meeting of the Society of Automotive Engineers to be held in Detroit. Further information may be obtained from the Society of Automotive Engineers, 29 W. 39th St., New York City.

December 4-7—Annual convention of the American Society of Mechanical Engineers, in the Engineering Societies Bldg., 29 W. 39th St., New York City. Calvin W. Rice, secretary.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St., and Lexington Ave., New York City.

March 18-24, 1923—Second general meeting of the International Chamber of Commerce in Rome, Italy. Lacey C. Zapf, secretary American Section, Mills Bldg., Washington, D. C.

NEW BOOKS AND PAMPHLETS

Radiators for Aircraft Engines. By S. R. Parsons and D. R. Harper 3rd. Technologic Paper No. 211 of the Bureau of Standards. 82 pages, 7 by 10 inches. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 50 cents.

Thermal Expansion of a Few Steels. By Wilmer Souder and Peter Hidnert. Scientific Paper No. 433 of the Bureau of Standards, Washington, D. C. 16 pages, 7 by 10 inches. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents.

Construction of New Type Transatlantic Receiving Sets. By M. B. Sleeper. 113 pages, 5¼ by 7¾ inches; 47 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, 75 cents.

This book contains complete information, with special drawings and photographs, on the building and use of transatlantic receiving sets. The use of the loud-speaking telephone receiver is also described. The recent recommendations of the National Board of Fire Underwriters are included.

Scientific Selling and Advertising. By Arthur Dunn. 159 pages, 6 by 9 inches. Published by Harper & Bros., 333 Pearl St., New York City. Price, $3.

In this book the author describes a system of selling and advertising which has been used by him for twenty years in selling and advertising a variety of products. The book contains twenty-six chapters, the headings of some of which indicate the ground covered: The Salesman's Relation to Modern Industry; Special Characteristics of Salesmen; Responsibility of Salesmen; Essentials in Advertising; Things Necessary for Success in Selling and Advertising—Interest in your Customers, Knowledge, Faith, Self-confidence, and Method of Presentation; Better Distribution; and Application of System to Selling Different Commodities.

Factory Storekeeping. By Henry H. Farquhar. 182 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $2.50

This book outlines the principles and methods by which one of the problems of industrial management—the handling and storage of materials—may be standardized and controlled. It is a manual for those who are in any way concerned with the purchasing, storage, and disbursement of materials in a factory. The author, who is assistant professor of industrial management at the Harvard Graduate School of Business Administration, has given a great deal of study to the subject dealt with, and covers in the ten chapters of the book the various factors involved in the storing of materials—personnel; organization; balance sheets; purchasing department; traffic, receiving and inspection departments; store-room layouts; classification of materials; and accounting, inventories, and statistics.

Modern Plumbing Illustrated. By R. M. Starbuck. 407 pages, 10 by 7½ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $5.

This fourth revised and enlarged edition forms a comprehensive work, illustrating and describing the drainage and ventilation of private dwellings, apartments, and public buildings. The latest approved methods in all branches of sanitary installation are given. The book contains seventy entirely new full-page illustrations each accompanied by several pages of descriptive matter, which form a concise treatment of each phase of the work under discussion, giving notes and practical suggestions, sizes of pipe, proper measurements for setting up work, etc. Suggestions on estimating plumbing construction are also included. The book is intended for master plumbers, architects, builders, plumbing inspectors, boards of health, boards of plumbing examiners, and for the property owner, as well as for the workman and apprentice.

Machine Tool Operation. By Henry D. Burghardt. 438 pages, 7½ by 4¾ inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $2.75.

This volume is Part II of Machine Tool Operation. Part I was published in 1919. The purpose of this book is to assist those who desire a knowledge of the principles and elementary operations of machine work. The aim has been to adapt the text to use in vocational, industrial, technical, and trade schools. Part I deals with the lathe work, bench work, and work at the forge. Part II deals with the fundamental principles of construction and operation of the drilling machine, shaper, planer, milling machine, and grinding machine. A final chapter embodying what every machinist should know concerning spur gears and bevel gears is included. The section on drilling machines covers drill press construction, drills and drilling, drill press tools and operations; the part on the shaper covers shaper construction and shaper work; the section on the planer covers planer construction and planer work; the milling machine section deals with milling machine construction, cutters and their holding devices, speed, feed, and chip, typical milling set-ups and elementary operations, the index-head and indexing operations, and spiral milling; the grinding machine section covers grinding machine construction, grinding wheels, principles and practice.

NEW CATALOGUES AND CIRCULARS

Herberts Machinery & Supply Co., Los Angeles and San Francisco, Cal. Monthly publication entitled "Herberts Machinery Topics."

B. F. Sturtevant Co., Hyde Park District, Boston, Mass. Folder entitled "Cinderless Cities and Why," describing an induced draft fan which also acts as a cinder separator.

James Clark, Jr., Electric Co., Inc., Louisville, Ky. Folder illustrating and pointing out the advantages of the Clark automatic drill—a portable electric drill embodying many new features.

Armstrong Cork & Insulation Co., Pittsburg, Pa. Folder entitled "A Neglected Source of Economy," describing the use of refrigerated drinking water systems for manufacturing plants.

David Lupton's Sons Co., Allegheny Ave., and Agate St., Philadelphia, Pa. Catalogue 110, entitled "Steel Windows," describing the company's makes of steel windows for all classes of buildings.

Morse Chain Co., Ithaca, N. Y. Folder illustrating Morse silent chain drives and calling attention to the exhibit of the company at the American Mining Congress Exposition at Cleveland, Ohio, October 9 to 14.

Sprague Electric Works of the General Electric Co. 527 W. 34th St., New York City. Bulletin 48718, on Sprague electric dynamometer chassis test system for automobile manufacturers, service stations, and public garages.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Folder 4500, describing Westinghouse full-safety motor starters. There are four types of these starters with capacities ranging from the smallest motor up to those of 15 horsepower, 550 volts.

New Departure Mfg. Co., Bristol, Conn. Leaflets 25FE to 28FE, covering band sawing machine equipped with New Departure ball bearings; drilling machine head mounted on ball bearings; and ball bearings in multiple-spindle drill countershaft.

Samuel Harris & Co., Chicago, Ill., dealers in tools and supplies for machinists and manufacturers, have issued a booklet entitled "Harris Reminder," containing among other material an article on the history and development of the Brown & Sharpe Mfg. Co.'s precision tools.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Folder 4453, entitled "Quiet-running Gears," dealing with micarta gears, and pointing out the qualities of quietness, durability, and efficiency of these gears; also publication 4249-A, describing the company's line of insulating and soldering compounds.

Victor Tool Co., Madison and W. M. R. R., Waynesboro, Pa. Catalogue of Victor self-opening die-heads, collapsible taps, floating tool-holders and nut facing machines. The catalogue is profusely illustrated with actual operation pictures, and shows clearly the application and use of the various lines of Victor tools.

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Catalogue describing the LeBlond 11-inch heavy-duty rapid-production lathe. A complete description of the machine and its features, together with illustrations of some of the more important details, is given. Complete specifications and list of equipment are included.

Firth-Sterling Steel Co., McKeesport, Pa. Catalogue entitled "Blue Chip High-speed Steel," containing information on the heat-treatment of this class of steel for different uses, such as for lathe and planer tools, milling cutters, drills, reamers, punches and dies, shears, taps, etc. The catalogue also lists the standard and special sizes of steel furnished by the company.

W. A. Jones Foundry & Machine Co., 4409 W. Roosevelt Road, Chicago, Ill. Gear catalogue No. 24, listing the company's complete line of cast-tooth gear patterns for spur gears, bevel gears, miter gears, worm-gears, and racks and pinions. The catalogue also contains list prices for rawhide pinions as well as miscellaneous information useful when laying out gear drives or for estimating purposes.

Reliance Gauge Column Co., 6008 Carnegie Ave., Cleveland, Ohio. Catalogue entitled "Reliance Steam Specialties," containing a full description of the products of the company, with directions for their installation and care. A digest of that part of the A. S. M. E. Boiler Code applying to water columns is included. The catalogue also contains some tables useful to engineers in laying out power plant piping and in installing power plant apparatus.

Canton Art Metal Co., Canton, Ohio. Catalogue of steel factory equipment and special sheet metal work manufactured by the company, including perforated plate and expanded metal tote-boxes for shops, plain tote-boxes, nesting tote-boxes, stacking trays, chip pans, waste cans, shop barrels, tool cabinets and tool stands, factory stools and chairs, gear guards, drying ovens, tanks and tank hoods, and factory stock-room shelving and equipment.

General Electric Co., Schenectady, N. Y. Bulletin 48028, entitled "Electrically Operated Pumps," showing the feasibility of applying electric motors for driving pumps of all kinds, and pointing out the items to be considered in selecting the best type and construction of motor and control for different installations. The bulletin covers 60 pages, 8 by 10½ inches, is profusely illustrated, and contains a great deal of specific information on the subject dealt with.

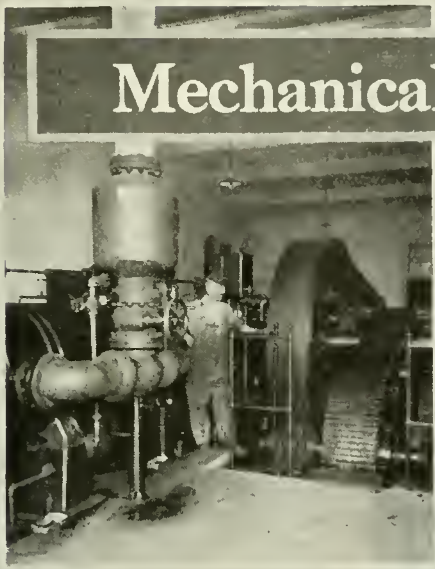
Chapin-Skelton Corporation, 406-408 Ash St., Syracuse, N. Y. Catalogue of reamers, boring-bars, lathe arbors, counterbores, production tools and special machines. Among the tools illustrated and described are the Skelton patent roughing reamers, S. A. E. standard roughing reamers, inserted-blade roughing reamers, helical finishing reamers, floating holders, taper pin reamers, bridge reamers, boring-bars, toolposts, burring fixtures, mandrels, counterbores, end-mills, and spot-facing tools.

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Catalogue describing the multi-cut lathe built by the company, containing a complete description of the machine together with illustrations showing the details of its construction. A number of specific examples of machining operations performed on the machine are included, showing the set-up, complete detail drawing of the work performed, and the time of operation. Instructions for setting up the machine, with tabulated information, are also included.

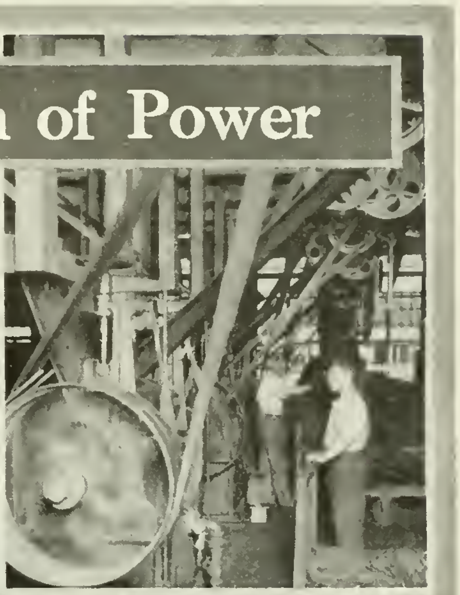
Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. Catalogue entitled "P. M. P." (Products-Markets-Policies) containing a description of the products of the company, emphasizing their special features and advantages, and including a market analysis to indicate the approximate field for the sale of these products and details of the policies of the Black & Decker Mfg. Co., showing exactly what assistance the company is in a position to render to jobbers and dealers in selling Black & Decker products.

Alvord Reamer & Tool Co., Millersburg, Pa. Catalogue 6, covering a complete line of metal cutting tools, including high-power milling cutters in all styles and types both of standard and special design. The catalogue lists among other tools, hand reamers, jobbers' reamers, chucking reamers, shell reamers, taper reamers for various purposes, bridge reamers, countersinks, center reamers, counterbores, shell drills, twist drills, plain milling cutters, side milling cutters, key-way cutters, end-mills, angular cutters, punches and dies, taps of different types, and threading dies.

OCTOBER MACHINERY 1922



Mechanical Transmission of Power



By FORREST E. CARDULLO
Chief Engineer,
The G. A. Gray Co.,
Cincinnati, Ohio
and
FRANKLIN D. JONES
Associate Editor of MACHINERY

MACHINE designers are confronted continually with problems relating to the transmission of power and means of obtaining mechanically certain velocities or movements. The selection of an improved method of transmitting motion and a given amount of energy may be governed entirely by fixed conditions, but frequently the designer finds it possible to use different methods, and then it is essential to weigh carefully the relative advantages. This general review of power-transmitting appliances is intended to feature the more important points relating to the application of different systems of transmission and include designing data applicable to common transmission problems.

Factors Governing the Selection of Transmissions

At the outset some of the factors influencing the selection of different forms of transmissions will be considered. The important factors are (1) kind of motion; (2) relative positions of driving and driven members; (3) velocities of driving and driven parts; (4) amount of power to be transmitted, and efficiency considered essential; (5) importance of quiet operation; and (6) possible effect of foreign matter or moisture upon operating conditions or life of drive. The order in which these different factors are given does not necessarily indicate their relative importance, since this varies with different classes of mechanisms.

Considering first the kind of motion, designers are concerned chiefly with rotating parts. The rotation may be either uniform, varying, or intermittent. The speed of rotation may, of course, be slow, medium, or fast. Provision for changing the velocity ratio may be required, as in the case of the change-gearing of lathes. Exactness of the velocity ratio may or may not be required and this is a matter which may fix the type of transmission. Sometimes an oscillating motion is necessary, one or more members swinging through an arc instead of making complete turns. Besides rotary motion, straight-line motion is frequent in the design of machine tools. Helical movements and even movements in an irregular line are sometimes necessary for certain types of work. A helical motion is required in order to give a cutting tool a uniform feed and rotary motion, while wire bending and knotting devices require movements in an irregular line.

The type of transmission would not ordinarily be selected by considering merely the kind of motion. For instance, shafts having practically uniform rotary motion might be driven either by gearing or by some type of belt transmission, depending upon other conditions. The relative positions of driving and driven members largely govern the selection. For instance, if parallel shafts are located quite close to each other, spur gears or herringbone gears are ordinarily used; on the other hand, if the center distance is relatively large, some kind of belt or chain drive is preferable under average conditions. If we assume, however, that a decided reduction in speed were required for a driven shaft, even though located some distance from the driver, then possibly a combination of worm-gearing with a connecting shaft would be used instead of the belt drive, although usually a combination of belt drive and reduction gearing would be employed.

The amount of power to be transmitted may or may not be of importance in designing a drive. Frequently the problem is confined to transmitting a certain motion possibly with given requirements as to speed or velocity changes, but without considering the amount of power, assuming that the latter is so small as to be negligible. On the other hand, there are many transmissions designed

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This review of mechanical means for transmitting power is intended to supplement the more special treatises previously published, the plan being to present, in condensed form, a broad view of this general subject. Important factors governing the selection of various standard devices for transmitting power mechanically are considered, in conjunction with methods of determining power-transmitting capacities. This article relates to the design and installation of shafting and belt and chain transmissions. The second installment, in the November number, will deal exclusively with power transmission problems that are met with in the application of various types of gearing.

primarily as power transmitters, and in these strength, efficiency, and durability are paramount. Existence of large amounts of foreign matter, such as dust, may affect the selection of a drive in some cases, but ordinarily the type of drive depends upon other conditions, since it is usually practicable to protect a transmission from injurious foreign matter by means of a casing or enclosure.

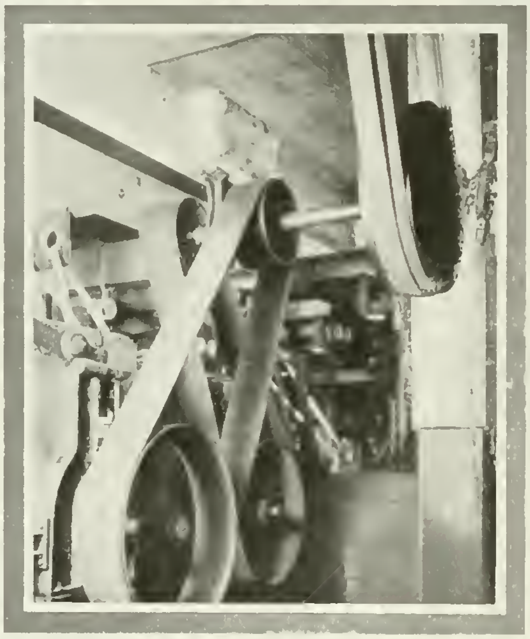
Quiet operation is very important with some transmissions, whereas with others noise is tolerated to permit using inexpensive equipment. For instance, some chain drives of the cheaper grades are comparatively noisy in operation, but are preferable for certain classes of service to the better grades of chain transmissions.

Having summarized the essential factors affecting the selection of transmissions, the more important features of different classes of drives will be dealt with as concisely as possible.

Shafting for Power Transmission

Since shafting is applied in various ways for transmitting power, either to support and drive pulleys, sprockets, gears, etc., or as a direct means of transmission, some of the points relating to the installation of shafting will be considered before gearing or belt transmissions are dealt with. In determining the size of shafting for a given installation, it is essential to consider whether the stresses are to be largely torsional, bending, or a combination of torsional and bending stresses. The torsional strength and the resistance to bending is proportional to the cube of the diameter. The following simple formulas are in common use for determining readily the size and approximate power-transmitting capacity of shafting:

$$D = \sqrt[3]{\frac{H \times F}{R}} \quad \text{or} \quad H = \frac{D^3 \times R}{F}$$



Belting not only provides a simple efficient means of transmitting power, but also serves to protect many driven machines against injurious stresses, as excessive overloads cause slippage.

In these formulas,

D = shafting diameter in inches;

H = horsepower to be transmitted, or power that the shaft will transmit;

R = revolutions per minute; and

F = a factor that varies according to the class of shafting or stresses considered allowable.

When these formulas are applied to the main shafts for power transmission with bearings located, say, 8 feet apart, F may have a value of 80, assuming that the speed is not excessive and the loads are steady. For ordinary lineshafting for medium and light service, subjected almost entirely to torsional stresses, F may be reduced to 50. For countershafts or other relatively short shafts, F may be further reduced to 25 or 35. For a "head shaft," or one carrying the receiving pulley, F should equal 100 or possibly 125. This head shaft incidentally, is connected to the smaller lineshafting by a reducing coupling, and it should be supported by bearings close to the main or receiving pulley.

Determining Sizes of Shafts Subjected to Bending and Torsional Stresses

When shafting is subjected to transverse loading so that it must resist severe bending, as well as torsional stresses, this combination of stresses should be taken into account in calculating the size of the shaft. According to the experience of at least one large manufacturer of power transmission apparatus broken shafts are frequently the result of disregarding the bending stresses in connection with drives having pulleys, gears, etc., located so far from the bearings as to impose upon the shaft a large transverse load.

In determining the diameter of a shaft that must withstand combined torsional and bending stresses, either an equivalent bending moment or torque is first computed, which produces a stress equivalent to the maximum stress produced by the combined moments.

Let:

D = shaft diameter, in inches;

T_e = equivalent torque or twisting moment in inch-pounds;

M_e = equivalent bending moment, in inch-pounds;

T = actual twisting moment;

M = actual bending moment;

S = allowable working stress in shear;

F = allowable tensile stress;

Z_o = ordinary sectional modulus; and

Z_p = polar sectional modulus, which is twice the ordinary sectional modulus.

Then we will have the following equations:

$$M_e = \frac{1}{2}\,(M + \sqrt{M^2 + T^2}) = FZ_o$$

$$T_e = M + \sqrt{M^2 + T^2} = SZ_p$$

Since the polar sectional modulus of a circular shaft equals 0.196 D^3; and the ordinary sectional modulus equals 0.098 D^3 we have the following:

$$D = \sqrt[3]{\frac{10.2\,M_e}{F}} \qquad D = \sqrt[3]{\frac{5.1\;T_e}{S}}$$

That formula which gives the highest value for D should be used, the shaft diameter being based upon whichever moment (bending or twisting) is large enough to be the controlling factor. The allowable shearing stress should equal about four-fifths of the permissible stress in tension.

Distance Between Shaft Bearings

Bearings for lineshafts operating under ordinary conditions are usually located from 6 to 10 feet apart, 8 feet being a fair average, but the distance should be determined with reference to the class of service and the speed of the shafting. According to common practice, the deflection of the shaft should not exceed 0.010 inch per foot of length, and the bearings should be placed close enough to each other to prevent centrifugal whirling action. A rule which has been applied for bare shafting is as follows:

To determine the distance between the bearings in feet, multiply 720 by the square of the shaft diameter, in inches, and extract the cube root of the product. For shafts carrying pulleys, etc., this rule is modified and shorter distances obtained by using the constant 140 instead of 720.

Three empirical formulas deduced by B. D. Pinkney, take into account the speed or effect of centrifugal force when applied to three classes of shafting. If

L = distance between bearings, in feet;

N = revolutions per minute;

D = shaft diameter, in inches; and

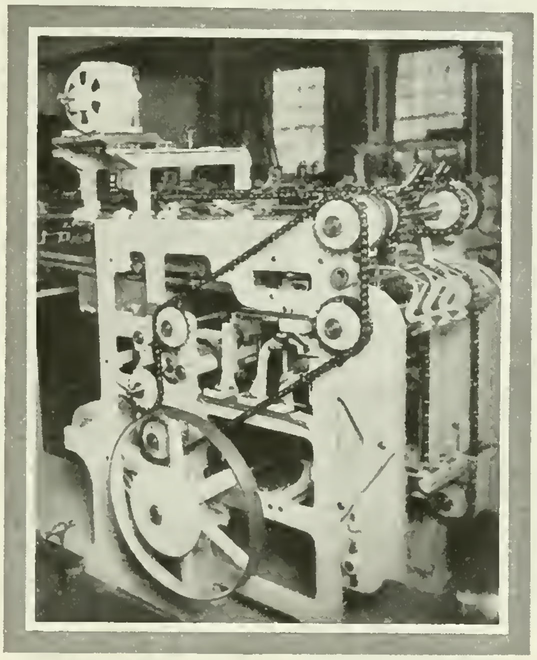
C = a constant depending upon the class of service,

$$L = C \times \left(\frac{1500}{N + 1500}\right) D^{2/3}$$

For head shafts or those to which power is applied, and also for shafts which must resist the bending action of pulleys, gears, etc., and which may be reversed under full load, $C = 5$; for ordinary lineshafts (except that section to which power is applied) and also for countershafts not reversible under full load, but having ample allowance for bending stresses from pulleys, etc., $C = 6.5$; for shafts and countershafts which merely transmit power and which have all the pulleys or the gearing located close to the bearings so that bending stresses may be considered to be negligible, $C = 9.5$.

The preceding formula and the different constants are based upon a maximum deflection of 0.010 inch per foot of length and were verified by an extensive series of tests. If the bearings used are of the rigid type, L equals the distance between the adjacent ends of the bearings, whereas for self-aligning bearings, L equals the center-to-center distance.

The speeds of lineshafting usually vary from 110 to 150 revolutions per minute for ordinary machine shop drives, although for high-speed machinery, such as grinders, the lineshaft speed may be increased to possibly 300 revolutions per minute. Lineshafting in woodworking shops usually runs at a speed of from 200 to 250 revolutions per minute.



Chain drives are positive and compact; and, in addition to general application for power transmission often enable designers of complicated machinery to transmit motion readily between various shafts.

Torsional Deflection of Shafts

A shaft subjected to ordinary service should be so proportioned that it cannot be twisted through a greater angle than about 0.08 degree per foot of length. When torsional deflection must be considered in the case of certain long shafts the following formula may be used in which

D = shaft diameter in inches;
C = a constant; and
T = torsional moment in inch-pounds.

$$D = C \times \sqrt[4]{T}$$

When shafts are for heavy loads and are to be reversed under full load, $C = 0.33$. For ordinary service, and when shafting is not to be reversed under full load, $C = 0.30$, and for light service with only gradual load fluctuations, $C = 0.28$.

Standard Sizes for Shafting

In order to reduce the fifty or sixty sizes of shafting now listed by the trade, to the relatively small number of sizes commonly used, the following list of diameters has been recommended as standard by the American Society of Mechanical Engineers and will doubtless be adopted in the near future:

Transmission Shafting—15/16, 1 3/16, 1 7/16, 1 11/16, 1 15/16, 2 3/16, 2 7/16, 2 15/16, 3 7/16, 3 15/16, 4 7/16, 4 15/16, 5 7/16, and 5 15/16 inches.

Machinery Shafting—Size intervals extending to 2½ inches, by sixteenth inches; from 2½ to 4 inches inclusive, by eighth inches; and from 4 to 6 inches by quarter inches.

Couplings for Connecting Power-transmitting Shafts

The function of some couplings is merely to join the ends of shaft sections rigidly so that in effect two or more sections form one continuous line of shafting. A second type of coupling or clutch is designed to allow one shaft section to be connected or disconnected at will. A third type known as a universal joint, allows considerable variation in angular position of the driving and driven shafts, and a fourth type designated as a flexible coupling, provides for lack of alignment between the driving and driven shafts, due either to bearing wear or original errors in alignment. Couplings of the latter class also provide a certain amount of elasticity or cushioning effect, thus avoiding shocks due to sudden starting.

Since these various classes of couplings are made in a great variety of designs, it would not be feasible to enter into details regarding the numerous forms in use, but elsewhere in this number will be found an article covering certain essential features relating to flexible couplings. Couplings of various kinds are ordinarily purchased from manufacturers, so that the average designer is more concerned with problems relating to transmissions of the belting or gearing types.

Transmission of Power by Belting

Power ratings for belt drives vary considerably, according to different authorities and investigators, even for belts of the same kind and applied under similar conditions, as will be seen by a comparison of the conclusions found in text-books, articles, and the literature published by belt manufacturers.

The general formula for determining the power rating follows:

$$H = \frac{SVW}{33{,}000}$$

In this formula,

H = horsepower;
S = effective belt pull, in pounds per inch of width;
V = belt velocity, in feet per minute; and
W = belt width, in inches.

The effective pull or difference between the tensions on the tight and slack sides is the variable factor. This factor is affected by belt velocity and arc of pulley contact as well as by belt thickness and its relation to the pulley diameter. It is evident that the kind and quality of the belting must be taken into account in determining the allowable working load, but even for the same belt quality, wide differences of opinion exist as to the amount of pull per unit of width or area that is conducive to the best results when initial cost, durability, and everything pertaining to it are allowed for.

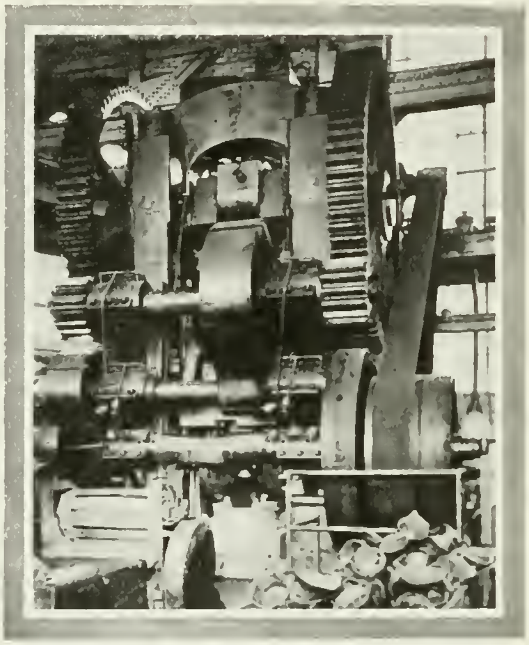
Obviously, if the working load is excessive, the life of belting will be reduced accordingly and the load on the bearings increased. On the other hand, if belts are given too low a rating, this means that wider and more expensive belts will be installed than is necessary. Somewhere between these extremes is the most economical rating, which is based not only upon the initial cost of the belt but also upon all subsequent costs connected with that particular installation. For instance, if a belt is subjected to such severe stresses that frequent delays for repairs are necessary, losses incident to these delays in manufacturing plants, may indicate that larger and more expensive belting would have been justified. The conditions under which a belt operates may also be of importance in this connection, as, for example, when a belt is frequently started and in starting must pick up a heavy load suddenly. In this case the rating should be relatively low to allow for the overload. It is evident that higher working stresses may be allowed for the better grades of belting, so that it is impracticable to specify working stresses unless they are related to belting of known quality.

More specific information on this subject will be found in the article entitled "Power Transmission by Belting," published in June MACHINERY, beginning on page 814. The method of determining belt ratings, as fully explained in this article, evidently conforms quite closely with the general recommendations of belting manufacturers. Another article entitled "Charts for Determining Belt Widths," which appeared in March MACHINERY (beginning on page 562) gives much lower power ratings, the theory being that these relatively low working tensions are conducive to economy when all the different factors have been taken into consideration.

Relation of Pulleys to Belt Drives

The type of pulley used for a belt drive is another factor affecting the power-transmitting capacity. For instance, tests have shown that steel pulleys have better gripping power than cast-iron pulleys, and the capacity of both steel and cast-iron pulleys can be increased by means of cork inserts in the rim which are applied to some pulleys that require an unusually high coefficient of friction. Covers of leather or rubber are also used in connection with some cast-iron pulleys to increase the pulling power. Wood pulleys have a much higher coefficient of friction than plain cast-iron pulleys for a normal percentage of belt slip, and all three types of pulleys mentioned have been used extensively and have been found to give satisfactory service under proper working conditions.

As a general rule, pulley diameters should be as large as other conditions will permit, one limiting factor being the belt velocity, which ordinarily should not exceed 4500 or possibly 4800 feet per minute. Information as to maximum speeds should preferably be obtained from the manufacturer of whatever type of pulley is to be used. Cast-iron pulleys are usually limited to a rim speed of 3000 feet per minute, unless special precautions have been taken regarding balance, and then the limit is generally 5000 feet per minute. Split cast-iron pulleys formed of two sections should be limited to 55 or 60 per cent of the speed of solid pulleys. Steel pulleys, which combine lightness with strength, are usually limited to about 6000 feet per minute for the common split type, and much higher speeds are allowed for the whole steel pulleys which are intended for unusual conditions as regards velocity. The maximum safe speeds for wood pulleys vary considerably for different types, manufacturers' recommendations ranging from 5000 up to 10,000 feet per minute, the latter speed applying to pulleys of special construction.



The universal need of positive drives in practically all mechanisms has focussed the attention of engineers for generations upon the development of gears adapted for different classes of service.

Chain Transmissions

Chain drives are especially applicable when the distance between the driving and driven shafts is too long for gearing and too short for belting, although this general statement does not apply under all conditions. Chain drives, however, are generally substituted for belting when the driving and driven shafts are comparatively close, and if correctly installed, the chain type of transmission is more durable than belting. It is also positive in action, compact, and without the initial tension required for a belt drive. A uniform turning movement is also obtained. While the initial cost of the chain drive is higher, this is warranted for many classes of service.

Several forms or types of chains have been developed for power transmission. The block chain, consisting of steel blocks connected by side links or plates is adapted for light machine drives, and the double width or twin type is used when the amount of power to be transmitted is relatively high. Roller chains differ from block chains in that rollers and bushings are inserted between the links instead of solid blocks. Roller chains are stronger than block chains, and are used in preference to the latter when the speeds and amount of power to be transmitted are comparatively high. Bushing chains resemble roller chains somewhat, but differ from the latter in that the bushings between the side links are not provided with rollers; they are adapted for transmitting considerable power at relatively low speeds. Silent chains provide a positive, durable, and efficient drive, especially where considerable power is to be transmitted.

Power Transmitted by Chain Drives

The amount of power that a given chain will transmit varies according to the speed and allowable pull or chain load. The working load for roller chains should not exceed 1/10 of the ultimate tensile strength of the chain, and it may be limited to 1/30 or 1/40 of the ultimate strength, particularly if the loads are to be applied suddenly. The working load varies according to the amount of rivet bearing surface the suddenness of the load, the speed of the driving sprocket, the quality of the chain, and the care it receives as regards lubrication According to the Diamond Chain & Mfg. Co., the chain pull should not, as a general rule, exceed 1000 pounds per square inch of projected rivet area, although a slow-speed transmission may operate satisfactorily with a chain pull of 2000 or even 3000 pounds per square inch of projected rivet area.

When the allowable working load is known, the amount of horsepower transmitted by chain drive may be determined by the following formula:

$$H = \frac{LV}{33{,}000}$$

where

$H =$ horsepower;

$L =$ allowable pull or working load, in pounds; and

$V =$ velocity of chain, in feet per minute.

Assume that the capacity of a roller chain is required, and that the projected rivet area is 0.72 square inch. The speed is to be 800 feet per minute, and 1500 pounds per square inch of projected rivet area is to be allowed. Then

$$H = \frac{1500 \times 0.72 \times 800}{33{,}000} = 26$$

For determining the load to which a chain is subjected with a given horsepower and speed, the formula is:

$$L = \frac{33{,}000 \times H}{V}$$

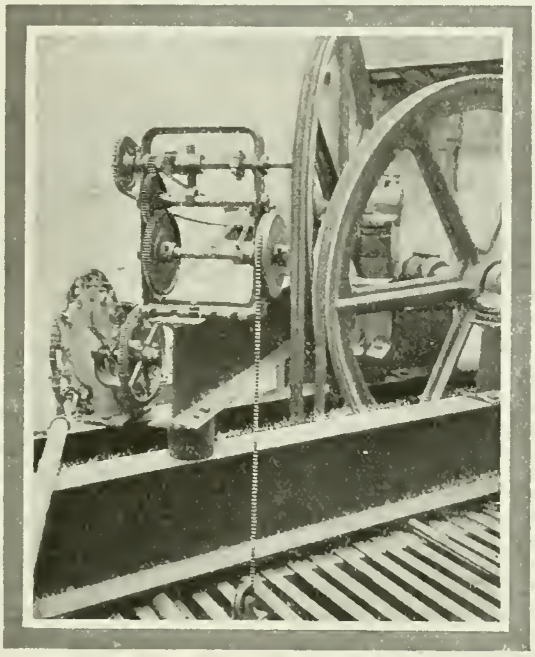
The minimum diameter for a sprocket shaft made of mild steel (according to the Diamond Chain & Mfg. Co.) should equal three times the cube root of the quotient obtained by dividing the horsepower by the revolutions per minute of the sprocket, assuming that the shaft is subjected to torsional stresses only. For torsional and bending stresses multiply this result by about 1.5.

In determining the pitch of a chain, the maximum speed of the smaller sprocket should be considered. A higher sprocket speed is allowable with a chain of short pitch than with one of long pitch. Speeds of 1000 to 1200 feet per minute are often recommended for roller chains, and 700 to 800 feet per minute for block chains; but if the conditions regarding sprocket speed and chain pull are favorable, these maximum speeds may be increased considerably. It has been demonstrated that chain speed alone has little to do with the destructive action between the chain and the sprocket, but high sprocket speed combined with long pitch is destructive and noisy because of the impact between the chain link and the sprocket as the roller seats itself. If P = maximum allowable pitch of chain and S = maximum allowable speed of sprocket in revolutions per minute, the following approximate formulas may be used to determine the values of P and S:

$$P = \left(\frac{900}{S}\right)^{2/3} \qquad S = \frac{900}{\sqrt{P^3}}$$

The capacity of chain drives should not be based on the ultimate strength of the chain exclusively, but rather upon working loads which are related to the durability of the transmission. This accounts for the fact that the bearing area of pins and bushings is taken as a basis. Some manufacturers of silent chains limit the working load to 650 pounds per square inch of projected pin area to minimize wear and insure maintaining an efficient drive.

An extensive and carefully conducted series of tests made by the Link-Belt Co. showed that the working load on Ewart detachable link belt should be obtained by dividing the ultimate strength by a factor varying according to the speed, as follows: For a velocity of 200 feet per minute, divide the average ultimate strength by 6; for a velocity of 300, divide by 8; for 400, divide by 10; for 500, divide by 12; for 600, divide by 16; and for 700, divide by 20.



Ropes made of steel wire are indispensable for hoisting, conveying, and similar applications, while fiber rope drives provide an efficient, quiet and fairly positive means of power transmission.

Transmissions are made in such a large variety of designs that it is not possible to give a general formula for determining the power-transmitting capacity, owing to the variable factors involved, but information of this kind may be obtained directly from the manufacturer of whatever type of chain is to be installed.

Bearings as Related to Transmission Efficiency

As the mechanical efficiency of a transmission may be affected decidedly by the bearings used, numerous experiments have been made for reducing frictional losses and insuring durable bearings which are safeguarded against defective operation. Losses in a single bearing may appear insignificant but when this loss is multiplied by the number of bearings required for many complete transmissions, the total waste is often of considerable magnitude. These bearing losses also continue indefinitely, so that an initial expense for bearings that minimize such waste may be negligible, when compared with the ultimate saving. In addition to waste through friction, losses due to bearing troubles and repair costs may be factors of great importance.

In connection with plain bearings, alloys for various kinds of service are available, as well as adequate lubricants and lubricating systems. Oilless bearings represent another development which meets certain bearing requirements. While ball and roller bearings are used extensively, they will doubtless be applied in the future to many classes of machinery now equipped with bearings of the sliding type. Since friction means waste, the reduction of friction in every way practicable has always been an important problem for mechanical engineers. Manufacturers of anti-friction bearings have perfected types that meet a wide range of operating conditions. Such bearings not only reduce frictional losses to a minimum, but also may be arranged to run satisfactorily for long periods with little or no attention. These developments have not been utilized by engineers as fully as is warranted by economical practice, although the application of ball and roller bearings is increasing continually.

In past numbers of MACHINERY various important details concerning the design and application of both plain and anti-friction bearings have been dealt with so this subject will not be considered further at the present time. The next and concluding installment of this article, which will appear in the November number, will deal with the power-transmitting capacities of various classes of gearing.

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It is stated in a recent issue of *Engineering* that the Technical Commission of the Royal Dutch Aero Club has offered a prize of 3000 guilders (about $1200, present exchange) for the best instrument or set of instruments which will indicate to the pilot of the airplane, flying in dense fog, his height from the ground or water. The indication must be independent of any installation on the ground or water, and also of the atmospheric pressure, and the error of indication must not be greater than 10 per cent for heights up to approximately 1000 feet. The competition is open to persons of all nationalities, and drawings and descriptive matter must reach the awarding jury at the offices of the Royal Dutch Aero Club Heerengracht 13, The Hague, Holland, not later than March 15, 1923.

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THE SWEDISH MACHINE INDUSTRIES

There has been little or no improvement in the Swedish machinery and electrical industries during 1922. While in September, 1920, these industries employed 60 000 workers, only about 25,000 were employed this spring. Wage reductions of about 40 per cent have been made as compared with 1920 wages. The only orders of any account that the industry has at present are those from Russia. The most serious conditions exist in the machine tool, the woodworking machinery, and the agricultural machinery industries. German competition, which for a couple of years was very serious is now less formidable, as German prices have reached the level of the world's markets; the difficulties experienced in regard to deliveries from Germany are also tending to check German imports.

Ball Bearings in Textile Mills

By HOWARD N. PASCOE, Electrical Engineer, Fafnir Bearing Co., New Britain, Conn.

IN the following are recorded the results obtained in three tests made to determine the power-saving possibilities of ball-bearing hanger boxes. In each test the shafting was driven by a 220-volt motor, and the power consumption was recorded with the original installation of plain bearings and with Fafnir ball bearings. The records were made on an Esterline graphic wattmeter, which indicated the power input for both sets of bearings for each test. The purpose of the tests was to show the power consumption using both types of bearings under as nearly identical operating conditions as possible, and to demonstrate the saving resulting from the use of ball bearings. The saving will vary for different localities and under different operating conditions. Where the cost of electric energy is higher, the saving in dollars and cents will be greater, as this varies as much as two or three cents per kilowatt-hour.

The first test was made at the mill of Follmer, Clogg & Co., Lancaster, Pa. Sixty feet of lineshafting, originally hung in three 2 15/16- and seven 1 15/16-inch plain babbitt bearings, was replaced by double ball-bearing hanger boxes. From this shafting fifteen single-deck spinning machines were driven. The wattmeter showed that with the original installation 1.85 kilowatts of power was used to drive the shafting only, and 1.65 kilowatts when the plain bearings were replaced by ball-bearing boxes—a saving of 0.20 kilowatt. The power for driving the shafts and the belts was 4.85 kilowatts with the original installation, and 3.90 kilowatts with ball bearings—a saving of 0.95 kilowatt.

Under normal operating conditions, that is, under the full load of fifteen machines, 17.8 kilowatts of power was used before the ball-bearing boxes were installed, and 15.8 kilowatts afterward, which represented a saving of 2 kilowatts, or the equivalent of 2.68 horsepower for the ball-bearing installation. The cost of power in this locality was especially low, being 1½ cents per kilowatt-hour. Figured on the basis of a fifty-hour week, this represents a yearly saving of:

2 kilowatts × 50 hours × 50 weeks × 1.5 cents = $75

The next test was conducted at the mill of D. C. Dery, Inc., Allentown, Pa., where plain types of lineshaft bearings were replaced by double ball-bearing hanger boxes. The lineshafting was 40 feet in length and was supported by five 2 7/16-inch plain bearing hanger boxes. Sixteen double-deck spinning machines were driven from this shafting. The wattmeter showed these results: For driving the lineshafting only, the power consumption with the original installation was 6 kilowatts, and with the ball-bearing installation, 4.25 kilowatts—a saving of 1.75 kilowatts. The power consumption for driving the shafts and belts with the plain bearings supporting the shaft was 10.25 kilowatts, while but 7.75 kilowatts of power was consumed with the ball-bearing installation—a saving of 2.50 kilowatts.

Under peak load, which is the normal operating condition, the wattmeter showed a consumption of 43 kilowatts when driving the sixteen spinning machines, and when the original plain hanger boxes were replaced by ball-bearing boxes, the saving in power appeared to be comparatively small, being only 0.75 kilowatt. The reading of the wattmeter, however, did not show all the conditions, which were as follows: A motor rated at 50 horsepower was used. The continuous load power consumption—43 kilowatts, which is equal to 57.5 horsepower—shows that the motor was overloaded. The line voltage was read at 202 volts or 8 per cent low for a 220-volt motor. The combined results of this overload and low voltage were reduced speed and an overheated motor.

In relieving these conditions by replacing the plain bearing boxes with ball-bearing hangers, there was an increase in spindle speed, but no direct indication of power saving. The use of ball bearings increased the spindle speed from 8500 to 9100 revolutions per minute, or 7.06 per cent, which means a corresponding increase in production. The power saving on the friction of the lineshafting alone, due to substituting ball-bearing hanger boxes, was stated to be 1.75 kilowatts; and in the case of the lineshafting and belting together, 2.5 kilowatts. This plainly indicates that with the increased friction load there was an increased power saving.

To express the decrease in friction load brought about by the use of ball bearings in terms of power saving, the percentage of speed increase may be conservatively used.

YEARLY SAVINGS WITH BALL-BEARING HANGER BOXES

Test No.	Saving in Oil	Saving in Labor	Saving in Power	Total
1	$4.75	$8.45	$75.00	$88.20
2	2.37	4.23	189.75	196.35
3	0.81	1.72	211.60	214.13

Machinery

That is to say, 7.06 per cent of the full-load power consumption (43 kilowatts), indicates a power saving for the ball-bearing hanger-box installation equivalent to 3.04 kilowatts or 4.08 horsepower. This, then, is the value that should be taken in calculating the actual saving in cost of power, and not the reading of the wattmeter (0.75 kilowatt), which does not reveal the true conditions at full load.

The cost of electric energy used in this test was 2½ cents per kilowatt-hour, which is probably an average rate. The yearly saving of which this test is indicative is:

3.04 kilowatts × 50 hours × 50 weeks × 2.5 cents = $189.75

In the third test, conducted at the Champlain Silk Mills, Brooklyn, N. Y., roller-bearing boxes, 1 11/16-inch size, were replaced with double ball-bearing hanger boxes. Six of these bearing boxes were used to support fifty feet of lineshafting, from which ten twisting machines were driven. The results of the comparative tests under the two installations were as follows: For the original bearing boxes 2.15 kilowatts of energy was consumed for driving the shaft only, and 2.075 kilowatts when the ball-bearing boxes were used—a saving of 0.075 kilowatt. To drive the shafting and belts, the wattmeter showed a consumption of 4.50 kilowatts with the original arrangement, and 3.875 kilowatts when ball-bearing boxes were used. This shows a saving of 0.625 kilowatt. Under normal conditions, when the ten twisting frames were in operation, the power used with the lineshafting running in the original bearing boxes was 17 kilowatts, and in the ball-bearing boxes 14.70 kilowatts. This represents a saving of 2.30 kilowatts or 3.08 horsepower.

The cost of electric energy was 3.68 cents per kilowatt-hour. Then the yearly saving in power is:

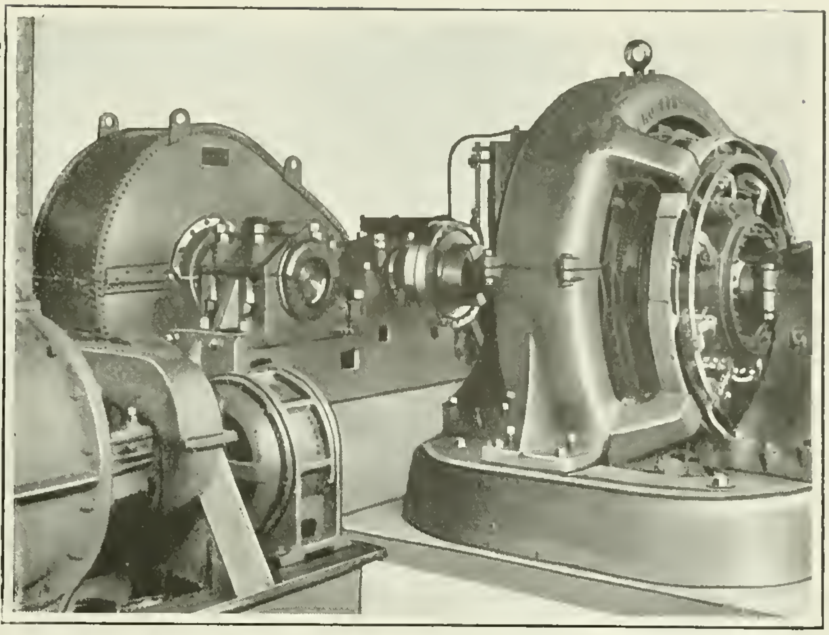
2.30 kilowatts × 50 hours × 50 weeks × 3.68 cents = $211.60

In addition to the direct saving in power, there were corresponding savings in oil and labor with the ball-bearing installations. The total direct savings per year for the three tests are summarized in the accompanying table.

Flexible Couplings

Where and How They Should be Used

By JOHN J. SERRELL
Smith & Serrell, Newark, N. J.



HOW much out of line will a flexible coupling run? This is perhaps the question most often asked about such couplings. Knowing that a costly misunderstanding may be encouraged in the minds of the few who glance at this first paragraph only, the writer will try to show those who study the full facts that the question referred to is often asked because of a misunderstanding. There are many more important things than the greatest allowable misalignment.

Basis for Selection of Prime Movers and Flexible Couplings

Since about 1890 there has been a marked development in high-speed machinery. This has been a competitive development brought about by the demand for a combined lower first cost and lower operating cost. A small high-speed motor developing 75 horsepower at 1800 revolutions per minute will cost much less than a motor or engine of the same power operating at 75 or 80 revolutions per minute. A small high-speed steam turbine, especially if its exhaust steam is used, may show even greater economy.

The selection of the kind and make of prime mover for driving any particular machine or group of machines is an engineering problem. The choice should be based on the first cost of the entire drive, the cost of power delivered to the driven machine, the cost of maintenance and repairs, and the assurance that the least possible delay in production will be caused by shutdowns, whether due to operating accidents or abuse. The same factors should determine the kind of flexible couplings to be used.

Direct-connected machinery having a driving unit supported in two bearings coupled directly to a driven unit, also supported in two bearings—or four bearings in a row—has been used for many years. Two bearings can be made self-aligning but no more. Therefore, it is necessary to line up the shafts of the connected machines.

Whether machines are to be direct-connected, or driven by belts, chains, or gears is another engineering problem. When a direct-connected drive is used, this selection is usually made because of economy in space, lower first cost, and lower maintenance cost—the combination representing a considerable saving.

Troubles Encountered where Direct-connected Machines have a Non-flexible Coupling

As the various kinds of prime movers have been developed and have been speeded up, builders and operators have experienced a lot of trouble with hot bearings, scored or broken shafts, broken couplings, loose keys etc. In fact, many entire installations have been wrecked either because (1) such direct-connected machines were not flexibly connected; (2) they were not properly aligned when installed; or (3) the alignment was not checked often enough to note and correct the errors in alignment always resulting from operation. It is difficult to line up four bearings with the necessary accuracy, and it is almost impossible to run them safely or economically without flexibility somewhere. With misalignment and a rigid connection, the chances are that either the coupling or the shafts will break, especially if the misalignment is excessive or long continued.

General Conditions Governing Use of Flexible Couplings

Lineshaft practice should not be confused with that followed for direct-connected machinery. With lineshafting, where it is usual to support the connected sections in hangers and bearings from 6 to 10 feet apart, there is usually sufficient flexibility to take care of any reasonable amount of error in alignment. Realigning at definite intervals will compensate for any slight inequality in the wear of bearings, slight settlements in the building, etc., and it is only in the exceptional installation that flexible couplings may show a saving over the usual rigid connection for lineshaft work. On direct-connected machinery, however, the shafts are proportionately much larger in diameter than those needed for the simple transmission of power, and the bearings are spaced relatively close together. These conditions are necessary in order to support the revolving weights rigidly, to minimize vibration, and to reduce over-all length.

Only in exceptional cases where the entire drive is most carefully designed and installed, where the operators are much above the average, and where constant attention is given to keeping the connected machines in exact alignment, can a rigid connection be used on direct-connected machinery. But if one machine is heavier than the other, if one bearing or one set of bearings is likely to wear faster than the others, or if operation of similar machines has shown that misalignment is likely and will cause trouble, then a flexible coupling should be used. On most high-speed direct-connected machinery it will be found that flexible couplings are used—or abused by those who ask the question mentioned in the opening paragraph of this article.

Initial Alignment and why it is Required

Most turbine builders line up their machines initially within 0.002 to 0.004 inch of the correct position. For lower speeds and heavy duty, 0.010 inch is good practice, and such alignment should be obtained easily without micrometer gages. The exercise of due care to obtain good initial alignment will provide greater capacity to handle subsequent operating misalignment, but any specification of definite limits is difficult. The greater the speed, the greater the care desirable. The important point is to obtain the best initial alignment possible with the tools available, and then check it occasionally after operation.

The fact that the driving and driven units are received all set up on a common bedplate is no assurance that they will be in proper alignment if installed without reasonable precautions. A bedplate can be sprung to a considerable extent by its own or the machine's weight due to being improperly supported or as the result of piping or internal strains. The alignment should always be checked before operating a new unit or upon assuming responsibility for the satisfactory performance of such drives.

Flexible Couplings for Various Kinds of Drives

There are many types and makes of flexible couplings. A shaft connection which simply delivers power when the shafts are at an angle is usually called a universal joint, and it should not be confused with a flexible coupling which is intended primarily for a straight-line drive, but will accommodate small angular and off-center misalignments and will also allow for some variation in endwise setting or endwise movement.

On small drives operating at moderate speeds where low first cost has been the only consideration, there are several types of flexible couplings using leather, rubber, or fabric as the flexible element. Where there is no backlash, the load being applied continuously in one direction without sudden or repeated reversal, it has been found satisfactory in some cases simply to have sufficient clearance between the contacting parts, provided that the alignment is maintained within very close limits, as such devices usually result in line or point contact and rapid wear occurs if there is misalignment.

Special types of couplings have been developed for continuous process work, as on steel rolling mills, where the capacity of the coupling for misalignment is really important. In designing couplings for such service, it is usual to sacrifice a considerable amount of over-all length in order to use what really amounts to two flexible couplings connected by an intermediate shaft, which may vary in length according to the probable maximum amount of off-center misalignment.

An all-metal type of flexible coupling is adapted for heavy-duty work, because of the smaller size involved, longer life, and less cost—first and last. Many drives are started suddenly, and one machine may impose a fluctuating or vibratory load on the other. For such drives it is often desirable to have a cushioning effect between the machines, which is supplied by coil springs or by laminated bundles of springs in the all-metal types.

Checking Coupling Alignment at Regular Intervals

With any flexible coupling, reasonable care should be used to obtain good initial alignment, and this should be checked at regular intervals. When a coupling is carefully lined up at the time of installation, its capacity for handling subsequent operating misalignments is increased, and it is better to check the alignment than to buy new machine and coupling parts. Regular checking will prevent excessive misalignment of long duration, which, with many couplings, will impose destructive strains on the connected machines if beyond the intended capacity of the coupling. With the laminated steel pin type, however, the replaceable units act as a safety device in the case of an operating accident and will yield if the misalignment is excessive, before serious damage is done to the connected machines.

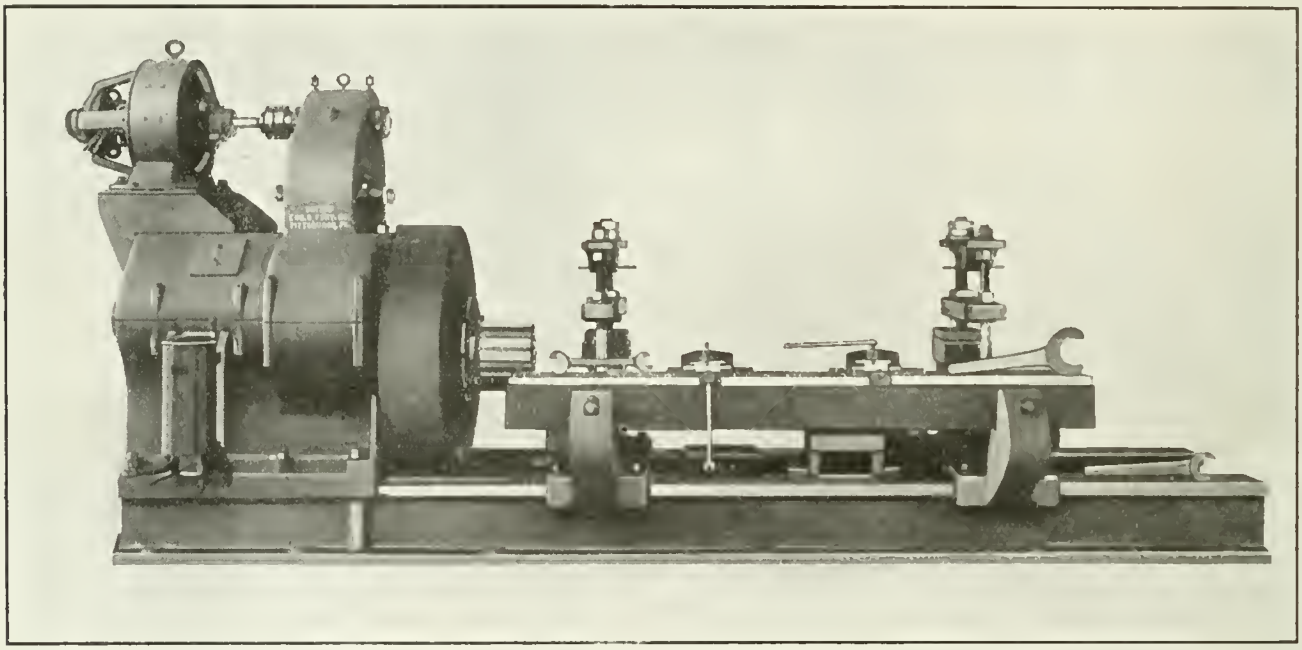


Fig. 1. Motor-driven Roll-turning Lathe with Flexible Coupling Connection—Such Couplings are often used on Large Machine Tools

For simplicity in lining up or checking the alignment both flanges should be of the same diameter and true with the bores. The flanges should be faced off square so that the angular alignment can be checked simply by measuring the distance between flanges. Out-of-center misalignment may be tested accurately enough for practical purposes by placing a straightedge across the coupling flanges, assuming that they are of the same diameters.

Points on Flexible Coupling Design

There should be no projecting unprotected parts on any flexible coupling to catch the clothing or hands of operators. On high-speed couplings there should be no parts to work loose or fly out.

For most direct-connected work it is desirable that the coupling shall be extensible, that it shall be flexible for off-center and for angular misalignment, and that it shall not impose excessive strains on the connected shafts even in case of excessive misalignment. Others things being equal. the capacity of the coupling to handle misalignment is important. The coupling should be readily assembled and taken apart. It should not be necessary to move one or both connected machines or their shafts to renew the wearing parts of the coupling. The various parts should be interchangeable so that they will not require expensive hand fitting, with the resulting high cost for renewals.

Misalignment will occur even on a carefully installed and well operated drive—sometimes excessive misalignment—and this means wear. The rapidity of the wear will depend upon many factors, principally upon the speed of the drive and the degree of misalignment.

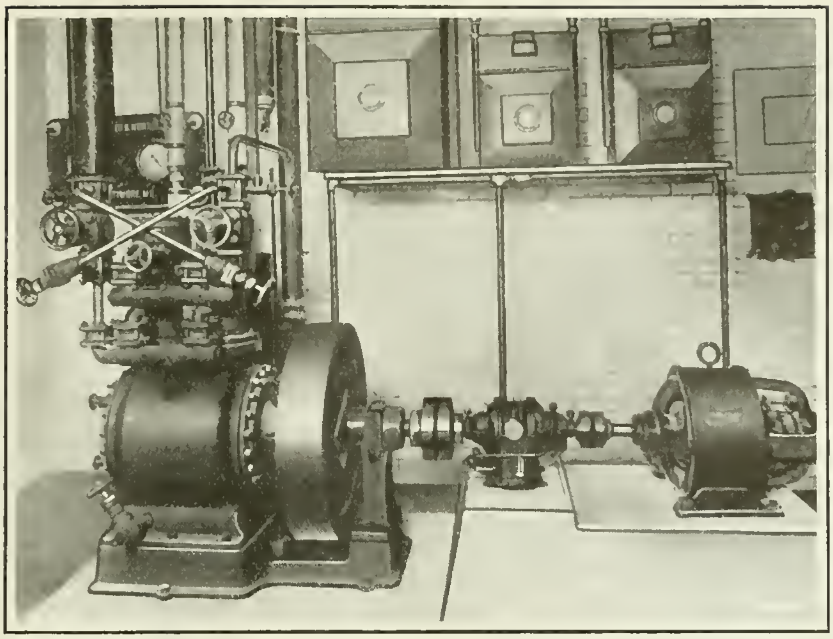


Fig. 2. Installation using Two Flexible Couplings—One between a 15-horsepower Motor and a Reduction Gear, and the Other between the Gear and an Ammonia Compressor

Size and Capacity of Flexible Couplings

Correct size selection is essential to satisfactory coupling and machine performance. Often there are unusual demands made on a flexible coupling. The loading is not always apparent without previous experience, and sometimes a word of advice or a suggestion from the service department of the coupling manufacturer will turn an apparently unsatisfactory drive into one that gives real satisfaction. These are the most important considerations in selecting or recommending a flexible coupling, especially with reference to how it is installed and used; in fact, they are far more important than the mere question of how much a coupling can be run out of line.

Most successful flexible couplings are designed with definite factors in mind. If fabric, rubber, etc., is used, the tensile strength or the compressive strength is generally the factor that determines the capacity of the coupling. These parts should be renewed fairly often so as to maintain the intended flexibility. If looseness of parts is the source of flexibility, then these parts should be renewed before excessive wear takes place.

When full flexibility in all-metal couplings is obtained by combining sliding movements with flexibility of materials, the unit bearing pressures and the fatigue strength of material must be considered. Lubrication of such sliding surfaces is advisable under exceptional conditions, but if the bearing pressures are relatively small and misalignment is not excessive, many years of protection from each set of coupling parts should be obtained without constant attention and lubrication.

If any flexible coupling fails to give complete protection against misalignment, if the parts wear out repeatedly or quickly, or if the coupling advertises wear by making a noise, it undoubtedly does so as the natural result of some cause. Approach such "trouble" with an open mind. Check up the alignment with the machines standing idle and check it again as carefully as possible with the machines operating under load. If the foundations are not sufficiently rigid or if the machine frames, bearings, etc., are not adequate, vibratory misalignments may be developed under peak loads and these may be the cause of operating troubles. Measure the spacing between flanges to note whether the coupling is operated within its intended mechanical limits. Observe whether the parts are so badly worn as to require renewal. Obtain the maximum load conditions imposed on the coupling, as the loads may be greater in actual practice than figured theoretically. Such a methodical examination will often locate the trouble and enable the cause to be eliminated so that the whole drive will again give entire satisfaction.

* * *

Great strides have been made by the Belgian engineering standardization committee. The standards of particular interest in the machinery field that have been adopted relate to shafts and pulleys, bolts and rivets, chain and wire rope. Copies of the standards can be obtained from the American Engineering Standards Committee, 29 W. 39th St., New York.

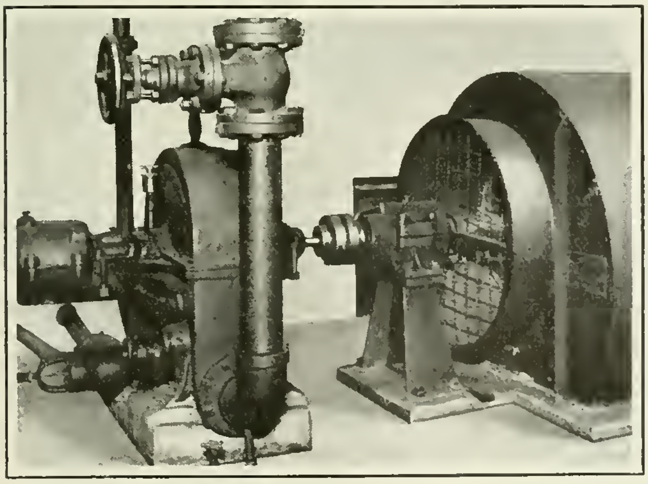


Fig. 3. Turbine-fan Installation using Flexible Coupling—Direct-connected Steam Turbine Drives have Flexible Couplings to compensate for Misalignments due to Expansion and Wear

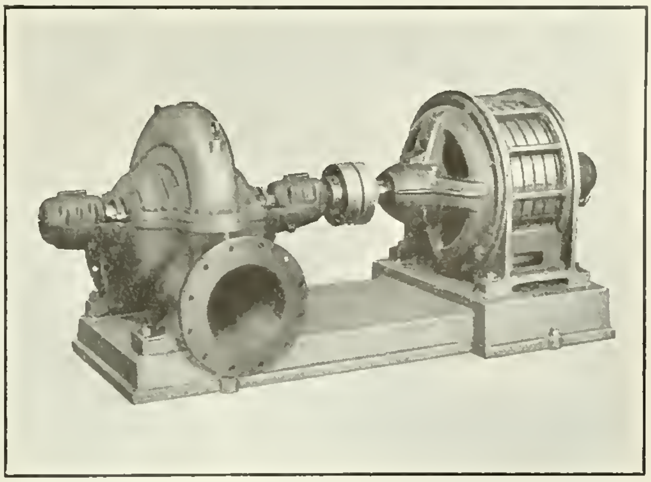


Fig. 4. Motor and Centrifugal Pump connected by Flexible Coupling—Even when mounted on a Common Bedplate, Alignment should always be checked after Installation

Inspecting Bearing Rollers by Machine

SATISFACTORY service can be obtained from roller bearings only if all the rollers are of the same diameter within close limits. It is not so important that they be of precisely the specified size; the main point is that they be uniform, so that each roller will carry its due proportion of the load. In cases where there is a lack of uniformity, the large sized rollers will be called upon to carry more than their share of the load. This condition soon results in wear, and it is a recognized fact that when wear once starts in either a roller bearing or a ball bearing, it proceeds rapidly until the bearing is destroyed.

The sorting of rollers by hand into groups varying by but a few ten-thousandths inch, is a slow process and usually requires a considerable number of employes. At the plant of the Bock Bearing Co., Toledo, Ohio, the most highly skilled inspectors could not gage more than 3000 rollers per ten-hour day. To lower the inspection cost, this company developed the ingenious machine shown in Figs. 1 and 2, which automatically inspects and sorts rollers at the rate of 3000 per hour.

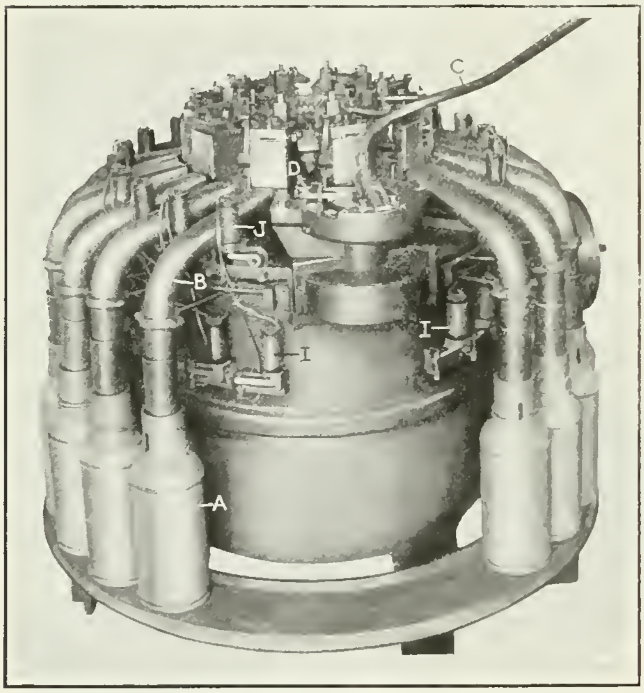


Fig. 1. Machine used in the Plant of the Bock Bearing Co. to inspect Rollers for Roller Bearings

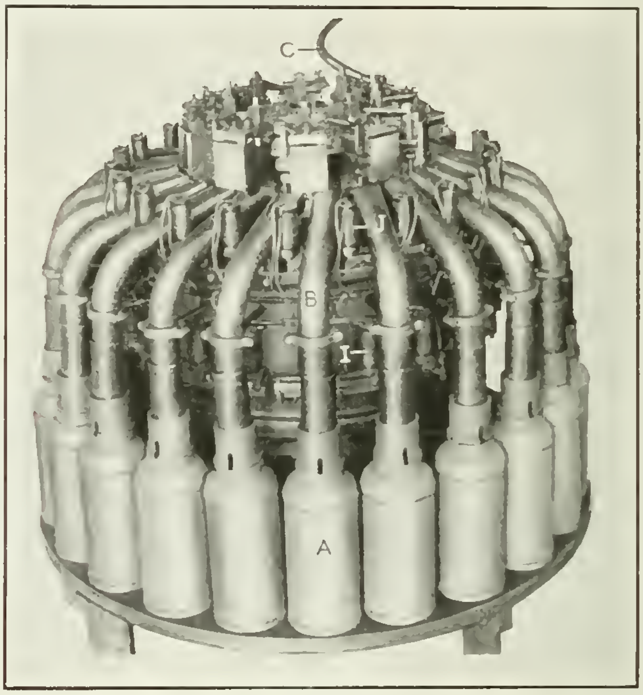


Fig. 2. Opposite Side of the Inspecting Machine from that illustrated in Fig. 1

Inspecting Rollers for Bock Bearings

The rollers in Bock bearings are tapered and have a spherical head. When they pass from the gaging machine to the assembling department there is positive assurance that all the rollers in a bearing will be of the same diameter within 0.0002 inch. Reference to the illustrations will show that the machine is circular in form and surrounded by a ring of nineteen containers *A*, into each of which a steel chute *B* leads. The rollers to be gaged descend from a hopper through chute *C* to gaging heads which carry them successively around a circular path. In making this circuit, each roller passes by entrances to the chutes leading to the containers, and when a given roller reaches the chute leading to the container that receives rollers of its particular size, the gripping mechanism is automatically released, thereby permitting the roller to drop into that container.

Operation of the Machine

When each roller reaches the lower end of chute *C*, a cam-actuated lever mechanism *D*, Fig. 1, pushes it forward between a pair of gripping jaws indicated at *E*, Fig. 3, which are tapered to conform to the shape of the roller. The upper jaw *E* is movable so as to accommodate rollers of different sizes, but the lower jaw is fixed. After a roller has been gripped between these two jaws its head slides along the smooth face of the cam-actuated lever *D*, Fig. 1, and enters the V-shaped slot of a third gaging block *F*, Fig. 3. The roller is pushed into contact with the V-block by compression spring *G*. After the head of a roller has been pushed against the V-block, the upper jaw *E* is locked in place. Thus the roller, as held by the three gaging members, is not only gaged for size as regards diameter, but the contact of the V-block with the spherical bearing surface on the head of the roller also serves to gage the relation between this surface and the conical bearing surface of the roller.

It has already been mentioned that a cam-actuated mechanism pushes the rollers into position between jaws *E*. As each roller descends from chute *C* it is automatically turned to enter the jaws in the proper manner. The raising of the upper jaw is also controlled by a cam mechanism, and the operation of the two sets of cams is synchronized so that the jaw automatically opens as the roller to be gaged is pushed forward. There are ten gaging heads, one between each two containers and the frame on which the gaging heads are mounted rotates continuously. Behind each upper jaw and secured to it is a short arm *H*, Fig. 3, the under side of which is accurately finished. This finished face moves over a series of electrical contacts made of copper, as the gaging head rotates. The contacts are

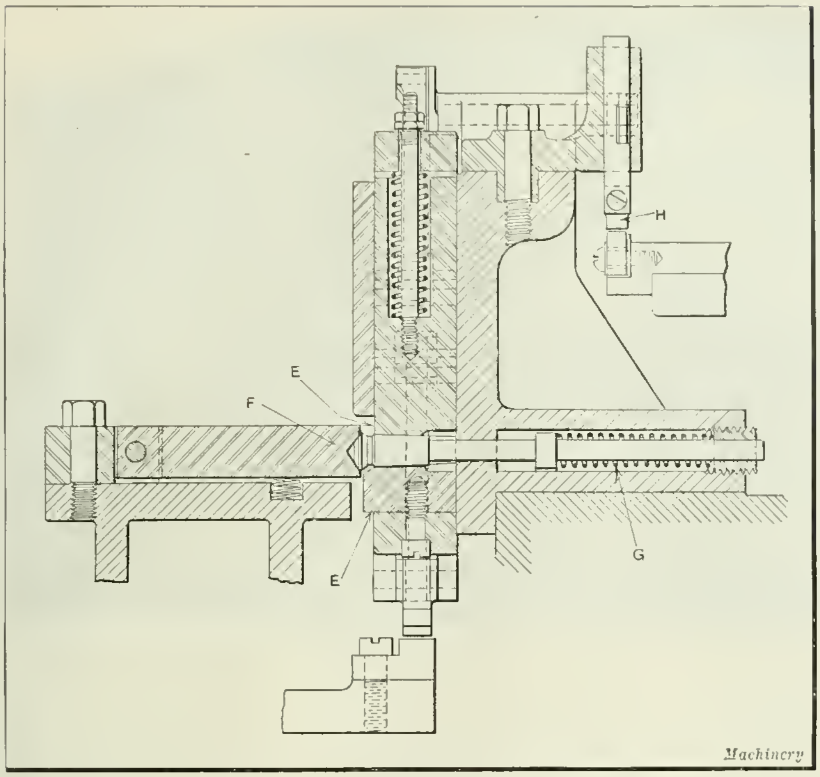


Fig. 3. Diagram of the Roller Gripping and Ejecting Mechanism

stepped progressively in increments of 0.0002 inch, and each contact is located opposite one of the containers.

When a roller is brought opposite the container that receives rollers of its particular size, the arm *H*, upon reaching the electrical contact, causes the current to be shunted through an electric coil *I*, Fig. 1, shutting off the current from coil *J* through which it normally passes. This, in turn, causes an electromagnet to release a cam which swings upward, and in so doing engages the cam that controls the upper jaw *E* which holds the roller in position. This action raises the upper jaw, and thereby releases the roller so that the spring *G*, Fig. 3, may eject it into the chute leading to the container.

Accuracy of the Sorting

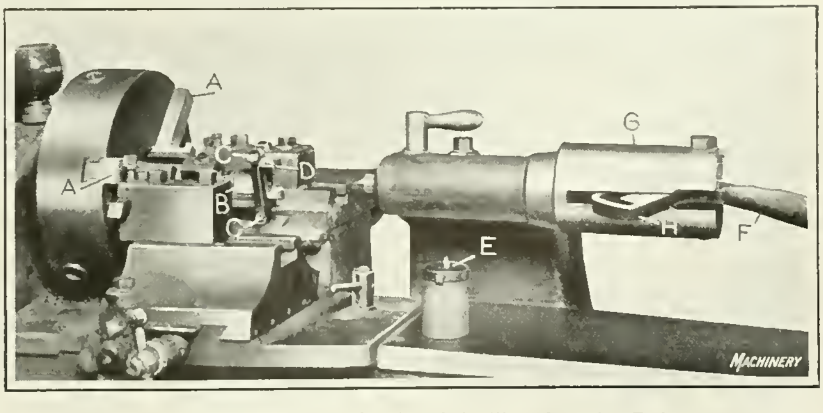
The operation of the machine is entirely automatic, it being merely necessary for the attendant to keep the supply hopper filled with rollers so that they may be continuously fed to the gaging heads. The first container receives all rollers larger in size than the maximum limit allowed on the nominal size. The next seventeen containers receive rollers differing in size by increments of 0.0002 inch, and the nineteenth container receives all under-sized rollers.

The contents of the first and the nineteenth containers are not necessarily scrap, because the machine does not sort to quite the maximum and minimum limits. For instance, on rollers having a nominal diameter of 0.3750 inch, the limits are + 0.0030 and — 0.0010 inch. As the seventeen containers receive rollers varying in size by 0.0002 inch, they provide for a total tolerance of 0.0034 inch. Consequently, there is still a range of 0.0006 inch in which the size of these rollers may deviate from the nominal diameter before they exceed the limits. The large rollers are sent back to the grinding department for regrinding and then returned to the gaging machine, where it is usually found that most of them come between the prescribed limits. Only the under-sized rollers are finally rejected as scrap.

CENTERING AND FACING AUTOMOBILE PISTONS

The accompanying illustration shows a Porter-Cable lathe especially arranged for centering and facing over-size pistons. This equipment is regularly used in the plant of the Houpert Machine Co., Long Island City, for the first operation in the manufacture of over-size pistons which this company carries in stock in rather large quantities. The pistons are chucked from the inside of the web of the skirt end by means of the special hook jaws *A*. A spring-backed centering arbor *B* is operated by a draw-in collet, and consists of a specially designed end which has four fingers *C* to engage the inner wall of the piston near the piston-pin bosses, and a V-block *D*, which seats on these bosses.

With the work thus located, a knurled holder *E* in which the centering tool is carried is employed to center the end of the rough casting. This tool-holder is slipped over the regular 60-degree lathe center and is advanced to center the end by means of handle *F*. An extension *G* is attached to the regular tailstock, through which the lathe center extends, this end of the center being slotted to carry a cam-roller. The cam-roller operates in cam *H*, the shape of which is designed to feed the centering tool to the proper depth. When this point is reached, the handle is pushed back slightly, the centering tool-holder removed and the lathe center advanced into the 60-degree center in the work, where it is locked as the cam is pivoted around further by the handle *F*. Facing tools in the front and rear tool-blocks then rough- and finish-face the skirt end of the pistons.



Lathe with Special Tailstock and Auxiliary Centering Tool

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AN INSTRUMENT FOR OBSERVING MOVING PARTS AT HIGH SPEED

The oscilloscope is the name given to an instrument which should be of considerable aid to designers of machinery, since it permits of an exact study and measurement of the movements of machinery parts functioning at high speeds. The principle upon which the oscilloscope works is interesting. The apparatus illuminates the moving object to be examined with a series of flashes from an electric lamp, these flashes being arranged to take place at regularly spaced intervals during the movement of the part. In other words, it enables the eye to take a series of flashlight photographs in regular sequence, and in such a way that the part appears to be moving at one-hundredth of its actual speed. The use of this instrument opens up an entirely new field in the investigation of machine tool operation at high speed.

Selling Machine Tools by Motion Pictures

By EDWARD K. HAMMOND

THE old proverb "To see is to believe" sets forth a fundamental principle of psychology. The average man is likely to be more impressed by what he actually sees than by what he hears, and it is for this reason that motion pictures have been made use of in selling manufactured products, especially engineering equipment. But aside from the fact that it is easier to believe a visible message than a spoken one, the motion picture has other advantages as a means of selling machine tools and shop accessories. Purchasers of factory equipment are fundamentally interested in what the machines are capable of doing. With this in view, it is the practice of some machinery builders to take their prospective customers to plants in which tools are being used on the same general line of work as that on which they are engaged. This often involves loss of time, and represents a considerable expenditure for traveling and hotel bills. Hence when it is necessary to do a great deal of "missionary" work of this kind to effect a sale, a large part of the profits resulting from the transaction is often swallowed up.

It is not unusual for a thoroughly capable machinery salesman to call upon a "prospect" a great many times before he is successful in getting him to visit a plant where the machines can be seen in operation. Aside from the problem of breaking down the customer's reserve and possible opposition to certain features of the proposition, it may be very hard to find a time when he can conveniently arrange to go and see the machines at work. The moving picture overcomes this difficulty by taking a view of the operation right to the prospective customer's office, where he can see and comprehend all the important details; and the interest which is aroused by the film exhibition is often an important factor in overcoming any opposition which may be encountered. It is important to note that the film not only shows the machine at work, but also the operating conditions, so that the customer will be assured that they are similar to those in his own plant.

Advantages of Portable Moving Picture Projection Machines

Portable projection machines are made for the use of salesmen. They are packed in cases which are of a convenient size to carry and weigh only from twenty to twenty-two pounds. Added to this, there is usually a 1000-foot roll of films, which weighs from ten to twelve pounds. The machine is motor-driven, power for this purpose being taken from an ordinary light socket; and a picture can be thrown on an ordinary wall or other opaque surface. It requires about fourteen minutes to show a full reel of film. Pictures of this kind are made on the so-called "non-flam" films which are said to eliminate danger of fire. When it is not convenient to show a film in a business office, arrangements can often be made for using the apparatus in a "movie" theater during the mornings when regular exhibitions are not in progress.

Requirements of a Successful Film

The reason for using films in demonstrating the merits of industrial plant equipment is that the customer, sitting in his own office, can obtain an accurate conception of working conditions in a plant where one of the machines in which he is interested is in operation. This being the case, it is evident that the greatest care should be exercised to have the film accurate in all details. The machine should be set up and running on an actual job, and before starting to make the film it should be ascertained that all details of the tooling and other essential features are accurate.

Some films have been made with a so-called story or plot worked into them; but as the purchaser of machine tools is interested chiefly in what they are capable of accomplishing in the way of production, it is probable that nothing will prove more interesting or effective in producing sales than a film that portrays actual working conditions. Before starting to make a picture, a definite plan of action should be evolved and approved by the sales manager and other officials of the machinery building corporation. The film should be planned in such a way that it carries a powerful selling argument. A film should never be made longer than is absolutely necessary to tell the story. Reiteration often dampens the interest of the customer.

Arranging to Exhibit the Film

After a film has been made, it must be brought to the attention of men who have authority to make purchases. It is obvious that the most carefully prepared film cannot be of any value unless it is kept in circulation among those who are prospective purchasers of the equipment that is being shown. When salesmen carry films with them to supplement their discussion with customers, they are used regu-

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For information contained in this article, the author is indebted to R. L. Herrick, motion picture industrial engineer, and to the Baumer Films, Inc., 6 W. 48th St., New York City. The projector shown in the title illustration was made by the De Vry Corporation, 141 W. 42nd St., New York City.

larly as a selling argument. But if films are used as mediums of general publicity, the advertising manager should see to it that they are kept in circulation, and that the places of exhibition are such that the films are likely to be seen by a sufficient number of prospective customers to justify the expense of their preparation.

Adapting the Film for its Purpose

In conducting general publicity work, films can often be advantageously employed for advertising products that are commonly shown in the popular magazines and other national advertising mediums. Arrangements can sometimes be made to show cleverly developed advertising films on the screens of the moving picture theaters where a charge is made for admission. In such cases, however, the story shown by the film ought to be developed along lines which emphasize elements of human interest and make publicity an incidental factor.

It would be difficult, of course, to find a sufficient number of prospective buyers of machine tools and shop equipment in regular movie theaters to warrant the making of films and the spending of time in arranging for their display. The better plan is to make films that are of sufficient technical interest so that various engineering societies throughout the country will be glad to arrange for their display at their regular meetings. Here the manufacturer shows his film before an audience largely composed of men who directly or indirectly influence buying. The same benefits should result from showing films in technical schools and before gatherings of students attending Y. M. C. A. evening courses.

How One Firm Used a Film

A number of industrial motion picture films have been made and used with gratifying results. As a case in point, a film demonstrating the application of a new type of air-operated tool was made. This film was originally made in three reels, so that approximately forty-five minutes was required for its exhibition. It showed the tool in use and had a lively story interwoven, so that there was plenty of the human interest element.

After the film was completed, a smoker was given at each of the branch offices of the company, to which possible buyers of these tools were invited. A pleasant evening's entertainment was provided, of which the showing of the film was only a part and, incidentally, the use of the new tool was brought to the attention of a group of men who had the authority to purchase it. After this preliminary showing, all the story was eliminated from the film, so that it became a purely technical demonstration of a pneumatic tool. With the idea of using it in this way, the film was made with the story in the first and third reels. The second reel was simply a technical demonstration of the tool. There have been over 500 showings of the film before a total of 50,000 men.

Types of Films Used for Industrial Motion Pictures

An ordinary moving picture film is run through the projecting machine at a speed of sixteen "frames" per second, and there are sixteen frames to a foot of film. As the film runs through the projection machine, these pictures are substituted for each other on the screen with such rapidity, that the eye is incapable of following the changes, with the result that one gets the impression of a machine or other object in motion. "High-speed" films are made by running the camera eight times as fast as the "normal-speed" projecting machine is operated. Then, in exhibiting the film produced in this manner, the projecting machine is run at normal speed. As a result it is possible to photograph the movements of a mechanism that operates too fast to be followed by the eye, and then to slow the projection down, so that the movements can be readily followed when the moving picture is shown on the screen. This is a valuable device for many lines of work, but there are few machine tools that operate fast enough to require films of this type.

The so-called "technigraphs" or animated drawing films are useful for showing cycles of movements. This method is valuable for showing the movements of the valves and pistons of a gasoline engine or the parts of various other mechanisms; but films of this kind are rarely applied in demonstrating machine tools. A new development in the motion picture industry is the stereoscopic film, which provides for giving exceptional depth to the view projected on the screen. This is a development in the industry which promises to give valuable results, although at present it is in a more or less experimental stage.

Cost of Making a Film

After reading the foregoing analysis of ways in which a motion picture film can be used to advantage in selling machine tools, the question naturally arises, "What will it cost to make a film?" The projection machine will cost from $225 to $250, and ordinary films of good quality can be produced for from $1000 to $2000 for a 1000-foot negative. High-speed films, and films showing animated drawings or so-called "technigraphs" cost considerably more, ranging in price from $4000 to $10 000. However, such films are not often required to show machine shop operations. After the negative has been produced, prints can be made from it at a cost of from $100 to $150. When a firm has a number of salesmen on the road and it is desired to have each man carry a film, it will be evident that the possibility of making an unlimited number of prints greatly reduces the cost of this method of demonstrating machine tools.

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COMING MEETING OF INTERNATIONAL CHAMBER OF COMMERCE

The second general meeting of the International Chamber of Commerce, an organization which includes delegates from all the leading nations of the world, will be held in Rome, Italy, March 18 to 24, 1924. Invitations to participate in this meeting have been extended to Chambers of Commerce and trade organizations in the United States, as well as to a large number of business men throughout the country. The present indications are that there will be from 200 to 300 American business men in attendance. Further information may be obtained from Lacy C. Zapf, secretary of the American Section of the International Chamber of Commerce, Mills Bldg., Washington, D. C. In order to enable members of the American Section who attend the meeting to broaden their knowledge of international affairs, a special tour will be arranged, which will offer an opportunity for those attending to study commercial and economic conditions in the Mediterranean countries, the Near East and Western Europe.

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VALUE OF MACHINE TOOLS AND METAL-WORKING MACHINERY EXPORTED TO JAPAN, 1912-1921

Year*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal-working Machinery
1912	......	......	......	....	....	$133,546
1913	......	......	......	....	....	119,558
1914	......	......	......	....	....	120,166
1915	......	......	......	....	....	86,166
1916	......	......	......	....	....	437,159
1917	......	......	......	....	....	1,092,317
1918	$577,440	$221,961	$476,215	$1,275,616	$1,249,660	2,525,276
1919	967,095	452,233	635,874	2,055,202	3,327,982	5,383,184
1920	503,304	494,154	956,784	1,954,242	2,296,341	4,250,583
1921	301,028	198,236	430,462	929,726	1,706,292	2,636,018

Machinery

*The figures given are for fiscal years up to and including 1918, and for calendar years thereafter. Detailed statistics not available for years previous to 1918.

Milling Locomotive Main Rods

Machining Locomotive Parts on Ingersoll Milling Machines

Results of Tests made to Determine the Possibilities of Reducing Costs in Railroad Shops by Milling

Machine tool manufacturers have given particular attention to the railroad field during the last two or three years, and as a result machines have been developed which, if generally used, would greatly reduce production costs in railroad shops. In tests recently conducted by the engineers of the Ingersoll Milling Machine Co., Rockford, Ill., various locomotive parts were machined by milling, the tests being carried out under conditions that could easily be duplicated in actual practice. Some of the results of these tests, which covered a period of three months, are set forth in this article.

Machines and Equipment Used in the Tests

For handling this class of work, two heavy-duty milling machines especially built for railroad shop work were employed. A planer-type horizontal milling machine was used for taking heavy cuts on the sides and edges of rods, and an adjustable rotary machine (also of special construction) was used for such operations as milling contours on the ends of connecting-rods, where a vertical type machine is inherently advantageous.

For the slabbing operations and for certain contour milling, a helical inserted-tooth cutter of special design was employed. The teeth in these cutters were made of high-speed steel, twisted into a helical shape. The advantages claimed for this special type cutter are that the shearing cut which it takes removes metal with an economical expenditure of power and that the surface produced has a smooth finish, provided, of course, that the proper speeds and feeds are used. The teeth of these cutters are held in place by hardened wedges and screws. This type of cutter is shown in use in Figs. 1 and 2 on the horizontal type of machine, and in Fig. 4 on the vertical machine.

For performing grooving operations, another cutter of special design was used in the test, the general appearance of which is shown in Fig. 3. These cutters have staggered inserted teeth, and are 10 inches in diameter, with a face width of 3¼ inches. The teeth are of high-speed steel and set at alternate angles, held in place by wedges and screws. The spacing of the teeth is great enough to allow liberal chip clearance.

Fixtures that are designed to hold connecting-rods so securely that a high table feed can be employed and that have provision for accurately and rapidly setting up a job were designed by the engineering department of the Ingersoll Milling Machine Co. These fixtures can be quickly adjusted and will accommodate locomotive rods of all makes. Some idea of the design may be had by referring to Fig. 1. They consist of hardened and ground plates that extend across the table and are provided with slots to accommodate clamp brackets which are located in different positions for clamping locomotive rods of various sizes. The brackets carry bolts which may be adjusted against the side of the work without obstructing the passage of the cutter. Patents have been applied for, covering the design of these fixtures as well as the special helical and staggered-tooth cutters.

Speeds, Feeds, and Material

The material of the locomotive forgings machined was, as a rule, a special chrome-vanadium alloy steel, heat-treated. The analysis and physical properties of this steel are as follows: Carbon, 0.38 to 0.48 per cent; manganese, 0.75 to 0.90 per cent; sulphur, 0.04 per cent (maximum); phosphorus, 0.04 per cent (maximum); chromium, 0.80 to 1 per cent; and vanadium, 0.15 per cent (minimum). The physical results of a typical test on an alloy steel rod of this analysis showed an elastic limit of 62,750 pounds per square inch; a tensile strength of 98,850 pounds per square inch; an elongation in two inches of 23 per cent; and a reduction in area of 53.3 per cent.

The scale on these forgings was exceptionally hard, and it was necessary in milling the sides and edges to use a comparatively slow cutter speed and to reduce the table feed correspondingly. In channeling, however, where there was

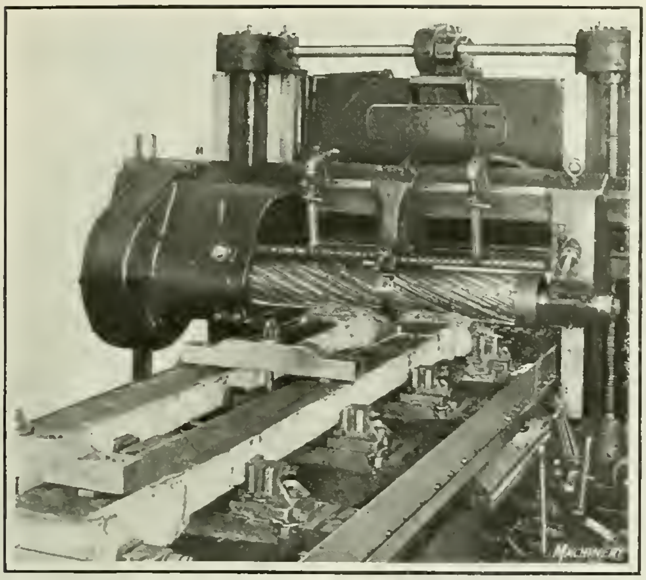

Fig. 1. Slabbing the Sides of Locomotive Main Rods

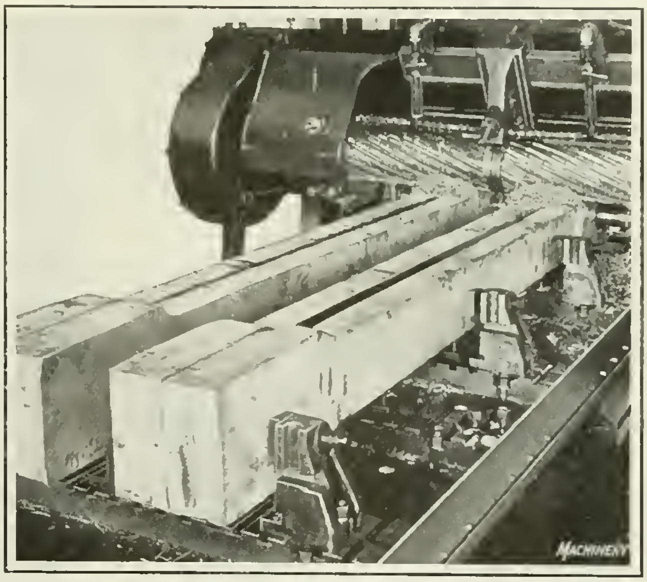

Fig. 2. Milling the Edges of Locomotive Main Rods

no difficulty from scale, it was possible to use a faster rate of speed and increase the table feed.

In machining locomotive main rod forgings, seven operations were performed, six of which were milling. The first consisted of slab-milling both sides of two forgings. The set-up for this job is illustrated in Fig. 1. Here the planer-type horizontal milling machine previously referred to is shown set up with two helical milling cutters and adjustable rod fixtures of the type previously described. The cutters are 9 inches in diameter and 24 inches long, and in the test were run at a speed of 33 feet per minute. As the scale on the forgings was exceptionally hard, it was necessary to reduce the cutter speed considerably, the table feed being likewise reduced to 3 inches per minute. This rate of feed, however, produced an exceptionally fine finish. The depth of cut was 19/32 inch, the total width of cut, 23 inches, and the amount of stock removed per minute, 41 cubic inches. The horsepower required per cubic inch of metal removed was 1.45, and the production time, floor to floor, for slabbing both sides of these two forgings was three hours and twenty-eight minutes.

The second operation consisted of drilling a hole in the piston end. This hole, which is 2½ inches in diameter, was drilled in the piston end and an arbor was passed through it for lining up the two forgings during the edge milling operation. The set-up for the edging operation is illustrated in Fig 2, which shows the arbor passing through two pairs of forgings to locate them relative to the cutters. The cutters used for edging were the same size and type as those used in the first operation and the feeds and speeds were the same. The depth of cut was 11/16 inch, the total width of cut, 20¾ inches, and the amount of metal removed per minute, 41 cubic inches. The horsepower required per cubic inch of metal removed was 1.38, and the floor to floor time for both sides of four rods was three hours and forty-two minutes.

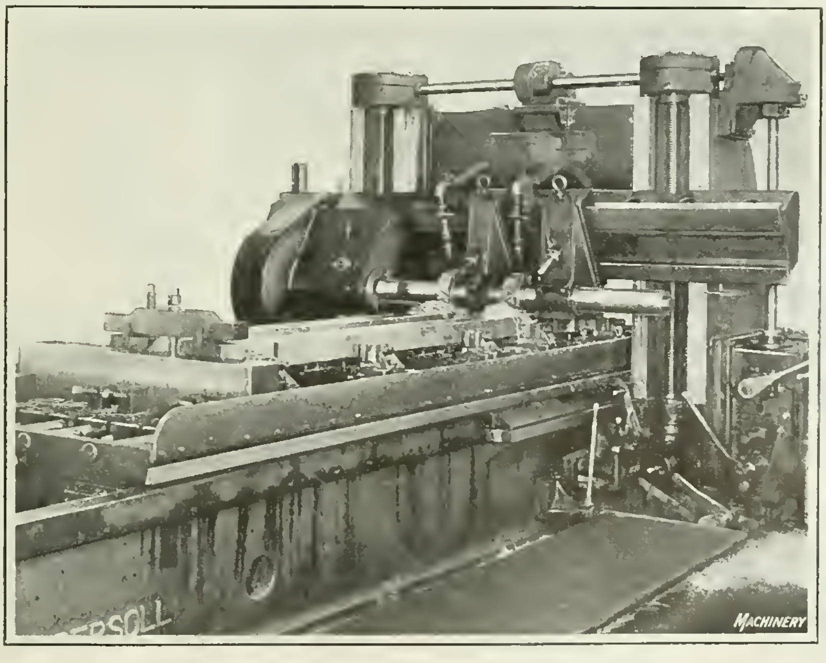

Fig. 3. Milling Tapered Channels in Locomotive Main Rods

After edging, the rods were set up in pairs on the horizontal type machine, preparatory to milling the tapered channels. Fig. 3 shows the set-up and the staggered inserted-tooth channeling cutters used. These cutters are 3¼ inches face width and 10 inches in diameter, and the cutter speed for this operation was 58 surface feet per minute, with a table feed of 5½ inches per minute. In this connection it will be noted that the cutter speed was increased over that used in the slabbing and edging operations, because in this case there was no hard scale to interfere. The higher cutter speed resulted in the table feed being increased proportionately. The depth of cut was 1 9/16 inches. Two cuts were taken in each channel, the first of which was 3¼ inches wide, and the second, with the rods set over to the proper angle, tapered from ¾ inch to 1¼ inches. The total amount of metal removed per minute by both cutters was 58.6 cubic inches, and the horsepower required per cubic inch, 1.13. The production time for completing four of these channels, one on each side of each rod, was five hours and ten minutes.

The three other milling operations required to finish the main rods were performed on the rotary vertical drilling machine previously referred to. Fig. 4 illustrates the set-up used in the fifth operation — contour-milling the piston end of the rods. It will be noted that in this set-up the lower end of the cutter was supported by a bearing in a bracket that was bolted to the spindle saddle. While the cut was being taken the piston end of the rod was moved around. A clamping

MILLING LOCOMOTIVE MAIN RODS AND MAIN ROD STRAPS

	Operation No.	Operation	Table Feed, Inches per Min.	Cutter Speed, Feet per Min.	Depth of Cut, Inches	Total Width of Cut, Inches	Total Cu. In. Metal Removed per Min.	Horsepower per Cubic Inch	Production Time, Floor to Floor
Main Rods Alloy Steel—Heat-treated	1	Slabbing (both sides)	3	33	19/32	23	41	1.45	3 hr. 28 min. (2 forgings)
	2	Drill hole	....	....	......	......	....	....	(2 forgings)
	3	Edging (both edges)	3	33	11/16	20¾	41	1.38	3 hr. 42 min. (4 forgings)
	4	Channeling (both sides)	5½	58	1 9/16	†	58.6	1.13	5 hr. 10 min. (2 forgings)
	5	Mill end contours	1½	35	⅜	10⅜	....	....	1 hr. 45 min. (2 forgings)
	6	Mill strap end	1	35	⅜	11	....	....	1 hr. 45 min. (2 forgings)
	7	Mill for brasses (2 cuts)	¼R* 1½ F*	50	⅛F*	10⅜	....	1.7	4 hr. 30 min. (2 forgings)
Main Rod Straps Alloy Steel—Heat-treated	1	Slabbing (both sides)	4½	52	⅜	12	....	....	2 hr. 6 min. (2 forgings)
	2	Mill exterior (except radius)	1½	53	⅜ to ½	5¼	....	....	1 hr. 25 min.
	3	Mill interior (except radius)	1½	50	⅜ to ½	5½	....	....	1 hr. 19 min.
	4	Mill inside corners	....	50	... ..	5½	....	....	50 minutes
	5	Mill outside corners	....	53	......	5½	....	....	48 minutes
	6	Mill around lug	....	50	......	5½	....	....	39 minutes

Machinery

*R, roughing cut; F, finishing cut. †First cut, 3¼ inches; second cut, ¾ to 1¼ inches.

bracket of the same general type as the one that was used on the horizontal milling machine fixtures was employed.

The cutters used were 5 inches in diameter, 12 inches long, and of the helical inserted-tooth high-speed type. The cutter speed used was 35 feet per minute, and a rate of table revolution equivalent to a feed of 1½ inches per minute. The depth of cut was ⅜ inch, and the width 10⅜ inches. The time required for machining two forgings was one hour and forty-five minutes.

The sixth operation consisted of milling the strap end of the rods, using practically the same set-up as that illustrated in Fig. 4. The cutter speed was 35 feet per minute; rate of feed, 1 inch per minute; depth of cut, ⅜ inch; and total width of cut, 11 inches. The production time was one hour and forty-five minutes for two forgings.

The final operation on the main rods consisted of milling out the piston end to accommodate the brasses and wedges, as shown in Fig. 5. Two rods were supported from a monorail hoist, which is part of the machine, and securely clamped together in alignment at the outer end and properly secured to the table at the piston end. A solid helical milling cutter, 2 inches in diameter, was used in this operation. The cutter was supported at the end by a bearing bracket. Two cuts were taken—a roughing cut, with a feed of ¼ inch per minute and a finishing cut, with a feed of 1½ inches per minute. For both the roughing and finishing cuts, the cutter speed was 50 feet per minute. In the finishing operation, which is that illustrated, the depth of cut was ⅛ inch, and the width 10⅜ inches. The horsepower required per cubic inch of metal removed was 1.7. The floor to floor machining time was four hours and thirty minutes for four cuts, two per rod.

Machining Main Rod Straps

Six milling operations were performed in machining the main rod straps, and the forgings were handled on machines of the same type as those on which the main rods were milled. The slabbing operation is illustrated in Fig. 6, which shows two rough forgings being slabbed. This illustration also gives an excellent idea of the method of securing the work. In the slabbing operation, two helical inserted-tooth milling cutters, 9 inches in diameter and 24 inches long, were used, operating at a speed of 52 feet per minute. Although these forgings were rough, the amount of scale was considerably less than in the case of the main rods, so that it was possible to increase the cutter speed, and also to increase the table feed from 3 to 4½ inches per minute. The depth of cut was ⅜ inch, and the width, except for the projecting lug on the side of the strap, 12 inches. The time required to slab both sides of two straps was two hours and six minutes.

The second milling operation consisted of machining the

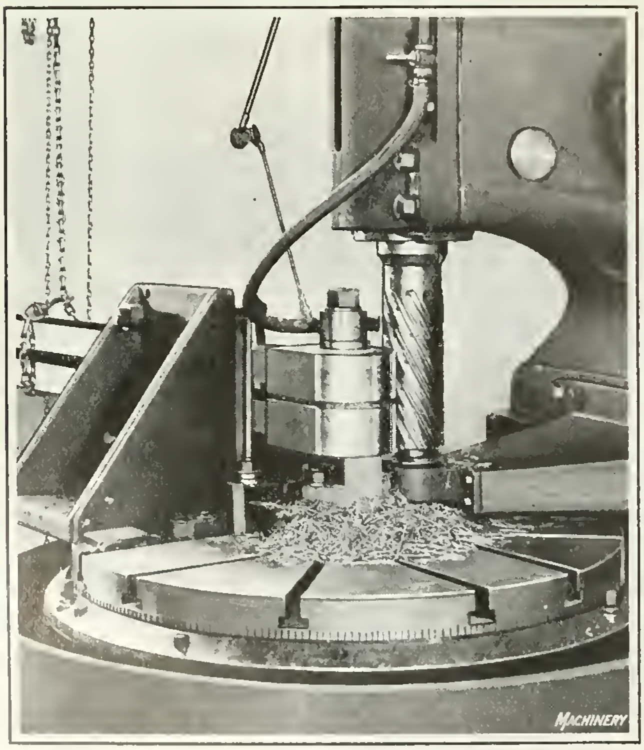

Fig. 4. Milling the Contour at the Piston End of the Rods

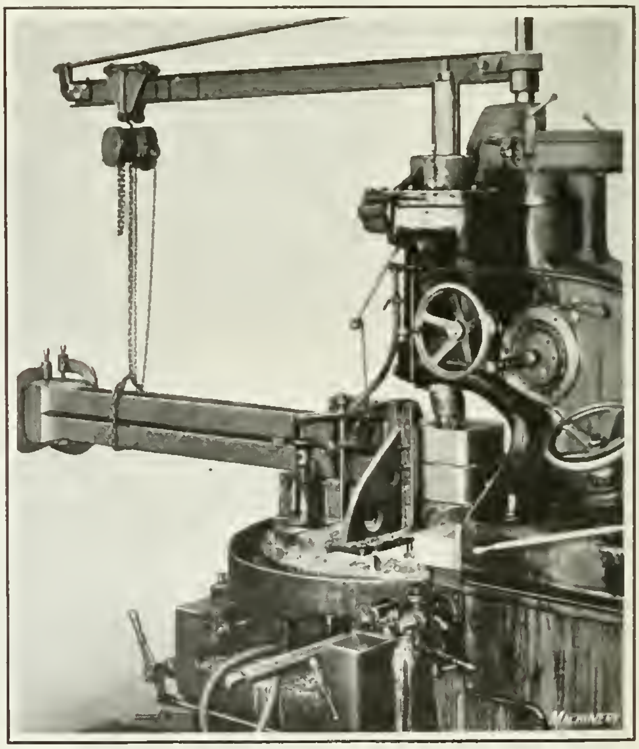

Fig. 5. Finish-milling the Piston End of the Rods

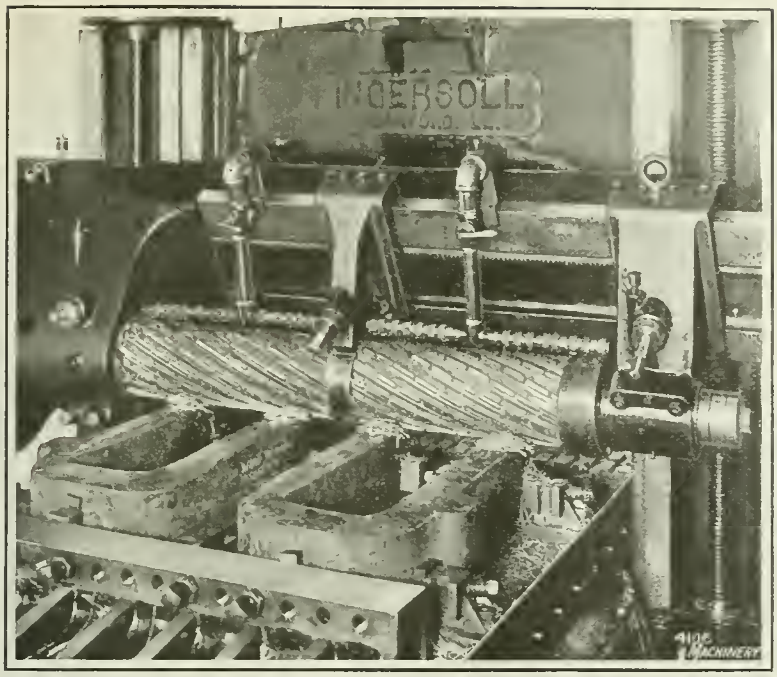

Fig. 6. Slab-milling Locomotive Main Rod Straps

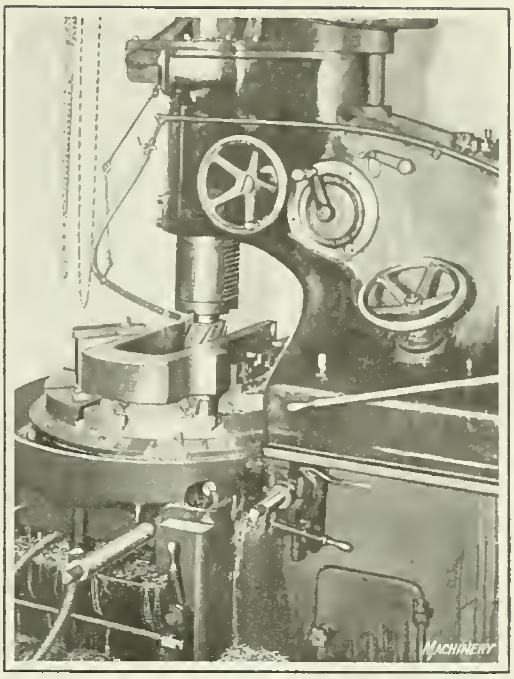

Fig. 7. Milling the Inside Surfaces

exterior surfaces, except those having a radius of less than 6 inches. This work was done on a vertical rotary machine with the work simply strapped to the platen, in the same manner as shown in Fig. 7. The data for this operation are as follows: Size of cutter, 6 inches diameter, 6 inches long (helical inserted-tooth); table feed, 1½ inches per minute; cutter speed, 53 feet per minute; depth of cut, ⅜ to ½ inch; width of cut, 5½ inches; and machining time per forging, one hour and twenty-five minutes.

The next operation consisted of milling the inside of the straps, except the 2-inch radius at the corners. This set-up is illustrated in Fig. 7. The machining data for this operation are practically the same as for milling the outside of the straps, except the machining time which is one hour and nineteen minutes. The set-up for finishing the inside corners of the straps to a 2-inch radius was similar to that shown in Fig 7 except that a solid type helical cutter, 2 inches in diameter, was used, and the machining time for this job was fifty minutes per operation.

The next milling operation which is the fifth in sequence, consisted of milling the outside corners, which have a 2½-inch radius. For this work, a set-up similar to that employed for the third operation was used. The cutter was 4 inches in diameter, of the helical inserted-tooth type, and operated at 53 surface feet per minute. The time required to machine two corners on each strap was forty-eight minutes, floor to floor. The last milling operation was machining the 2-inch radius around the exterior lug, as illustrated in Fig. 8. Here a 2-inch diameter solid helical cutter is shown in use, with its lower end supported in a bearing. The cutter speed was 50 feet per minute, the width of cut, 5½ inches, and the machining time, floor to floor, thirty-nine minutes for milling the two corners of each lug. For convenient reference, the data obtained as a result of the Ingersoll tests are presented in condensed form in the accompanying table.

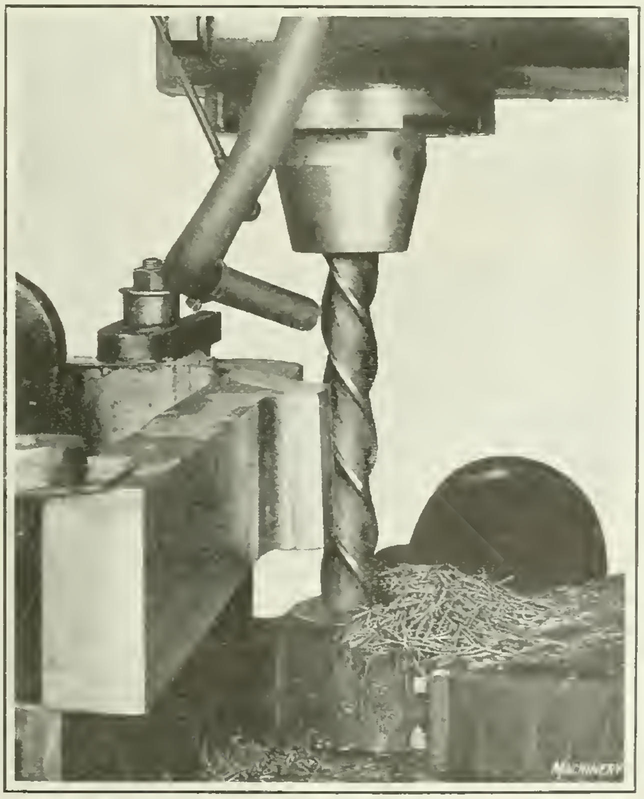

Fig. 8. Rounding the Corners of an Exterior Lug on the Straps

* * *

EYE INJURIES IN THE INDUSTRIES

The number of accidents resulting in workmen's losing one or both eyes is very great and strenuous efforts have been made to reduce them through the use of goggles. A great deal of experimenting has been done to secure satisfactory glass for goggles, and to produce designs that would meet all objections. Nevertheless workers generally are not favorably inclined toward the use of goggles. It appears that there is a slackening of attention to safety provisions in many industrial plants, and recent publications of the organizations interested in accident prevention have stated that safety provisions and insistence on the use of safety appliances have been discontinued in many places, and that the working conditions have been allowed to drift into the careless methods of former years. This is to be regretted, and while a great deal of it is due to the attitude of the worker who is likely to become indifferent to the dangers of his occupation, the management of industrial firms must continue to be vigilant and to bring pressure to bear to insure that safety appliances will be properly used.

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STANDARDS FOR ROLLER BEARINGS

Referring to the value of standardization in the automotive industries, B. B. Bachman, president of the Society of Automotive Engineers, lays great stress upon the necessity for proceeding in a rational way "to extend and continue the standards work which was inaugurated about twelve years ago, and which has been carried on continuously since. Cooperative endeavor of this kind is vitally essential."

Among the many things that the Society of Automotive Engineers is endeavoring to standardize are the dimensions for tapered roller bearings, on which a committee has been at work for some time. Ball bearings have been standardized so that the number of sizes available are limited to what is considered essential for the needs of the industries. Work is also progressing on standardizing straight roller bearings, a subject of equal importance. In the tapered roller bearing field there are now over 200 sizes used in the automotive industry, and it is believed that about 50 sizes would probably care for practically all requirements. It has been suggested that possibly the sizes could be so determined that tapered roller bearings would be interchangeable with the already standardized ball bearings.

This work is of great importance, and while it is evident that as the work of standardization proceeds, a great many differences of opinion will be encountered, there is no doubt that standards can be established that will meet the requirements of all. It may appear at times that too rigid standardization might be unwise, and might result in harmful restriction of initiative in the design and development of mechanical devices. Nevertheless, when standardization methods are not too drastic, they will always be found of value to the industry. Great savings in manufacture and in distribution will result, the methods of manufacture can be simplified, the range of sizes that have to be kept in stock can be reduced, the capital investment of manufacturers and dealers will be less, and the ultimate consumer will be able to buy a standardized product at a price much lower than that of a product where the number of types or sizes made is far in excess of actual needs.

* * *

TOOL STEEL SOLD ON A SERVICE BASIS

When a customer buys pig iron or structural steel, he buys so many tons of steel and pays for it, and there the transaction ends; but when a user of tool steel buys, it is not exactly so many pounds of steel he wants to acquire—it is the service of a tool steel to be used as a cutting tool. The value of steel to the buyer cannot be measured in pounds, but in performance. In this respect, tool steel as a product is in the same class as machine tools. The machine tool buyer is not seeking so many hundred pounds of cast iron and steel. What he wants is the reliable service of a machine that will perform certain work of a given quality in a given time. The same with tool steel—its value depends entirely upon its performance in cutting metal. If it does not stand up as required under a cut, the seller is sure to hear from the buyer. If it fails to respond properly to heat-treatment, the steel manufacturer will be asked to tell how his steel can be heat-treated to give maximum performance. With steels of good quality, the best results depend, of course, upon adequate heat-treatment.

Naturally, the price of tool steel should also be governed by its performance—in speaking of tool steel in this general way, high-speed steels, of course, are included. Composition or analysis alone does not determine the merit of a steel. It is possible to make two steels of exactly the same analysis, and yet one may be far superior to the other in cutting qualities. That is why firms that specify chemical analysis only are sometimes able to buy tool steel at a very low price. It is much easier for the steel manufacturer to make a steel of a given analysis than to make a steel that will measure up to certain performance requirements.

Users of tool steel who realize that they are buying steel, not by the pound but for service, will find that by insisting upon service rather than analysis they will get more actual value for their money. Manufacturers of tool steel and high-speed steel are able to render service to those who are able and willing to cooperate with them by stating exactly what their requirements are. More and more this becomes the modern idea of business—to sell not merely goods, machines, devices, or tools, but, in principle at least, to sell service.

* * *

THE HIGH-DUTY MACHINE TOOL

The introduction of a new machine or method is a slow process. High-duty, high-production machine tools are not yet fully appreciated by many manufacturers employing tool equipment. Few industries have taken advantage of the improved machine tools placed at their disposal during recent years to the extent that the automobile industry has, and as a result, the cost of its product has been reduced. In many other branches of the machinery industry we still find machine tools of obsolete types, with no capacity for steady high production. They continue to cut metal, but the speeds and feeds and other features do not compare with up-to-date machines. These faithful servants are steadily losing money for their owners, but there seems to be no desire to part with them.

The foreman of a shop using a line of lathes about twenty years old, questioned about the continued use of machines built before the days of high-speed steel, answered: "Well they are doing their share, with a little patching up every now and then." His superiors apparently were of the same opinion, or they would have replaced this equipment long ago. "Their share" was a very small one compared with what a new high-duty lathe could do; and the "patching up every now and then," over a period of years, probably cost almost as much as new machines.

The scrapping of worn-out or out-of-date machine tools and their replacement by new machines of greater capacity would usually save the buyers of shop equipment money. This is especially true of railroad shops but similar conditions will be found in many shops manufacturing pumps, steam engines, conveying machinery, and textile machinery, to mention but a few of the lines of manufacture in which there has not been so universal an application of modern machine tools as in the automobile industry. Prices of machine tools are as low now as they are likely to be for years. Eliminate the money-wasting machines that handicap you in competition, and get ready for the good times just ahead.

Assembling by Conveyor

A Recently Developed Assembly System for Increasing Production and Reducing Manufacturing Costs

By WARREN ORDWAY, The Lamson Co., Syracuse, N. Y.

IN the manufacture of a large class of products such as carburetors, meters, radio parts, lighting fixtures, etc., the cost of the material is negligible, as compared with the cost of manufacturing the component parts and assembling them. In some cases the assembly cost amounts to as much as 50 per cent or more of the total cost. A great deal of attention has been given to developing automatic machinery for turning, stamping, or casting small parts in quantity, but until recently the assembly has usually been done by the same old-fashioned bench methods that have been in use for generations.

The present article will show the application of conveyors in assembling systems, whereby the old bench system is eliminated and the assembly of light units made as quick and easily controlled as the manufacture of the parts entering into their construction. This new system is applicable to practically any assembly operation as well as to filling containers with liquids, inspecting, packing and boxing, and a hundred other uses. One advantage of the system here described is that it can be installed in an old plant as well as in a new one. The mechanical equipment required can usually be built around the existing production system without requiring serious changes in plant lay-out. Two typical installations are described in the following — one at the plant of the Moto-Meter Co., Inc., Long Island City, N. Y., makers of the Boyce "Moto-Meter" and the other at the plant of Mitchell & Co., Boston, Mass., makers of radio equipment.

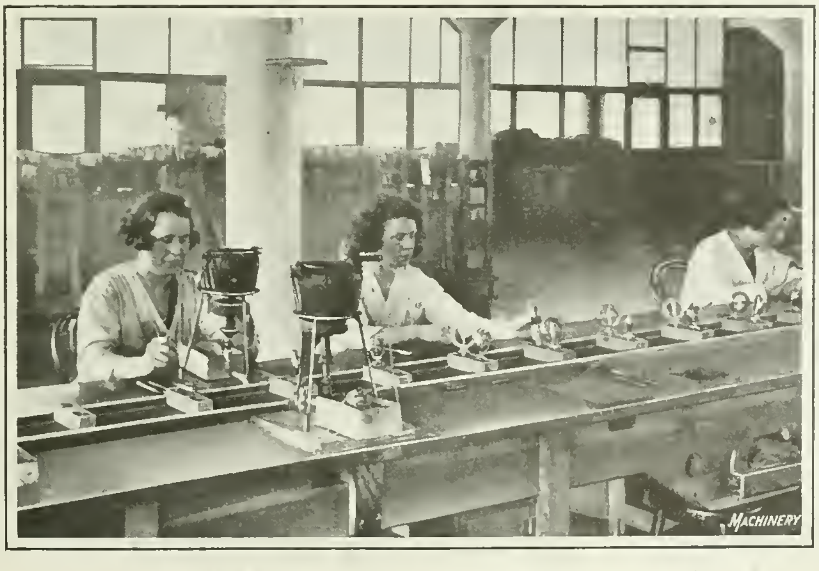


Fig. 1. Assembling "Moto-Meters" by the Conveyor Method; Cleats bored to hold Two Meters are attached to the Belt

Assembling "Moto-meters" by the Conveyor System

If Cadillac or Studebaker should wire to the Moto-Meter Co. for a thousand moto-meters, with special nameplates, it is probable that the order would be filled the same day, or at the latest by the next day. It might be imagined that to give such service as this an enormous stock of finished meters would be required, as there are seven separate models, and about 145 different types of nameplates that are in constant demand. But if a supply were kept in stock of the many hundreds of different combinations of models and nameplates which would be required to fill any order that might be expected, a great deal of capital would be kept tied up in finished goods.

As a matter of fact, that is the way the business was handled up to a few months ago. The finished stock amounted to about 160,000 meters. Today 100,000 fewer instruments are required in finished stock, and deliveries are made even more promptly than before. This remarkable achievement has been obtained by the installation of the conveyor system of assembly designed and built by the Lamson Co., Syracuse, N. Y. Before the installation of the conveyor system, the method used was one that is quite generally practiced in many plants today.

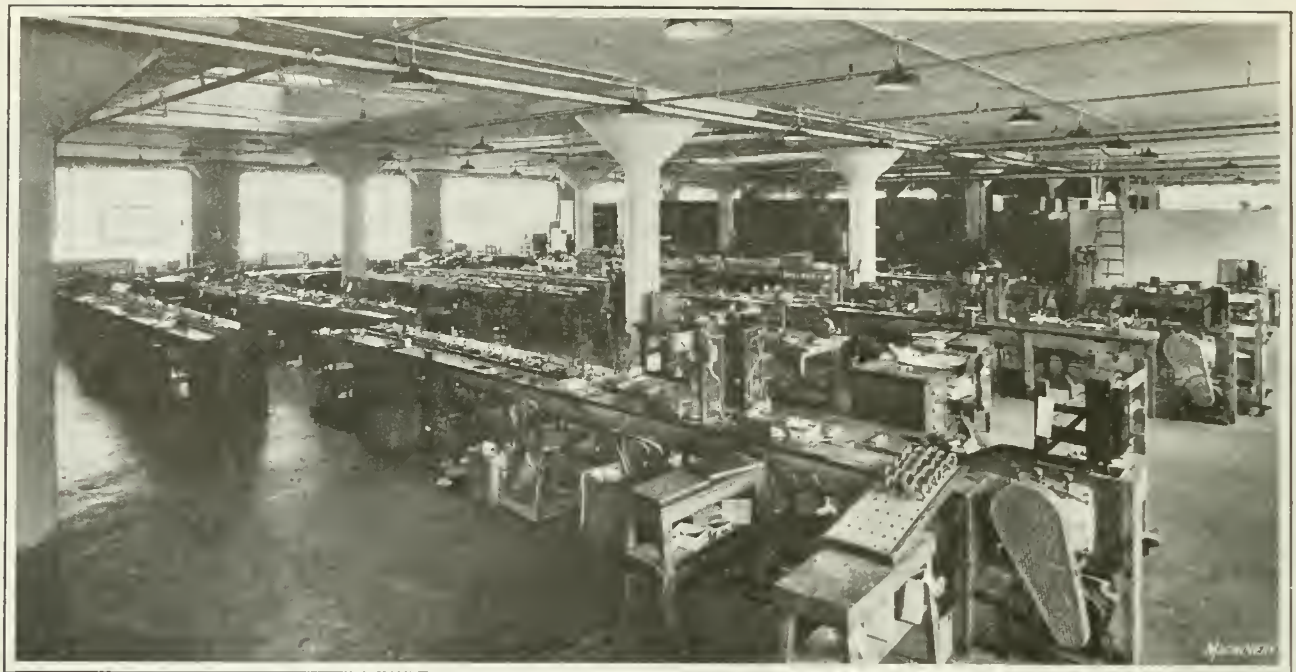


Fig. 2. General View of the Assembling Department of the Moto-Meter Co., showing the Large Number of Conveyors used

The meter frames came from the finished materials stock room on trucks holding six trays of fifty meters each, and passed from operation to operation on them.

There were about 100 trucks and 100 assembly tables measuring 4 by 2 feet at which the various assembly operations were performed. Besides taking up a great deal of space, and cluttering up the room with tables and trucks, this system required three or four days to finish an order, and tied up 20,000 instruments on a production schedule of 5000 per day. The workers found it hard to perform their tasks efficiently, as they were constantly interrupted by having to lift the trays of instruments on and off the trucks, and push the trucks about between the assembly tables.

Conveyors Adapted to Existing Production System

The conveyor system was built around this older production system without interfering with the methods of assembly which had been found satisfactory. The conveyor system is built in three units of three conveyors each, which carry the instruments past the various workers in the assembly line. The frames are started at one end, and the various parts are added as they pass along the conveyor, till at the discharge end, the finished, inspected, and boxed instruments are delivered ready for shipment.

The first operation is putting the frame together. This task is given to a girl who is chosen for her speed and alertness, as she sets the pace for the entire assembly operation. Once a frame is started along the line it must go through every process at the predetermined rate of production. Any slowing up of any operation causes the instruments to pile up, and is immediately seen and remedied. Besides insuring greater and more uniform production, this conveyor system makes the task of supervision far easier, as the conveyor itself serves as a pace-setter for every task.

There are six operations performed along the first conveyor: (1) putting the frames together; (2) rolling in the cap over the tube; (3) cementing in the thermometer; (4) scraping off superfluous cement; (5) enameling the back of the tube; and (6) inspecting. After the first inspection, the meters are sent down two conveyor lines, where the following operations are performed: (1) Back assembly; (2) front assembly; (3) final inspection; (4) packing; and (5) sealing and packing in cartons.

As indicated by the illustrations, the system consists of belts driven by electric motors; the belts are 6 inches wide with wooden cleats, bored to hold the moto-meters upright. The instruments are easily removed from the belt, and as easily slipped back into these bored cleats. The belts are driven at slow speed (from about 5 to 10 feet per minute) which can be varied to give any capacity desired. In an assembly line of this kind, however, a comparatively slow belt movement gives ample carrying capacity for the largest production the operators can turn out.

Speed and Flexibility of the System

The chief advantage of the conveyor system of assembly is the speed with which orders are put through and the consequent cutting down of stock in process and finished stock. In the plant of the Moto-Meter Co., the conveyors have cut down the time necessary to fill an average order from four days to considerably less than a day. This means that most orders can be filled the day they are received from semi-finished stock. The stock in process necessary for a production of 5000 instruments a day has been cut from 20,000 to 7500. The finished stock, as has been previously described, has been cut down from 160 000 to 60,000 instruments, with even better service to customers than before.

Savings of Labor and Space Due to Conveyor System

In addition to these savings, the savings in labor amount to 15 per cent, and would pay for the entire system in about two and one-half years. This greater labor efficiency comes from saving the girls' time by eliminating the moving about of trays and racks of product, and from the pacemaking feature of the conveyor, which insures steady and uniform production. As all unnecessary hand and body movements of the operators are done away with, they do their work with much less fatigue, and turn out an increased production with much less effort than previously.

The space saved by the system is also considerable. Each assembly table formerly used occupied 4 by 2 feet, and the trucks were bulky and required considerable aisle space. Compared with this, the conveyor system occupied only a fraction of the space, and every square foot is put to productive use. The wear and tear on the trucks and the floor, while hard to compute, is also an item which becomes fairly large during the course of a year.

Effect of System on Operators

A great deal has been said about the objection of labor to new labor-saving machinery, and particularly to machinery that sets a pace in regard to working speeds. This objection has not been found to apply in the Moto-Meter plant in regard to the assembly conveyor system, because the assemblers, while they are enabled to turn out more work than under the old system, can do it with much less physical labor and fatigue. The conveyors save them all the heavy work of lifting the trays of instruments and pushing about cumbersome trucks, and leave them only the lighter work requiring their particular skill.

Assembling Radio Parts by the Conveyor System

The experience of Mitchell & Co., Boston, radio equipment manufacturers, may prove of value to any company whose problem is that of increasing production without a corresponding increase in equipment and personnel. This company used conveyors to obtain a bigger share of the flood of radio business in the early part of this year than they could otherwise have obtained. Although the conveyor system used by this company is moderate in size and in first cost, C. R. Dumble, chief engineer of the company, states that it has increased the production per worker five times, and the production from a given area of floor space ten times.

Before the conveyor system was installed, assembly was done in the usual way on tables, each operator putting together complete the various items handled. The floor space required was large, and the production was low, as it was difficult to check the work of each assembler. The rejections, too, were large enough to be quite an item of expense. Under the conveyor system, every job is broken up into a number of individual operations, each one of which is performed by one or more workers. The work is done on a moving conveyor which carries the parts from operation to operation, and takes the finished and boxed product to the stock-room.

Construction of Conveyors

There are two conveyors, 24 inches wide and 46 feet long, which are electrically driven at 90 feet per minute. Each conveyor has two partitions running its entire length, which virtually divides the belt into three 8-inch belts. The two outside partitions are used to carry the parts between operations, while the central section carries the boxed product to storage. The outside belts are equipped with movable switches, one at each operator's place which throws the parts out on the assembly benches located on each side of the belt. These switches provide a very flexible arrangement. They can be set to deliver from each operator to the next, or, where two or more operators perform one operation, they can be thrown in and out of position as each operator desires more material to work on.

Assembling Radio Switches

A good example of what the system accomplishes is found in the assembly of radio switches, one of the specialties of the company. Eight operators are required who perform the following operations: (1) Remove paper from knob; (2) screw blade or insert; (3) put shaft on insert; (4) tighten shaft; (5) and (6) put on bushing, spring, and nut; (7) inspect, wrap, and put in box; (8) put on cover and place on belt. Composition knobs are brought to the worker at the first operation about once an hour. Most of the other parts are so small that a box of them under the conveyor, will last all day. The paper packing boxes which come to the packer are carried on a narrow conveyor discharging from a hopper over the conveyor table.

In the operation of the system the various tasks require different degrees of speed and application. The system is therefore run in continuous half-hour shifts, with short rest periods between, the operators being moved after each rest period. In this way a girl who packs for a half hour—a task requiring great speed and accuracy—may remove the wrappers from the knobs during the next period—the easiest task on the conveyor line. This moving from task to task makes for a more flexible organization and relieves the monotony of doing one small operation all day long. The pacemaker for this system is the fourth operator who tightens shafts. On this task a skilled male operator is employed continuously.

The Feature of Automatic Supervision

This system practically does away with any need of supervision. Each operator, while the belt is moving, must keep her work up with the rest, or else her parts will stack up and at once become noticeable. The first operator, while not serving as a forewoman, acts as a "flywheel of production" and irons out any irregularities of output that may occur along the line, by helping out the girls who are behind. The effect on the workers is also remarkable, as shirkers are automatically eliminated. The earnings of the employes are also greater than under the ordinary assembling methods, as piece-work prices can be so set as to permit of a bigger daily wage. The inspection, too, is practically automatic. Each operator becomes virtually the inspector of the work of the previous operator. The high quality of this consecutive inspection is evident from the fact that out of 50,000 of a certain type of switches manufactured, there is said to have been but one defective unit.

The production with conveyors has been increased fivefold. Under the old plan, four operators, at benches, turned out 300 switches complete per hour. With the conveyor

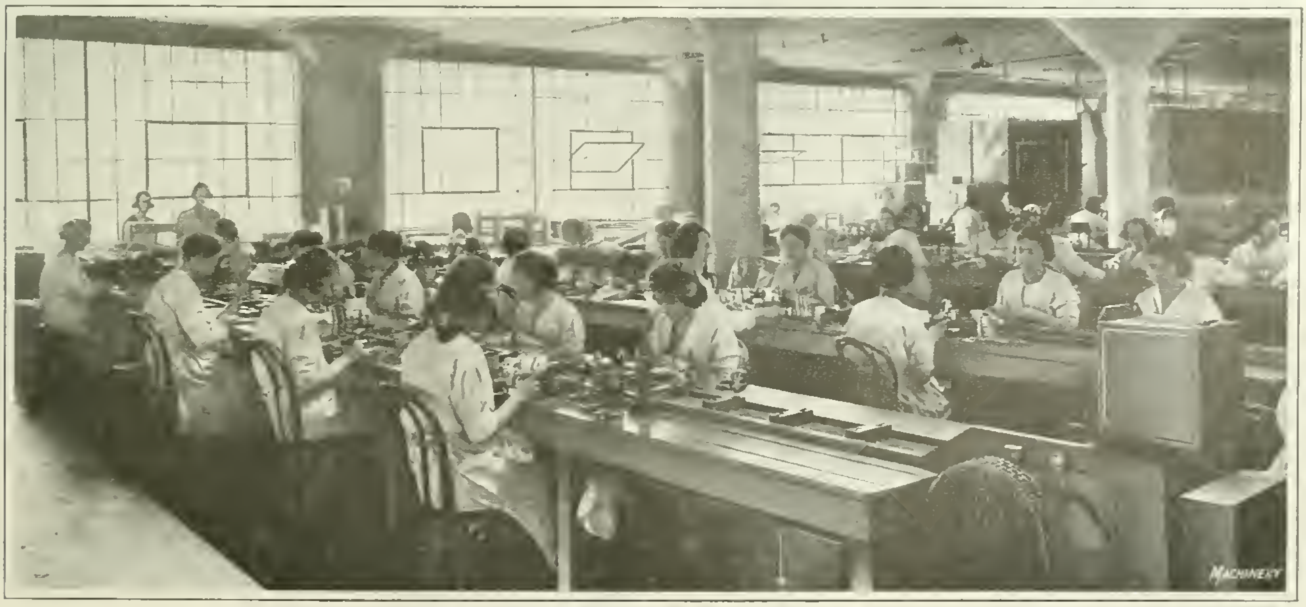


Fig. 3. A View of the Assembling Department, showing Conveyors with Operators at Work

eight operators can easily complete 3000 switches in an hour. The space required is only one-tenth of what was needed with the tables for an equal production. Four people required a floor space of 10 by 18 feet for 300 per hour, while about the same space is sufficient to turn out 3000 per hour with the conveyor. Three thousand boxes of finished switches alone, representing one hour's work, would pile up 20 feet of table 4 feet wide, while with the conveyor they are in the stock-room almost as soon as complete. This is a very important advantage with rents as high as they are today, and in itself will pay for the conveyor in a few months' time. The speed of the new system is self-evident. Orders that formerly required several days to fill can now be shipped the day the order is received.

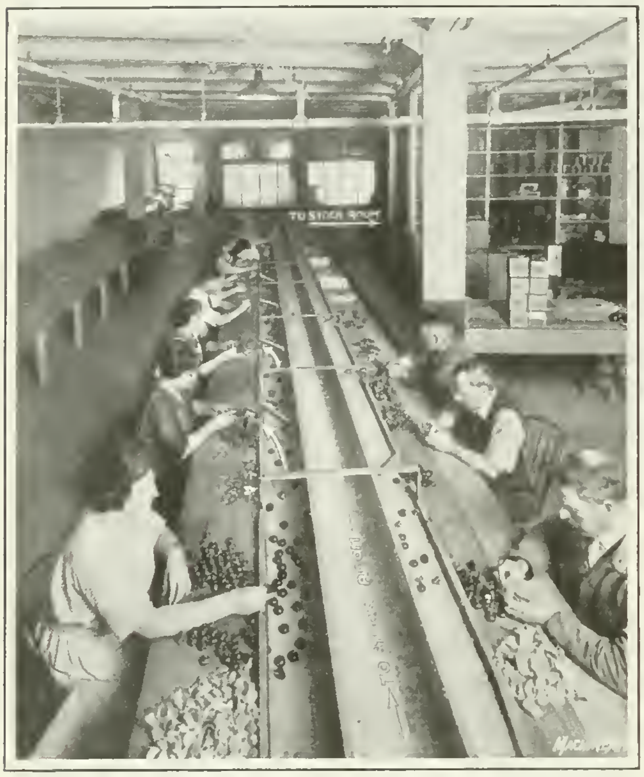


Fig. 4. Assembling Radio Apparatus by the Conveyor System

Assembling Automobiles by the Conveyor System

One of the most familiar applications of the conveyor system of assembling and one of the earliest to be worked out, is the consecutive assembly of automobiles. The Lamson system used by the Franklin Motor Car Co., Syracuse, N. Y., is a good example. Here the chassis is assembled along a conveyor running the length of the department, the wheels are put on as the chassis passes across one end, and the body is put on and finished as the automobiles are carried down a conveyor parallel with the first. Although the workmen were changed from a piece-work to a day-work basis when this conveyor was installed, the production was increased to such a point that the daily quota of cars was turned out with about 20 per cent fewer employes.

An interesting story is told about this conveyor. Owing to a break in the power line, it was put out of service for an hour or two one morning. During the afternoon, the conveyor was speeded up enough to complete the daily quota of cars, and the workmen made up the lost production without knowing what was going on until they were told about it at the end of the day.

The conveyor systems described are typical of those used in various plants making machines or apparatus from metal or wood. Numerous other applications could be cited, as in cash register manufacture, lighting and starting sets in automobile manufacture, etc., but the examples shown indicate the general application of the conveyor system of assembly.

CONVENTION OF THE SOCIETY OF INDUSTRIAL ENGINEERS

The Society of Industrial Engineers will meet for its ninth annual convention at the Hotel McAlpin, New York, October 18 to 20. At the opening session at 3:00 P. M., Wednesday, October 18, Joseph W. Roe, president of the society, will speak on "The Relation of Economics to Industry."

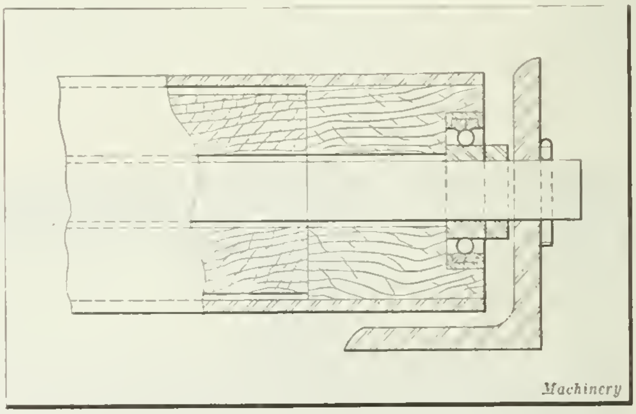
"The Economic Background Necessary for a Business Executive," is a topic that will receive special consideration at a general meeting of the Educational Group on the first day of the convention. At another meeting, Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, will present a paper on "The Economic Aspect of Production." Arthur J. Todd, director of labor, B. Kuppenheimer & Co., will deliver a paper on "The Industrial Age." A. J. Lutterback, comptroller, Palmolive Co., will speak on "The Budget and the Financial Forecast."

At the banquet, three other speakers of note will address the convention—F. H. Sisson, vice-president, Guaranty Trust Co.; D. R. Dewey, Massachusetts Institute of Technology; and Royal R. Keely. Mr. Keely has recently returned from two years engineering work in Russia. He is an industrial engineer and will speak on "The Industrial Situation in Russia." The Friday evening session is to be devoted to the subject "The Application of Material Handling for the Purpose of Reducing Costs and Increasing Production." There will be an interesting exhibit of material-handling equipment, as well as other factory and office equipment.

* * *

ROLLER FOR GRAVITY CONVEYOR

Gravity conveyors of the roller type are used in automobile and other manufacturing plants for assembling various units, and are often subjected to severe service in handling the heavier parts. At the plant of the Studebaker Corporation the experience has been that pressed-steel and cast-iron rollers are unsatisfactory for conveyors used in assembling such units as the motor and, as a consequence, in new conveyor installations this company is using rollers of the design illustrated. The roller consists of a steel tube 2½ inches outside diameter and 5/32 inch thick, which is backed up by a hard-wood core that extends the length of the tube. At each end of the hardwood core is a Schatz annular ball bearing. The inner race of the bearing rests on the round bar which supports the roller in the angle-iron of the conveyor frame. This angle-iron is 2 by 3 inches. The round bar of the roller is held in place by means of cotter-pins. These rollers are made in various lengths to suit conditions.



Gravity Conveyor Roller with Hard-wood Core and Steel Outer Surface

* * *

The production of automobiles and trucks in the United States for the eight months ended August 31 was about 1,660,000 cars, compared with 1,668,500 cars for the entire year of 1921.

Can Tapered Roller Bearings be Run at High Speeds?

By T. V. BUCKWALTER, Chief Engineer, The Timken Roller Bearing Co., Canton, Ohio

It is generally believed among engineers and shop men that tapered roller bearings are not suitable for bearings running at high speeds—that is, at 3000 revolutions per minute and over. This belief is so firmly established in the minds of many well informed technical men that it has been deemed advisable to place on record the results obtained in running tapered roller bearings economically and efficiently at speeds exceeding not only 3000 revolutions per minute, but 10,000 revolutions. When it becomes thoroughly appreciated that tapered roller bearings can be successfully used for high speeds, an entirely new field will be opened up for the application of these bearings. Their advantages in machine construction will lessen operation costs in machine shops and other industrial plants. There are some applications for which it appears that no other type of bearing is quite as satisfactory as a roller bearing, and for that class of service there will be an opportunity to save in maintenance expense.

PERFORMANCE records of tapered roller bearings over as many as ten years in the plants of important manufacturers have proved conclusively that tapered roller bearings will carry heavy loads efficiently and economically at continuous speeds as high as 11,500 revolutions per minute. The term "high speed" is generally applied to machines operating at 3000 revolutions per minute and over, including grinding and buffing machines, motors and certain special-purpose machines. The bearings in the transmissions and pinions of many automobiles operate at speeds in excess of 3000 revolutions per minute, which is only a medium speed, it is true, in comparison with the much higher speeds of many kinds of industrial machinery. But the transmission or pinion bearing, although operating at only 3000 revolutions per minute, is actually subjected to more severe service than the industrial machine bearing operating at a much higher rate, for the simple reason that the automobile bearing transmits more power and consequently carries a heavier load.

Experience of Users of Tapered Roller Bearings Operating at High Speeds

It is not surprising, considering its conspicuous success in automotive service, that the tapered roller bearing is giving such a good account of itself in the faster, but less severe, service met in industrial machinery. The experiences of users of tapered roller bearings operating at high speeds will no doubt be of interest, and therefore a number will be cited in this article.

One manufacturer states that before using tapered roller bearings in his buffing, polishing, and spinning lathes, the bearings required four complete replacements a year, the average bearing life being about three months. Since changing to tapered roller bearings two years ago no replacement has been necessary, the bearings still functioning as well as when new and no wear being apparent. During this time the lathes have operated continuously at 3400 revolutions per minute nine hours per day.

A technical instrument manufacturer, using a well-known polishing lathe, replaced the bearings furnished by the lathe manufacturer with tapered roller bearings. After fifteen months of service at 4350 revolutions per minute for eight hours per day, the tapered bearings were found to be in good condition and adjustment was unnecessary. This manufacturer states that with the bearings formerly used two entire replacements would have been required.

A manufacturer of polishing machines operating at speeds up to 10,000 revolutions per minute, has equipped his machinery with tapered roller bearings since 1911, and has never received a complaint of bearing failure from his customers. He states that on direct motor-driven polishing machines having the wheels mounted on the armature shaft, the tapered roller bearing is ideal, especially with alternating-current motors, because it holds the rotor central and prevents it from dragging on the stator and burning out the windings.

A large automobile manufacturer has placed tapered roller bearings from his regular stock in grinding machines of his own design and manufacture. His internal grinding machines operate at a speed of about 16,000 revolutions per minute. According to the production manager, the advantage derived is the reduction of the maintenance force on grinder spindles to about one-third that required when the spindles were equipped with plain bearings.

Another large automobile manufacturer is introducing tapered roller bearings in a general line of machinery of his own design and manufacture. Some of the grinding machines operate at a speed of 11 500 revolutions per minute. A manufacturer of automobile accessories has also introduced tapered roller bearings in grinding machinery of his own design and manufacture, the spindles of which run at 7000 revolutions per minute.

Conclusion

The facilities for the production of tapered roller bearings might almost be said to have been commandeered by the automotive industry until within recent months. The application of these bearings in the mechanical field within the last ten years, therefore, has been largely voluntary with manufacturers. Notwithstanding this conlition, there are upwards of 400 applications in the mechanical field in a wide variety of loads, speeds, and kinds of service. This general success has prompted a leading manufacturer of tapered roller bearings to organize for a more general introduction of the tapered roller bearing to the mechanical field.

* * *

PACKING FOR EXPORT

The Bureau of Domestic and Foreign Commerce has often pointed out the importance of proper packing for export. It is stated that frequently American manufacturers do not pack any more securely for export than they do for domestic shipments. As a specific example, in one shipment of nuts and bolts contained in wooden kegs, 80 per cent of the kegs burst when they were lowered from the ship into lighters, the contents being scattered all over and having to be shoveled into bags and later sorted out by hand. European exporters, it is stated, use sheet-iron containers, which are greatly to be preferred. One European firm recently secured an order for fifteen tons of rivets by cable, because an American concern disregarded the instructions to ship in double bags of heavy material, which, while not as good as sheet-iron kegs, nevertheless are greatly superior to wooden containers.

Tests on Anti-friction Lineshaft Bearings

By J. F. McGUINNESS, Directing Transmission Engineer, Hyatt Roller Bearing Co., New York

To the manufacturer whose main object is to operate his plant on the most efficient basis, the merits of a new or improved piece of machinery are founded entirely upon the actual saving derived from its use. If, by comparison with the equipment it replaces, the difference in power consumption, labor, production and maintenance is sufficient to pay for the new machine within a reasonable period—say one year—the purchase of such equipment is considered an attractive investment. When E. I. du Pont de Nemours & Co., one of the country's largest power consumers, took up the question of using anti-friction bearings on lineshafting as a means of reducing power consumption, the engineers in charge of their power transmission department approached the subject with the single idea of determining the investment value of anti-friction equipment. This department, supervising the transmission of power throughout the duPont organization, could not report favorably on the anti-friction idea without first giving it a thorough test under practical working conditions.

In looking about for an installation of maximum severity (one termed a hard drive) a double-shaft drive was selected in the sulphonating house connected with the dye plant at Carney's Point, N. J. At that time this shafting was equipped with twenty-eight ring-oiling bearings, the sizes being 2 7/16, 2 15/16 and 3 7/16 inches. This shafting transmitted power to large vats containing paddles, which agitated heavy and somewhat viscous liquids used in the manufacture of dyes. The plant was operated on a twenty-four hour per day basis continually.

In order that the test of both the ring-oiling bearings and the anti-friction bearings could be conducted under conditions as nearly alike as possible, it was decided to run both tests the same day. A corps of engineers, therefore, in charge of William Stanier, chief transmission engineer of the duPont organization, set up the necessary instruments consisting of a wattmeter, an ammeter and a recording wattmeter. The actual test of power consumption with the shafting running in ring-oiling bearings was begun at 10:00 A. M. and consumed altogether one hour and forty-five minutes. During the test, readings were taken at full load, the lineshaft running with the countershaft belts disconnected and with the motor running idle.

The anti-friction bearings were of the flexible roller, split type, and these were substituted for the plain bearings without removing pulleys couplings or collars. Four millwrights, each one aided by a helper, made this change, the average time required to remove one ring-oiling bearing and set in place one roller bearing being about six minutes. After the roller bearings had been oiled and allowed to run for a half hour, the power consumption of the shafting equipped with roller bearings was recorded, the same combinations of drive being used as during the ring-oiling test. The figures recorded as a result of these tests are as follows:

Type of Bearing Tested	Power Consumed
Ring-oiling bearings	31.3 H. P.
Roller bearings	26.8 H. P.
Saving with roller bearings	4.5 H. P. (or 3357 watts)

These figures show a power saving of 14.4 per cent under full load by using roller bearings. Assume that the costs are $0.013 per kilowatt-hour for power, $0.40 per gallon for oil and $0.65 per hour for labor. The ring-oiling bearings are oiled once a week, but the roller bearings require attention only once every three months. The time for oiling either set of bearings averages 1.4 hours and the entire equipment consumed 1.5 gallons of oil at each refilling.

The efficiency of roller bearings from the standpoint of dollars and cents may be readily ascertained. As there is a saving of 3357 watts, the annual saving in power based upon 7200 hours, is determined as follows:

$$\frac{3357}{1000} \times 7200 \times 0.013 = \$314.22$$

Oil and oiling labor costs for the ring-oiling bearings are as follows:

Oil cost = 1.5 gal. × 52 weeks × $0.40 per gal. = $31.20
Labor cost = 1.4 hrs. × 52 weeks × $0.65....... = $47.32
Total per hour = $78.52

Oil and oiling labor costs for the roller bearings are as follows:

$$\$78.52 \times \frac{4 \text{ times yearly}}{52} = \$6.04$$

Hence the saving in oil and labor = $78.52 — $6.04 = $72.48 and the total saving by using roller bearings = $314.22 + $72.48 = $386.70.

To determine the value of roller bearings as an investment, the following figures were compiled:

Cost of roller bearings	$654.27
Cost of ring-oiling bearings	$432.00
Additional cost of roller bearings	$222.27

$$\frac{\text{Annual saving by using roller bearings}}{\text{Additional cost of roller bearings}} = \frac{\$386.70}{\$222.27} \times 100 = 174 \text{ per cent}$$

The time required to pay for the additional cost of the roller bearings equals:

$$\frac{\text{Additional cost of roller bearings}}{\text{Annual saving by using roller bearings}} = \frac{\$222.27}{\$386.70} = 6/10 \text{ year or } 7.2 \text{ months}$$

The economy resulting from the use of roller bearings on lineshafting is obtained on small installations as well as large ones. From the testimony of a number of users covering a wide variety of industries, power savings are reported ranging from 14 to 27 per cent of the total load. Considering the local conditions governing every installation, this range of savings is logical. Apart from the power-saving features of roller bearings, consideration must be given to their merit from the standpoint of endurance. Records are available showing service running from twenty years to as high as thirty years without a single item of repair or change.

* * *

In a paper recently read before the Royal Society of England by Sir Robert A. Hadfield, attention was drawn to the iron resources of the world. It has recently been estimated that if the iron output should continue to grow at the pre-war rate of increase of 5 per cent annually, the world's supply of iron would be exhausted in 150 years. It was pointed out that if China should begin to use steel in the same quantity as the United States uses it, the output of pig iron in the world would so increase that the richest sources of iron ore now known would soon be exhausted.

Strength of Internal Spur Gear Teeth

By DOUGLAS T. HAMILTON, The Fellows Gear Shaper Co., Springfield, Vt.

THE tooth action of internal spur gears is somewhat different from that of external gears, and problems are met with in designing internal gears that are not present in the other type. Several of these problems relate to the strength of the teeth. Before discussing this subject, however, it might be advisable to review briefly an improved method for determining the strength of gear teeth. The parabola scheme, which is well known, is a rather hit-and-miss method, and in order to obtain accurate results, it is necessary that the person using it have some experience in dealing with the strength of gear teeth. It is simple to apply, but the results are not so accurate as can be obtained by other methods.

The derivation of the parabola or Lewis method is illustrated diagrammatically in Fig. 1, where the tooth pressure *P* is resolved into two forces *R* and *T* meeting at point *B*. This is the top of the parabola, one leg of which is tangent at *C* to the tooth profile. The parabola thus constructed encloses a cantilever beam of uniform strength, which is tangent to the tooth outline at the weakest portion of the tooth—at points *C* and *F*. The problem is to determine the location of the line *CF*.

Determining the Weakest Section of Tooth by Calculation

In the improved method of determining the strength of gear teeth, as illustrated in Fig. 2, a gear tooth is drawn from four to ten times its actual size. The fillet on one side should be carefully drawn in, because the weakest section of the tooth generally lies in the vicinity of the fillet, and an inaccurately drawn fillet might change the calculated strength of the tooth considerably. If the gear tooth is to be cut with a generating cutter, the fillet should be "generated," whereas if the tooth is to be cut with a formed milling cutter, the fillet should be carefully drawn. If fairly accurate results are desired, a 10 to 1 scale is preferable. After the drawing of the tooth has been completed, a series of parallel lines e, e_1, e_2, and e_3 are drawn 0.100 inch apart and at right angles to the center line of the tooth. Then a line f is constructed. The pressure line P is drawn through the point of the tooth and tangent to the base circle, and the line f passes through the point of intersection of lines R and P.

Now, the weakest section of the tooth can be determined by measurements and by calculation. The procedure is to measure the length of line e from the vertical axis of the tooth to the tooth curve, or distance g. Then square this distance and divide it by distance h. This gives a factor. For example, g in this particular case equals 0.1015 inch and h equals 0.2 inch; then $0.1015^2 \div 0.2 = 0.0515$. Proceeding in this manner, starting well above what appears to be the weakest section and continuing until the values begin to increase again, the lowest value will indicate the weakest section of the tooth. The distance g_2 squared and divided by h_2 gives 0.05101, which lies between 0.0512 and 0.05107.

In order to prove that line e_2 indicates the weakest section of the tooth, measure and calculate on each side of line e_2, taking spaces 0.050 inch apart. In this way it can be determined very accurately just where the weakest section of the tooth really is. The value x obtained by squaring the base of the triangle at the weakest section and dividing by its height, as explained in the foregoing, gives the value x that is used in the Lewis formula, as illustrated in the diagram Fig. 1.

Factors Governing the Strength of Internal Gear Teeth

To show how the Lewis formula can be applied to internal gear teeth, it will be first necessary to explain briefly the difference between an internal and an external gear. An internal gear might be defined as an external gear turned inside out, so that the addendum of the teeth is within the pitch circle. This condition causes a different action of the teeth in that, for the same ratio of teeth, the length of the line of action is increased somewhat in an internal gear. Furthermore, modifications of the teeth are necessary on internal teeth when a small pressure angle and certain tooth

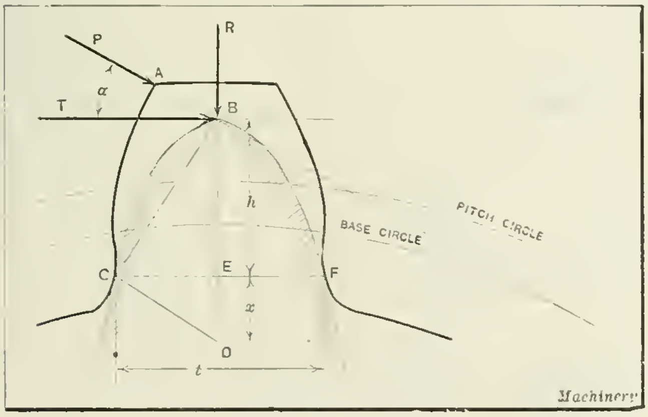


Fig. 1. Diagram used in the Derivation of the Lewis Formula

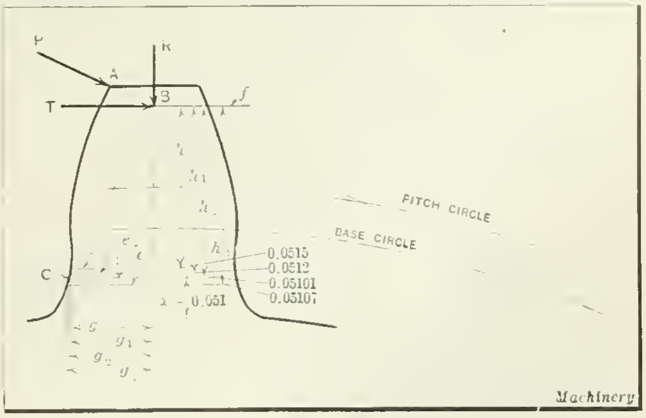


Fig. 2. Lay-out for finding the Weakest Section of a Gear Tooth

ratios are used. This will be seen in the lay-out at *A*, Fig. 3, which shows that if a pinion having 16 teeth of 8 diametral pitch is to run with an internal gear having 40 teeth, the pressure angle being 14½ degrees it is necessary that the teeth of the internal gear be entirely removed for the length of the cross-hatched portion *C* and that they be modified for the length indicated by the dark portion *D*. Increasing the number of teeth in the pinion and keeping all other factors the same, reduces the shaded and dark tooth portions as shown at *B*.

If the internal gear tooth is not modified, it will interfere with the flank of the pinion tooth, and the gears will not have the correct action. That part of the internal tooth which extends inside the base circle can be removed, as there can be no possible rolling action inside the circle from which the involute is generated. The gear tooth is obviously stronger than the pinion tooth, so that, in determining the strength of an internal gear tooth, it is always necessary to deal with the pinion.

Determining the Initial Point of Tooth Contact

In calculating the strength of an internal gear tooth, the initial point of contact of the pinion and gear teeth must first be determined. This is governed by several factors—the pressure angle, the tooth length, the ratio of the gear and pinion, the type of cutter used, and the relative number of teeth in the cutter used, if it is of the gear-shaper type. The first three points are made clear in diagram Fig. 4, in which are constructed the pitch, base, and root circles, as well as the inside circle of the gear and the outside circle of the pinion. There are 40 teeth of 8/10 diametral pitch on the gear, and 16 teeth on the pinion, the pressure angle being 20 degrees. If there is no under-cutting of the pinion tooth, which is practically the case with the conditions shown, that part of the internal tooth that extends inside the initial point of contact *E* will interfere with the flank of the pinion, and should be modified to give proper action. The initial point of contact *E* is that point at which a line drawn from the center of the pinion and at right angles to the line of action cuts the latter. This point also locates the base circle of the pinion. Now, regarding the cutter, if this is of the gear-shaper type and has a larger number of teeth than the pinion that is to run with the gear, it will in certain cases cut away more of the tooth than is actually required, and hence the initial point of contact will take place farther along the line of action. It is therefore necessary to take the number of teeth in both the cutter and the pinion into consideration, as they determine, in connection with the other factors mentioned, the location of the initial point of contact.

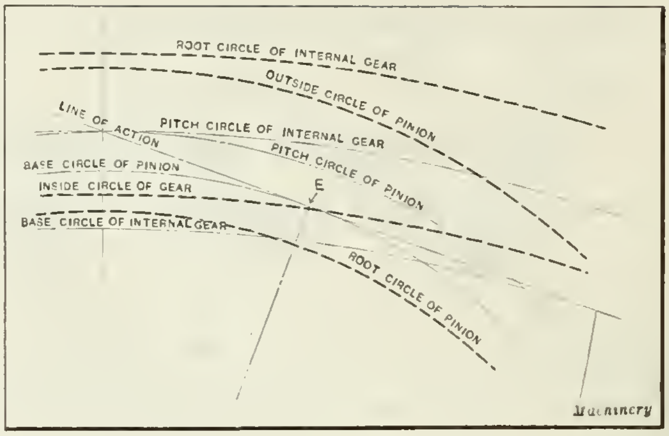


Fig. 4. Lay-out indicating the Manner in which Certain Factors control the Location of the Initial Point of Tooth Contact

Application of the Lewis Formula to Internal Gear Teeth

To illustrate how the Lewis formula is applied to determine the strength of internal gear teeth, assume that it is necessary to find the strength of the internal gear represented at *A*, Fig. 3. Here, the initial point of contact *F* is advanced along the line of action from point *E* which corresponds to point *E* in Fig. 4. It will also be seen in Fig. 3 that the internal gear will not run with this pinion unless the dark and cross-hatched parts of the tooth are corrected and removed, respectively. The point of application of the load on the gear tooth is, of course, along the line of action at the point of contact.

Calculation will show that x is equal to 0.177 for the gear tooth, and to 0.042 for the pinion tooth. An increase in the number of teeth in the pinion, all other conditions remaining the same, affects the strength of the internal gear tooth. By increasing the number of teeth in the pinion to 24, and keeping all other factors as they were, as shown at *B*, factor x for the pinion is increased to 0.0515, and for the internal gear tooth it is reduced to 0.135. This results from the longer leverage or effective lengthening of the tooth. Obviously, the shorter the tooth, relative to the thickness at the base, the stronger it is; and by increasing the length of the tooth, keeping the base the same, the tooth becomes weaker.

Fig. 5 shows the effect of an increase in the pressure angle and the use of a stub tooth on the strength. At *A* is shown a 13-tooth pinion of 8/10 diametral pitch, 20-degree pressure angle, in mesh with a 40-tooth internal gear. The darkened portion indicates the amount to be removed from the gear tooth to insure proper action. The value of x for the gear is 0.129.

A gear and pinion having the same ratio of teeth, but of 8 diametral pitch and 14½-degree pressure angle, is shown at *B*. More trimming is necessary, thus reducing the effective length of the tooth, and although the pressure angle is less, the tooth is theoretically stronger, owing to the shortening of the working length, the value of x being 0.1480. It is evident that a shortening of

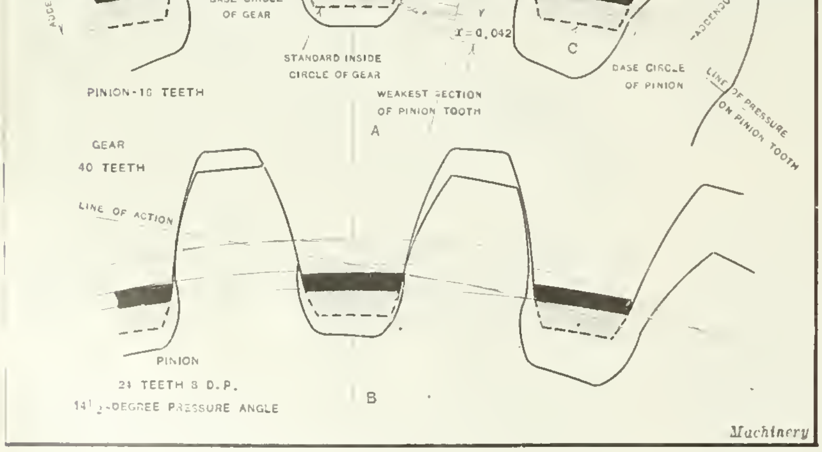

GEAR
40 TEETH, 8 D.P.
14½-DEGREE PRESSURE ANGLE
x = 0.177
Y
WEAKEST SECTION OF GEAR TOOTH
ROOT CIRCLE OF INTERNAL GEAR
LINE OF ACTION
PITCH CIRCLE OF INTERNAL GEAR
F
D
E
ADDENDUM
BASE CIRCLE OF GEAR
Y
x = 0.042
C
ADDENDUM
STANDARD INSIDE CIRCLE OF GEAR
BASE CIRCLE OF PINION
LINE OF PRESSURE ON PINION TOOTH
PINION-16 TEETH
WEAKEST SECTION OF PINION TOOTH
A
GEAR
40 TEETH
LINE OF ACTION
PINION
24 TEETH 8 D.P.
14½-DEGREE PRESSURE ANGLE
B
Machinery

Fig. 3. Modifications Necessary on Internal Gear Teeth

the tooth affects the strength more than an increase in the pressure angle. Of course all the factors involved have not been discussed—only the main points regarding the effective strength have been explained.

One reason that the strength of internal gears does not receive more attention is that when an internal gear and pinion are made from the same material, the pinion is obviously always the weaker member, and the strength of the internal gear teeth is immaterial. But when an internal gear is made from one material and the pinion from another, it is necessary that the strength of both be found. In this connection, it might be stated that when an internal gear and pinion are to be made from the same material, the strengths of the pinion and internal gear teeth are sometimes balanced approximately. This is done by increasing the thickness of the pinion tooth at the pitch line, and increasing the width of the tooth space in the internal gear a proportional amount. This can only be done by a cut-and-try method, but it is comparatively simple in application.

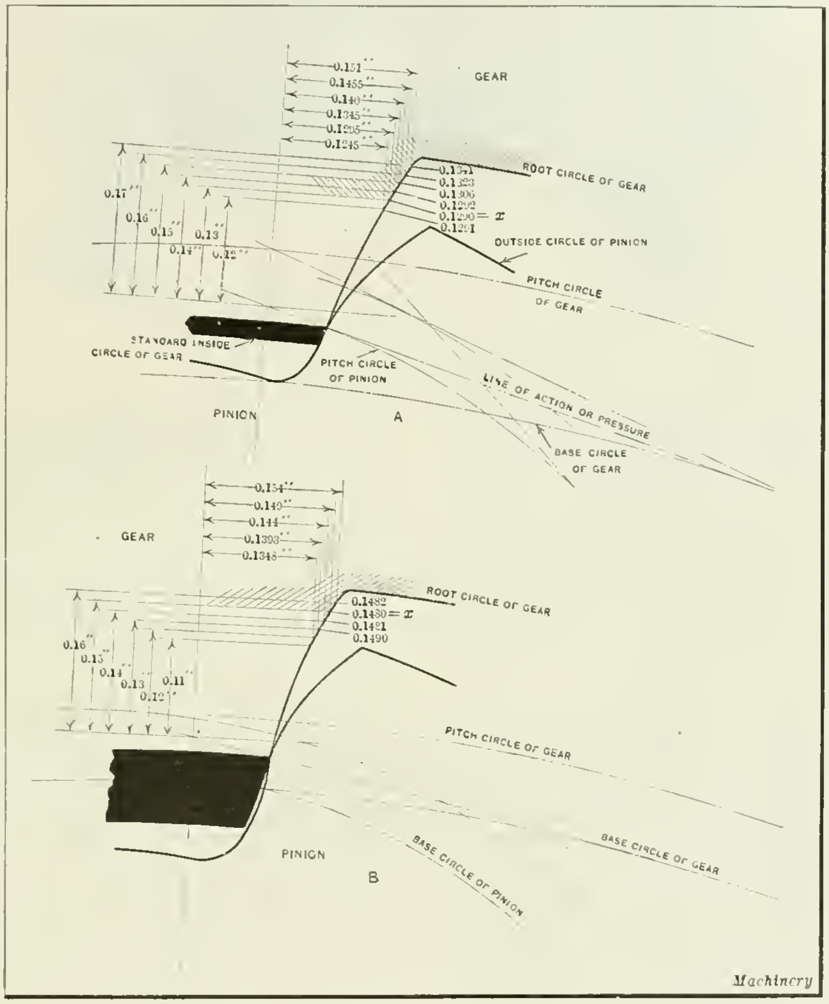


Fig. 5. An Application of the Method described

A modification of the Lewis formula in which the value x as found by the method outlined in this article may be used, is as follows:

$$W = Sf \times \frac{2x}{3}$$

in which

W = applied load in pounds;

S = safe stress in pounds per square inch;

f = width of face in inches; and

x = factor determined as previously explained.

There is no necessity for including the circular pitch in the formula, as this is taken into consideration in determining the weakest section of the tooth. This formula gives exactly the same results as the Lewis formula.

* * *

FORGING AND COLD-DRAWING OF INVAR

Invar, an alloy steel very high in nickel, is difficult to work mechanically. Experiments have been conducted by the metallurgical division of the Bureau of Standards with a view to determining the conditions under which forging and cold-drawing of invar may be possible. It was found that very light reductions could be made at one heat, and that the forging temperature should not be allowed to drop below 1800 degrees F. during the first reduction. The experiments consisted of forging an ingot down to a 3/8-inch rod; a part of this rod was then cut off and machined to a 1/4-inch diameter, and this part was then cold-drawn, with two intermediate annealings, to a wire approximately 1/16 inch in diameter.

EMPLOYMENT SERVICE OF NATIONAL ENGINEERING SOCIETIES

The employment bureau of the four national engineering societies—the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Institute of Electrical Engineers—is rendering a valuable service to the members of these societies as well as to the industrial world at large. The service of this employment bureau is unique in that it is given free of charge to both employer and employe, and hence can be rendered in a perfectly impartial manner, the best men obtainable being supplied to fill available positions. Many large corporations throughout the country are now using this employment service, and are obtaining through it not only engineers for technical positions. A personal interview with the applicants will be arranged for whe this is requested.

All the engineers whose records are listed in the employment bureau are members of one or more of the national engineering societies. When any concern applies to the bureau for a man of a certain type, the records of a number of men will be sent if desired, and a personal interview with the applicants will be arranged for, if this is requested. The applicants are carefully selected by the bureau according to the qualifications specified by the prospective employer. The bureau has on file not only the records of technically trained and experienced men, but also of specialists with engineering qualifications—production engineers, sales engineers, purchasing agents, traffic managers chemists, etc. The bureau is under the charge of Walter D. Brown with headquarters at 29 W. 39th St., New York City.

The records of the bureau show an interesting trend toward improved business conditions. Up to the end of February, this year, the number of unemployed engineers on file increased every month, but beginning with March the number of engineers placed has exceeded the number that have applied for positions during each month.

* * *

It is reported that the Swedish Machine Tool Export Co., a sales organization representing a number of the leading Swedish machine tool firms, has obtained a contract for machine tools valued at over $300,000 to be delivered to a newly established locomotive works in Poland, partially supported by the Polish Government.

New Design of Centering Machine

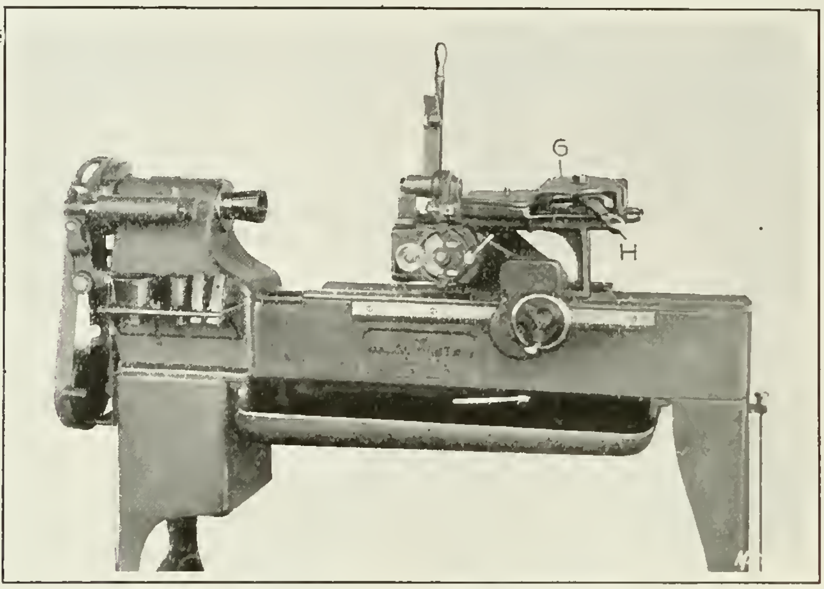


Fig. 1. Centering Machine with Simplified Chucking Method which permits the Centering of Ends of Various Cross-sections

Numerous parts produced from bar stock in turret lathes and automatic screw machines later undergo grinding, milling, or other operations in which it is desirable to have the work mounted on centers. A list of such parts would include reamers, taps, and a large variety of automobile parts and other pieces on which it may be necessary to mill an integral spur or bevel gear, a worm or a thread. The centering of parts produced in large quantities should be performed on a simple machine that operates quickly, so that the centering cost per part will be negligible. The Hanson-Whitney Machine Co., Hartford, Conn., has recently improved the centering machine of its manufacture which was described in August, 1921, MACHINERY, the new features including a greatly simplified chucking arrangement and a rack-and-pinion feed for the tool carriage. The ends of the work are centered by successive drilling and countersinking operations.

The Chucking Features

Centering is accomplished on this machine with the work rotating, one end being driven by the chuck, while the other end is supported by the rollers of a steadyrest close to the centering tools. The chuck on the original machine gripped the work by means of jaws that were opened and closed by a handle, and, although satisfactory, it was a rather complicated design. On the new machine the set of five hardened internally threaded parts seen on the tray of the headstock in Fig. 2 serve as chucks. One end of the work is inserted into the proper sized chuck, as shown in the cross-sectional view of a chuck at the top of Fig. 4. The chucks have a triple thread which insures that the work will be gripped at three points, one of which is directly opposite the other two.

The chuck has a capacity for work from ¼ to 3 3/16 inches in diameter. From Fig. 4 it will be noted that work of a variety of cross-sections can be held, but, of course, there must be a round cross-section at some point close to the ends to permit supporting by means of the steadyrest rollers. With a part having a hexagonal head, for instance, centering of the head end would be accomplished with the steadyrest rollers revolving on the shank of the part immediately beneath the head. Each chuck is held in the headstock spindle by means of a projecting pin on the shank which engages a slot that is clearly shown in Fig. 2, in the end of the spindle. A spring detent in the spindle hole also engages a groove in the chuck shank as a further precaution against the chuck becoming disassembled from the spindle while the machine is in operation.

Design of the Steadyrest

A close-up view of the steadyrest, which is integral with the front end of the tool carriage, is shown in Fig. 3. It will be seen that two rollers support the work underneath. These rollers are adjustable to suit the diameter of the work at the point where it rotates on the rollers. Adjustments are made by revolving the knurled handwheel *A* which is attached to a screw having a right-hand thread at one end and a left-hand thread at the other. Mounted on this screw are two nuts which are simultaneously brought toward each other or moved apart as the screw is revolved.

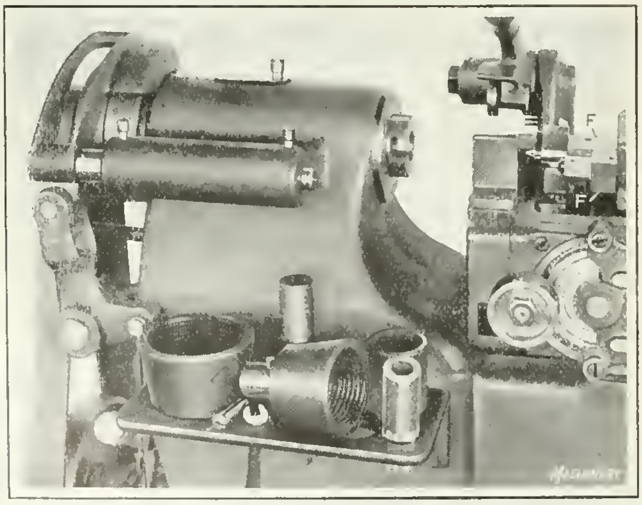


Fig. 2. View showing the Improved Headstock and Tray of Chucks

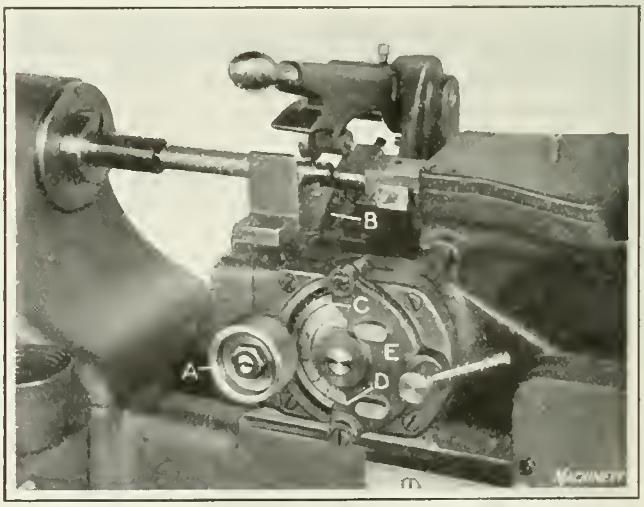


Fig. 3. View of the Steadyrest Rollers and their Adjusting Mechanism

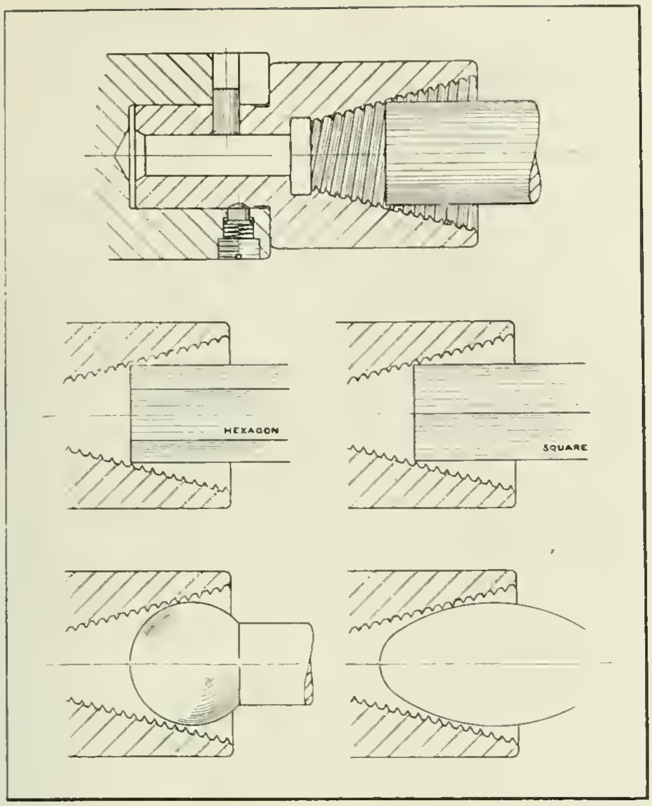


Fig. 4. A Few of the Typical Ends of Parts that can be chucked in the Machine shown in Fig. 1

Machined lugs on the nuts engage slots in the roller-holders *B*, and consequently the roller-holders are fed upward or downward at an angle when the handwheel is turned. The screw has pinion teeth cut on it near the front end which engage the teeth of gear *C*. This gear has two dials on the outside face, one of which is graduated in thirty-seconds of an inch, and the other in millimeters.

In setting the steadyrest rollers for work dimensioned in inches, handwheel *A* is revolved until the proper graduation of the dial on gear *C* is brought into line with edge *D* on clamp *E*. After a setting has been made, clamp *E* is tightened against the face of gear *C* by means of the binding handle. Handle *A* cannot be revolved until the binding handle is again loosened. The upper roller of the steadyrest is attached to a handle which is raised and lowered each time work is inserted. A coil spring in the bearing of this handle prevents it from dropping when raised.

Operation of the Centering Tools

The tool carriage is moved along the bed to suit the length of the work being centered, by revolving its handwheel. This actuates a pinion which engages with a rack on the front of the bed. The drill chuck and countersink are each held in holders which have shanks that are inserted in the ends of sliding bars *F*, Fig. 2. The drill chuck is mounted in the forward sliding bar and the countersink in the rear one. These sliding bars are mounted in bracket *G*, Fig. 1, which is rocked forward and backward to bring the drill and countersink successively into alignment with the work axis, when handle *H* is directly at right angles to the center line of the tool carriage. Pulling handle *H* ahead of this position causes the drill to be fed into the work, and pulling the handle to the rear causes the countersink to be advanced. Stops prevent bracket *G* from rocking when either tool is being advanced, and control the depth of drilling and countersinking. Long life of the countersink is obtained by grinding both ends for cutting, and the ends are ground eccentrically so that the tool cuts only on the bottom edge. This design tends to hold the work on the lower rollers of the steadyrest, and so not much pressure need be applied to the steadyrest lever.

Oil is supplied to the points of the drill and countersink by an ingenious arrangement. The pump and oil are contained in the compartment underneath the front end of the bed, the pump being driven by belt from a pulley mounted on the spindle outside the loose pulley. By this arrangement the pump is driven only with the spindle. Oil is pumped through a telescopic shaft in the bed which connects with a member on the tool carriage. The oil is forced through the arm upon which bracket *G* swivels and forward through sliding bars *F*, Fig. 2, and the tool-holders, being finally delivered to the tools. By means of an automatic arrangement oil is delivered to a tool only as it is being fed forward, and is immediately shut off as the other tool begins to advance. The starting and stopping of the machine is effected by a foot-treadle, which operates the belt-shifter. Thus the hands of the operator are entirely frée for the removal and insertion of work and the operation of the tool-feeding handle. A piece of leather on the belt-shifter acts as a brake on the spindle as soon as the belt is thrown on the loose pulley. Both the spindle and loose pulley are provided with ball bearings. The standard spindle speed is 850 revolutions per minute.

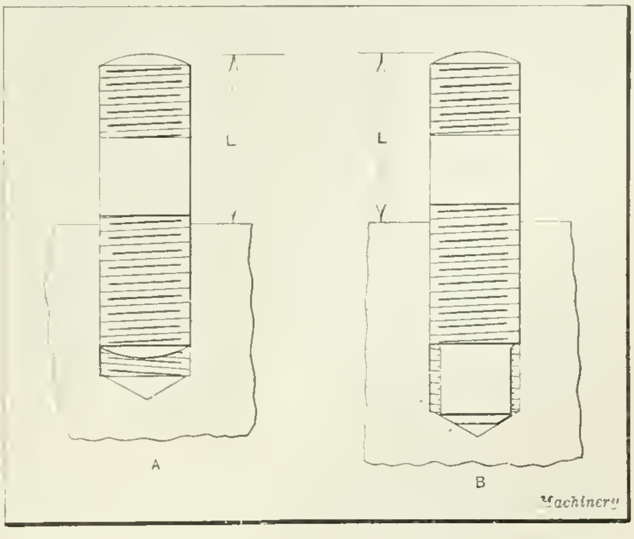
* * *

STUD BOLTS

By LEROY M. CURRY

Two designs of stud bolts are shown in the accompanying illustration. The bolt shown at *A* is the type in most general use, while that at *B* is an improved design. The improved style has the end turned down below the root diameter of the threads for a distance sufficient to allow for imperfect threads at the bottom of the hole. The idea is to enable the bolt to be locked or clamped in the hole, by bottoming the chamfered or rounded end of the bolt.

In view *B* it is obvious that length *L* depends only on the depth of the drilled hole and the length of the stud, both of which are easy to maintain as close as necessary. With the construction shown at *A*, there is always much trouble because of variation of the length *L*, and if the threads are not a good tight fit in the hole, the studs are quite likely to turn when the nut is being removed from the upper end of the stud. This is because the stud only tightens on about two imperfect threads either at the top or the bottom of the hole; whereas with the other form, the threads are jammed their entire length, even though the stud is not a tight fit in the tapped hole. On account of the initial strain placed on the threads by tightening the stud, it is advisable that the holes into which the studs are inserted be made a little more, rather than less, than the nominal depth required, especially in castings.



(A) Common Style of Stud Bolt; (B) Bolt with End turned down

Babbitt Metal

By L. D. ALLEN, General Manager, L. D. Allen Metal Works, Chicago, Ill.

WHEN we consider that from 20 to 30 per cent of the power developed for the operation of machinery is lost in bearing friction, it is surprising to note how little attention is paid to this loss. The explanation is that only by the installation of carefully constructed testing apparatus can the real cause be discovered. It is the pull or drag in each bearing, multiplied by the number of bearings throughout a plant, that accounts for the great losses in power and the large expense in repair bills, the latter being due to the wearing or burning out of bearings, unnecessary oil consumption, wear on driving gears and belting, etc.

Very few people realize the significance of the fact that 400 pounds or more of each ton of fuel burned under the boilers is consumed by the friction load. Power that is wasted through friction is converted into heat. This heat, to avoid fusion of the bearing liner, must be radiated as fast as it is produced so that the temperature of the bearing surface will be kept below the danger point. For this reason the anti-frictional and heat-conducting properties of a bearing liner are important, although not so important as the load-carrying and cohesive strength of the liner. The consistency and heat-conducting properties of the lubricant, as well as the method of lubrication, are also important factors. The reason that the anti-frictional properties of a bearing metal are not quite so important as its load-carrying properties is that the oil film is supposed to prevent metallic contact between the journal and the bearing surface. The cause of bearing failure is many times due to the journal being forced into full load and speed before the oil film has had an opportunity to warm up and spread sufficiently to cover the entire rubbing surface.

Babbitt metals should never be bought on a price basis, but solely with regard to their adaptability for the bearings for which they are to be used. The more dense and compact the structure of the bearing liner, the less will it give or compress under the journal pressure. Vibration usually occurs when a metal gives and creates an excessive space between the journal and the bearing surface. For this reason all bearing metals must be carefully alloyed under experienced supervision, because a slight variation in ingredients and in the manner of combining them will change the metal from a dense, homogeneous alloy to a coarse-grained mechanical mixture of doubtful quality.

Apart from the retarding influence of an unsuitable lubricant, friction is caused by the unevenness of the surfaces in moving contact. There are no absolutely smooth surfaces. They may seem smooth to the touch, but a strong magnifying glass will reveal minute projections and roughnesses, which in rubbing contact produce friction and heat. In the manufacture of bearing metals, it is important, therefore, that only such constituent metals be used as will produce a smooth, mirror-like bearing surface. Lead possesses the best anti-frictional properties, but lead alone is too soft to carry the load, and therefore must be strengthened by the addition of antimony to give greater hardness, and tin and copper to give both hardness and toughness. In a bearing metal, tin also serves as a solder to unite or bind together the ingredients of which the alloy is composed.

Load on Bearings

Carefully conducted tests in research laboratories have proved that the maximum load per square inch on any type of bearing should not exceed 2500 pounds, and that three-fourths of the machinery in operation should carry a bearing load not exceeding 1500 pounds per square inch. If the bearings are of the proper dimensions with respect to the length, diameter, and thickness of the liner, and positive lubrication is assured, it has been found that a babbitt metal, triple alloyed, semi-tin or lead-based, is the most durable and economical metal for bearing loads up to 1800 pounds per square inch. A babbitt metal of this nature, properly produced, will show a compressive strength, when a block or cube, one inch square is tested, of from 16,000 to 20,000 pounds, but this does not mean that it will stand more than approximately 1800 pounds per square inch of surface of a liner ⅛ or ¼ inch thick. The thinner the liner under heavy load and stress, the higher the tin and copper content required in the alloy.

For extremely severe bearing conditions, what is known as "genuine babbitt" is sometimes used because of its toughness and ability to resist bending stresses. Genuine babbitt is composed of from 80 to 90 per cent of tin. A moment's reflection will suggest, however, that bearing liners are very rarely subjected to bending stresses. In 99 per cent of the cases, a metal low in tin, that will withstand the bearing pressure and that will not heat when the surface is subjected to journal friction, is the best metal to use. The author, who for a long period of years has specialized on bearing metals, has in many cases replaced tin-base genuine babbitts with alloys, containing from one-third to one-half less tin, and which are toughened and hardened through the methods by which they are produced. These alloys can be made at a proportionately lower cost to the user and are of greater service value, because of their better anti-frictional properties. They are of sufficient strength to carry the load, but because they contain a higher percentage of lead, they heat less under given speeds and pressures.

The following experience may be mentioned as an example. The writer was asked to visit the East St. Louis plant of the American Car & Foundry Co., where trouble had been experienced with bearings in the overhead drives. The bearings that gave the most trouble were made of genuine babbitt containing about 88 per cent tin. These bearings gave trouble by melting or fusing; the metal, being high in tin, heated more rapidly under journal friction than a metal containing a large percentage of lead. Furthermore, the overhead bearings were somewhat neglected as regards lubrication. A hard lead-based babbitt with a compression test of about 1800 pounds per square inch was substituted, and the trouble disappeared.

Considerations in Buying Babbitt Metal

Babbitt metals should never be bought on a price basis, but solely with regard to their adaptability for the bearings for which they are to be used. The more dense and compact the structure of the bearing liner, the less will it give or compress under the journal pressure. Vibration usually occurs when a metal gives and creates an excessive space between the journal and the bearing surface. For this reason all bearing metals must be carefully alloyed under experienced supervision, because a slight variation in ingredients and in the manner of combining them will change the metal from a dense, compact, homogeneous alloy to a coarse-grained mechanical mixture of doubtful quality.

It is erroneous to recommend a single lead-based brand of babbitt as suitable for all conditions. Bearing conditions may be classified under three headings—general-purpose conditions, that is, average speed and average to heavy loads; extra heavy conditions, that is, fairly high speed and heavy load; and extreme service conditions, that is, extreme speeds and loads, especially when the bearings are also subjected to vibration, intermittent loads, pounding and shocks.

Composition of Bearing Metals

The metals used in the manufacture of various babbitts are two or more of the following: Tin, lead, copper, antimony, and bismuth.

Tin toughens the alloy, lowers the melting point, and assists in producing a strong, homogeneous mixture. It is a "dry" metal, that is, it is somewhat lacking in anti-frictional properties. Under heavy friction it heats quickly and fuses. When heated, it melts at about 450 degrees F.; its specific gravity is 7.35 and its comparative hardness is 4.5. The grades generally used in the manufacture of babbitt metals are known as Straits tin, Chinese tin, and Bolivian tin, depending on the standard of purity required.

Lead imparts softness and reduces the tendency to heat in a bearing by reducing friction; it has greater friction-reducing qualities than any other metal, resembling graphite in this respect. It melts at about 620 degrees F. Its specific gravity is 11.38, and its comparative hardness 1.5.

Copper hardens and toughens a bearing alloy and raises the melting point. It increases the friction slightly. Copper melts at a temperature of 1943 degrees F. It has a specific gravity of 8.85, and a comparative hardness of 2.5. Very little copper is used in babbitt metal, only from 0.25 to 0.5 per cent being used in a lead-based babbitt. There are some high-tin mixtures that contain as much as 10 per cent copper such as hard genuine babbitt, which is composed of 80 per cent of tin, 10 per cent of antimony, and 10 per cent of copper. The author does not believe that copper is a desirable constituent in a lead-based babbitt. It hardens the babbitt somewhat, but it reduces the anti-frictional properties, and imparts less compactness or density to the structure or body of the alloy.

Antimony is a hard, brittle metal of crystalline structure. It hardens an alloy and raises the melting point. It reduces friction, thereby reducing the heating of the bearing. It melts at about 1169 degrees F. It has a specific gravity of 6.76, and a comparative hardness of 3.5. The crystalline grain of a fracture is due to antimony. It is imperative that the antimony in a bearing alloy be completely reduced and evenly distributed throughout the mass; otherwise there will be hard, segregated spots on the surface of the liner, developing frictional heat and cutting or scoring the journal.

Bismuth reduces friction and prevents shrinkage, as it expands on cooling. It lowers the melting point of an alloy, as it melts at a temperature of 507 degrees F. Its specific gravity is 9.82, and its comparative hardness 2.3. As bismuth usually costs more than $2 a pound, it is not used to a large extent in babbitt alloys.

Aluminum is rarely used in babbitt metal except as a deoxidizer. It melts at a temperature of about 1160 degrees F. Its specific gravity is 2.6, and its comparative hardness 2.2. It imparts some toughness by closing the grain, and acts as a flux; but it slightly increases the friction, thus offsetting its toughening properties, and making it of no practical value in a bearing metal.

Certain combinations of tin, copper, and antimony shrink on cooling. Tin and lead alone shrink slightly, and antimony remains about constant. Any two metals mixed together in the form of an alloy produce a metal which has a lower melting point than that of the original metal having the higher melting point, and in some cases lower than that of the metal with the lower melting point.

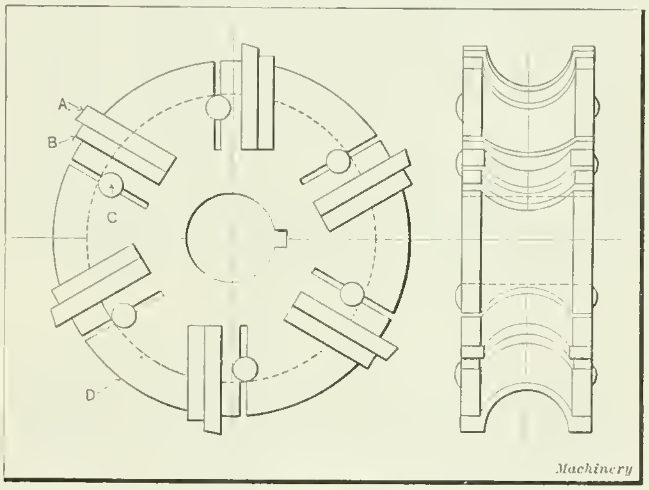
* * *

INEXPENSIVE FORMED MILLING CUTTER

By GEORGE C. HANNEMAN

The high initial cost of formed milling cutters often precludes their use on work for which they are otherwise well adapted. The formed cutter illustrated is, however, comparatively inexpensive to make. It can therefore be used in many instances where production requirements do not justify making a formed cutter of the usual type. The cutter shown has removable blades, and is made by a method that eliminates the expensive backing-off process. The body of the cutter is milled exactly the same as for an ordinary inserted-blade cutter except that the blade slots are made about twice as wide as the blades are thick. The remainder of the space in each slot is filled by a soft steel spacer block such as shown at *B*.

In making the cutter, each spacing block is placed in front of its respective blade and clamped in place by a taper pin *C*. The cutter blades are then turned to shape without backing off. A cut is also taken on the sides of the blades to obtain true surfaces from which to reset or locate the blades after they have been hardened. The blade shown at *A* is in the position occupied when its profile is being turned, while the other blades are shown in their proper working positions. The slots and their corresponding blades are numbered before the blades are removed for hardening.



Inserted-blade Type of Formed Milling Cutter

After being hardened, the blades are properly located in the body *D* by mounting the latter member on an arbor in a lathe, using an indicator to assist in bringing the trued-up sides of the blades into alignment. It will be noted from the illustration that the cutter clearance is obtained by changing the position of the spacing blocks so as to lie behind the cutting blades instead of in front of them. For very accurate work it is necessary to allow for the slight change in depth of cut which results from moving the blades forward. The widths of the turned surfaces will not be affected by this change in the cutter position, but the depth of the cutter profile must be made slightly less, as in the case of screw machine tools of the circular type. For special parts that are required in limited quantities, the use of this type of formed cutter has been found very economical. The body *D* of the cutter can, of course, be used for blades of different shapes.

Cutting Large Bevel Gears

Methods of Stocking out and Finishing Bevel Gears on Single- and Two-tool Planers of the Form-copying or Templet Types

By FRANKLIN D. JONES

VERY large bevel gears, and many of medium size, are cut by using gear planers of the templet or form-copying type. Such machines are also used for cutting the larger sizes of spur gears, as explained in a previous article, but their application to very large bevel gears is universal. More distinct types of machines have been designed for cutting spur gears of various sizes than for cutting bevel gears, since the former present a simpler gear-cutting problem. For instance, spur gears may be cut readily with formed cutters, and a great many are produced by this simple method; but as the tooth of a bevel gear has the same cross-sectional shape on a diminishing scale toward the apex of the pitch cone, it cannot be given the correct shape with a formed cutter, although this method has been used to a limited extent for bevel gears. The templet principle, however, provides a relatively simple method of cutting bevel gears of medium and large sizes, especially in gear shops or wherever a variety of pitches or sizes is encountered; this accounts for the general use of the templet or form-copying type of gear planer for the class of work mentioned.

Cutting Bevel Gears on Planers of the Single-tool Form-copying Type

Bevel gear planers of the form-copying type commonly operate with a single tool, although a two-tool design has been developed, which will be described later. The single-tool Gleason planer of 24-inch size is shown in Fig. 1. When this planer is at work, the tool-slide is given a reciprocating motion by a crank adjusted for a stroke equal to the face width of the gear being cut, plus about ¾ inch over-travel, or possibly 1 inch on larger machines. The arm carrying the tool-slide is pivoted so it can swing about a horizontal axis. The entire tool-head (with its tool-slide, crank drive, and pivoted arm) is mounted on a turret or baseplate supported by the main bed.

This turret swings about a vertical axis to feed the tool inward, and at the same time the tool-slide arm swings about its horizontal axis, provided the supporting roller *R* is resting on one of the curved forms or templets *B* or *C*, which are used when taking finishing cuts. The inward feeding movement and the backward motion to withdraw the tool for indexing are obtained from a cam acting through an adjustable lever for varying the angle through which the turret swings. This angular movement is regulated according to the depth of the gear teeth, and is equal to the angle subtended by the whole depth of the tooth, plus 1½ degrees for clearance. The turret is set to suit the pitch cone angle of the gear being cut.

When cutting teeth from the solid, the tooth spaces are first roughed out, as described later, and then the teeth are finished first on one side all around the gear and then on the opposite side. The holder to which the forms are

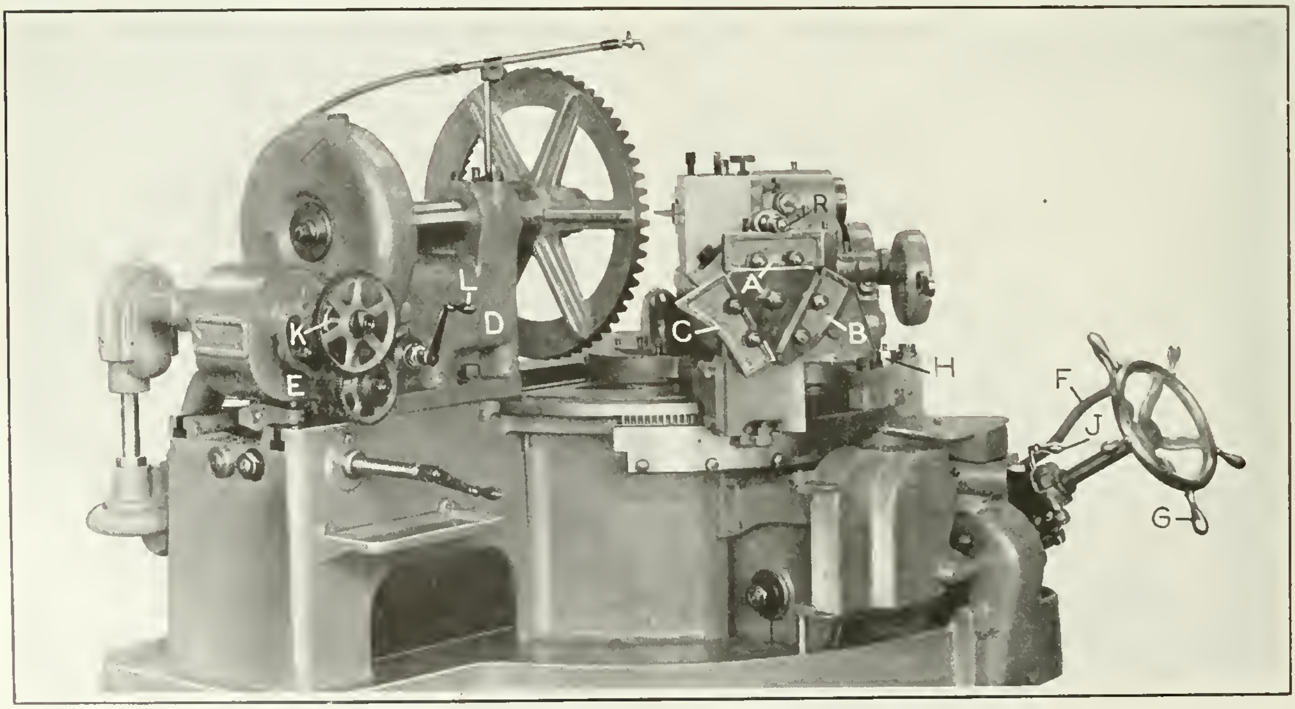


Fig. 1. Bevel Gear Planer of the Single-tool Form-copying Type

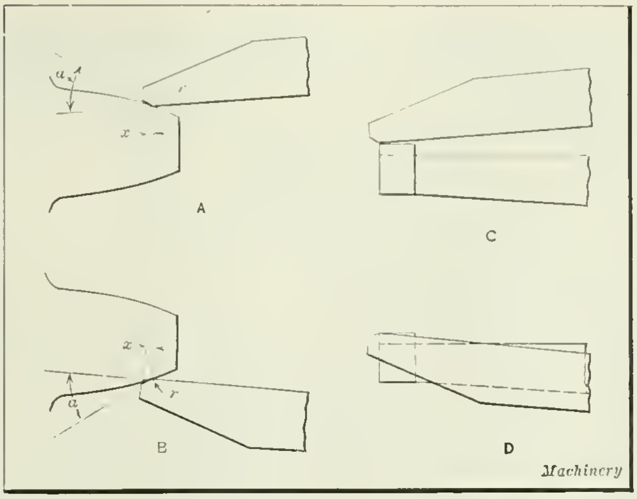


Fig. 2. Tools used for finishing Upper and Lower Sides of Teeth

attached can be turned about a horizontal axis for locating the different forms in the working position. The indexing movement of the gear being cut is controlled automatically through change-gears located at *E*, which are selected by referring to an index table furnished with the machine. The planer illustrated in Fig. 1 will cut miter gears up to 24 inches pitch diameter, and bevel gears of a 2 to 1 ratio up to 28 inches pitch diameter. Machines of the form-copying type are made for cutting gears up to the largest sizes ordinarily encountered in commercial work, and such machines have the advantage of using tools of a simple inexpensive form.

When a bevel gear is cut from the solid (instead of planing teeth which have been roughly cast to shape, as is customary for very large gears) there are several methods of roughing or stocking out the teeth. When roughing steel or cast-iron gears up to about 2 diametral pitch, it is well to use a single V-shaped tool, as indicated by the diagram *A*, Fig. 3. While this tool may have plain cutting edges, the stepped or corrugated form indicated is preferable, as it breaks up the chips. The size of the roughing tool depends upon the width of the tooth space at the small end. The tool should be wide enough to leave about 1/32 inch of stock on each side of the teeth at the small end, and the length of the cutting end must be at least equal to the full depth of the teeth at the large end.

Sometimes when cutting "flat gears" (gears having a large pitch cone angle) of, say, 2 diametral pitch, especially if the section is light and the gear blank tends to spring, it might be necessary first to cut parallel slots in the center of each tooth space, as indicated by diagram *B*, and then follow with a V-shaped roughing tool. Gears coarser than 2 diametral pitch and with pitch cone angles of less than 45 degrees may be roughed out by using a combination slotting and V-tool, as indicated by diagram *C*. The combination slotting and V-tool arrangement is not readily applicable to the 24-inch gear planer, so it finds use only on the larger sizes. The slotting tool is always set to cut slightly deeper than the V-tool, so that the latter never cuts on the point. When cutting "flat gears," or those that have large pitch cone angles (above 45 degrees) there is sometimes a tendency for the work to spring in toward the tool and stall the machine when a heavy cut is being taken, which makes it necessary to relieve the cutting action by not setting the V-tool in to the full depth.

Another combination tool that is sometimes used is illustrated by diagram *D*. This is a narrow slotting tool extending to the full depth, followed by a wider slotting tool which goes in as far as the pitch line. When the work is such that combination tools cannot be used, and the pitch of the teeth is too large to permit roughing from the solid with a V-shaped tool, it is necessary to cut plain slots first and then follow with a V-shaped tool.

Diagrams *A* and *B*, Fig. 2, show the type of tool used for finishing the upper and lower sides of the teeth, respectively. The end of the finishing tool must be small enough to pass through the space at the small end without touching the tooth on the opposite side. The tools are rounded at *r* just enough to leave a smooth cut. The distance *x* and the angle *a* (which is about 35 degrees) should be the same for both finishing tools. The toolpost is so arranged as to allow the tool to swing away from the work during the return stroke, the same as on an ordinary planer. The tool is always returned to the cutting position by means of a stop, which should be properly adjusted before using the machine.

Setting the Tools

The tool-holders are so constructed that the tools may be adjusted for height by means of a wedge, and for lengthwise position by means of a stop-nut. A gage placed on the tool-slide arm shows when the tools are properly set. Diagrams *C* and *D*, Fig. 2, show the ends of upper and lower finishing tools set in correct relation with the end of this gage. In the first place, the roughing tool is inserted

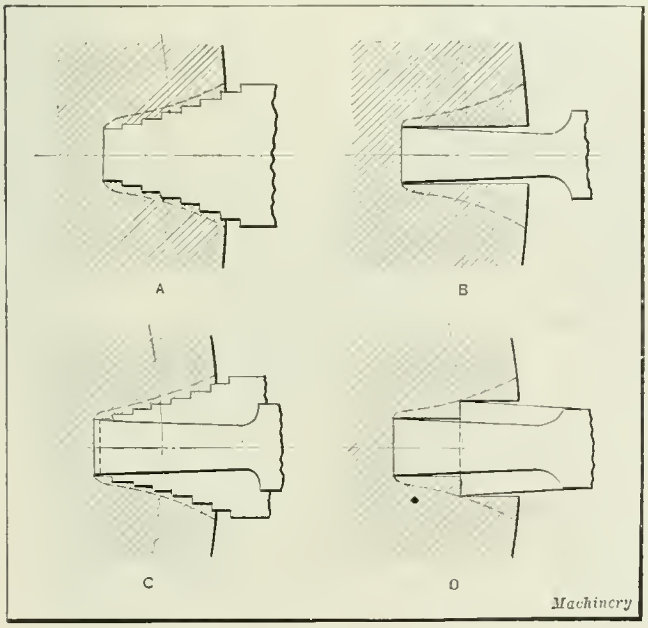


Fig. 3. Different Forms of Tools used for Roughing or Stocking Cuts

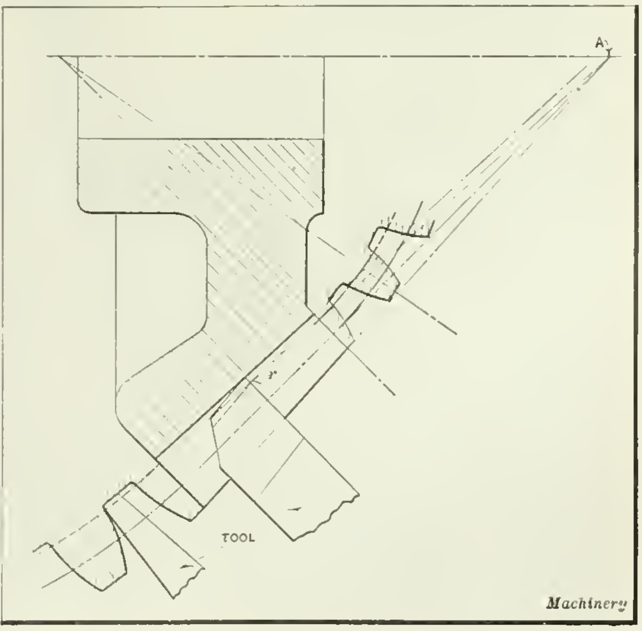


Fig. 4. Diagram showing how Clearance Space is formed by Planing Tool

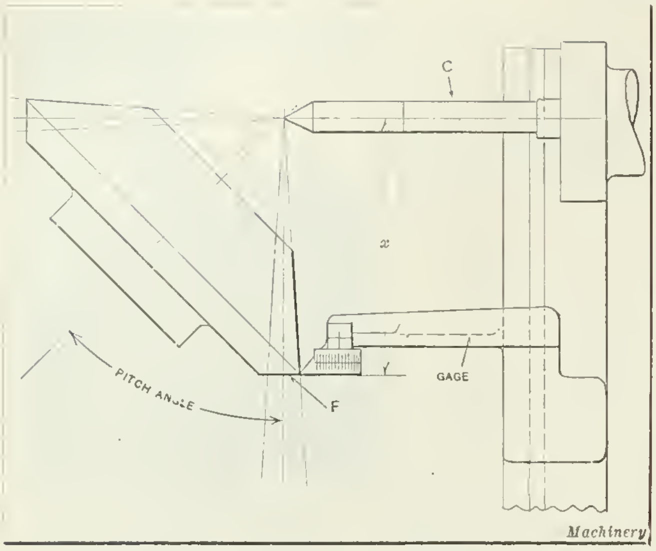


Fig. 5. Cone Distance Gage used for locating Gear Blank in Correct Position axially

in the toolpost, and the end is set even with the end of the gage. The tool is also adjusted for height until it is central with the end of the gage. The roughing tool is next replaced by the lower-side finishing tool, which is adjusted so that the cutting point *r* coincides with the outer corner of the gage, thus locating the tool vertically and lengthwise. The tool for the upper side is next set in the same way and is left in the machine for further adjustments.

When a pair of planed gears is in mesh, it will be seen that the clearance between the end of one tooth and the bottom of the corresponding tooth space is the same at both the large and small ends; consequently, the clearance at the small end is larger in proportion to the size of the tooth at this end, and it might be inferred from this that the gears are not properly in mesh. The clearance should, however, be the same at both ends, because when the tools are set as illustrated by diagrams *C* and *D*, part of the tool projects beyond the cutting point an amount represented by dimension *x* (see diagrams *A* and *B*). When the tool is set properly, the cutting point *r* travels along a line coinciding with the apex *A* of the pitch cone, as indicated by the diagram Fig. 4. This cutting point *r* will always travel toward *A*, or the center of the machine, as the tool feeds in across the surface of the tooth. As the clearance space is formed by that part of the tool projecting beyond the cutting point, the width of the clearance space at the large end of the tooth is the same as at the small end.

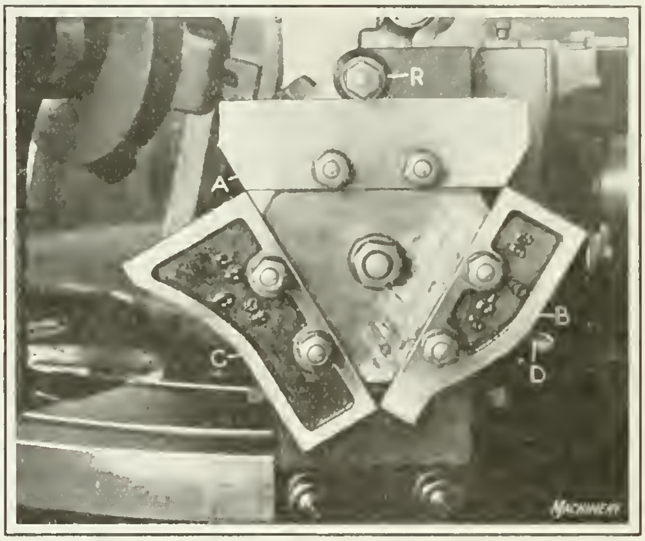


Fig. 6. Detail View of Forms on Gear Planer which control Movement as Tool feeds inward

Angular Position of Turret

The turret which supports the tool-slide is set to the pitch cone angle by means of graduations on its base in conjunction with a fixed pointer. When this adjustment is made, an auxiliary centering form is attached to the form-holder in place of form *C*, Fig. 1, for the lower side. This centering form has a V-shaped notch, which engages roller *R*. The roller must be in contact with both sides of the V-slot in the centering form when the turret has been adjusted to the required pitch cone angle.

Setting Gear Blank in Cutting Position

After the turret has been set with reference to the pitch angle, the head *D* carrying the work-spindle is adjusted along the bed to locate the gear blank in the proper cutting position. The gear blank will be in the right position when the apex of the pitch cone coincides with the center of the machine, or with the point of intersection between the vertical axis about which the turret swivels and the horizontal axis about which the tool-slide swivels. The cone distance gage, shown in Fig. 5, is used in making this adjustment. The vernier on the gage is first set to conform to the pitch depth or addendum of the gear to be cut. The gage is then placed on the tool-slide arm. The head carrying the work-spindle is next moved along the bed until the pointer of the gage stands at zero when the extreme outside edge of the gear blank is in contact with the vernier, as shown by the illustration. The gear blank is then in the correct cutting position.

When locating a pinion having a pitch cone angle of, say, 15 degrees or less, it is preferable to set the blank by measuring the cone distance *x* instead of using the cone distance gage. The cone distance or pitch cone radius can be determined by dividing half the pitch diameter by the sine of the pitch cone angle. This calculated dimension should correspond with distance *x* from the point of center-pin *C* to face *F* of the gear blank. The center-pin should be pushed all the way into its socket to locate the point at the center of the machine. A scale that is graduated in hundredths should preferably be used for checking this dimension.

Adjustment for Depth of Cut

A line representing the full depth of the teeth at the large end, is scratched on the back angle or face of the gear blank, and is used in setting the tools. This may be done accurately when turning the gear blank. On the 24-inch machine the tools are set by first disconnecting the feed clutch and engaging the hand feed clutch by means of lever *F*, Fig. 1. Then the feed-cam is turned by handwheel *G* until the cam lever has moved to the limit of its travel toward the left. The tool-slide is then shifted along the arm by hand, until the tool just clears the angular surface at the large ends of the teeth. Next a nut at *H* is turned until the turret has swung in far enough to bring the end of the upper tool (which was left in position) opposite the middle of the full-depth line scratched on the gear. The roughing

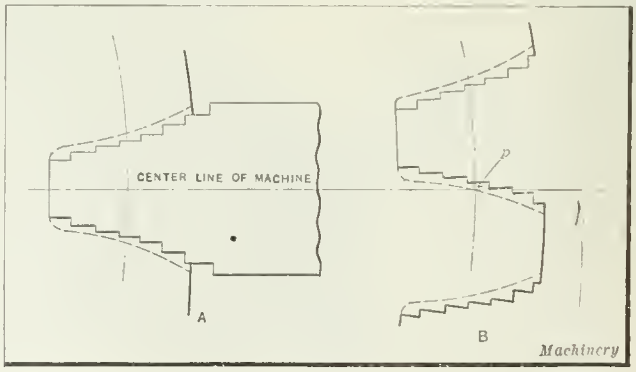


Fig. 7. (A) Position when roughing (B) Position when finishing

tool is then inserted and adjusted until it also reaches this line.

Provision is made for setting the toolposts at different angles in order to change the angular position of the tools relative to the gear. This adjustment, however, is not required for cutting involute teeth, and is only used for pinions having cycloidal teeth, the object being to provide clearance for the tool at the pitch line when cutting the flanks.

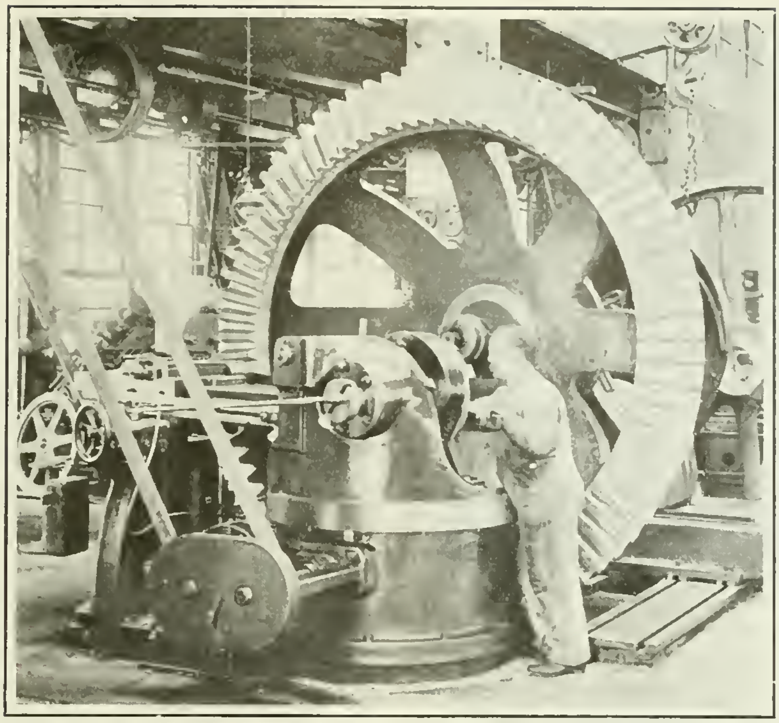


Fig. 8. Planing Cast-steel Bevel Gear having a Circular Pitch of 5 Inches

Taking Stocking Cuts

The index mechanism must be properly geared and adjusted, and the stroke, as well as the cutting position of the tool, must be so regulated that the tool has an over-travel of, say, ⅝ inch at the large ends and ⅛ inch at the small ends of the teeth. The rate of feed and number of strokes per minute must also be varied to suit the gear to be cut, which is done by using different combinations of speed and feed gears. The machine is now ready for the stocking cuts.

After determining the type of stocking tool to use, the first tooth space is roughed out. As the tool feeds straight in or radially, a straight edge is used instead of a curved form, and this is shown in the operating position in Figs. 1 and 6. When a tool is approaching the bottom of the first tooth space, care should be taken to see that it does not cut below the full-depth circle. When a slight change in depth is necessary, this is made by changing the travel of the turret. Crank *J*, Fig. 1 is used for making this adjustment.

Taking Finishing Cuts

The forms that control the path followed by the tools when taking finishing cuts are selected according to the pitch cone angle, by referring to a chart accompanying the machine. The roughing tool is replaced by the upper-side finishing tool, and the form *B* (see Fig. 6) for the upper sides of the teeth is swung around to the operating position. A latch controlled by handle *D* engages a slot and locates the form-carrying plate. The plate should be tightened after the form to be used is in position.

When the gear is being stocked out, the roughing tool is in a central position relative to the center line of the machine or to a horizontal plane coinciding with the axis of the gear (see diagram *A*, Fig. 7). Before taking the finishing cuts, the gear must be rotated until pitch point *p* (diagram *B*) coincides with the center line of the machine. In order to change the position of the gear, a clutch at *K* (Fig. 1) connecting with the indexing gear train, is disengaged and crank *L* on the indexing worm shaft is used to turn one section of the clutch relative to the other section. If two cuts are to be taken for finishing each side (the second being a light finishing cut) crank *L* is turned to the right (assuming the upper sides of the teeth are to be planed)

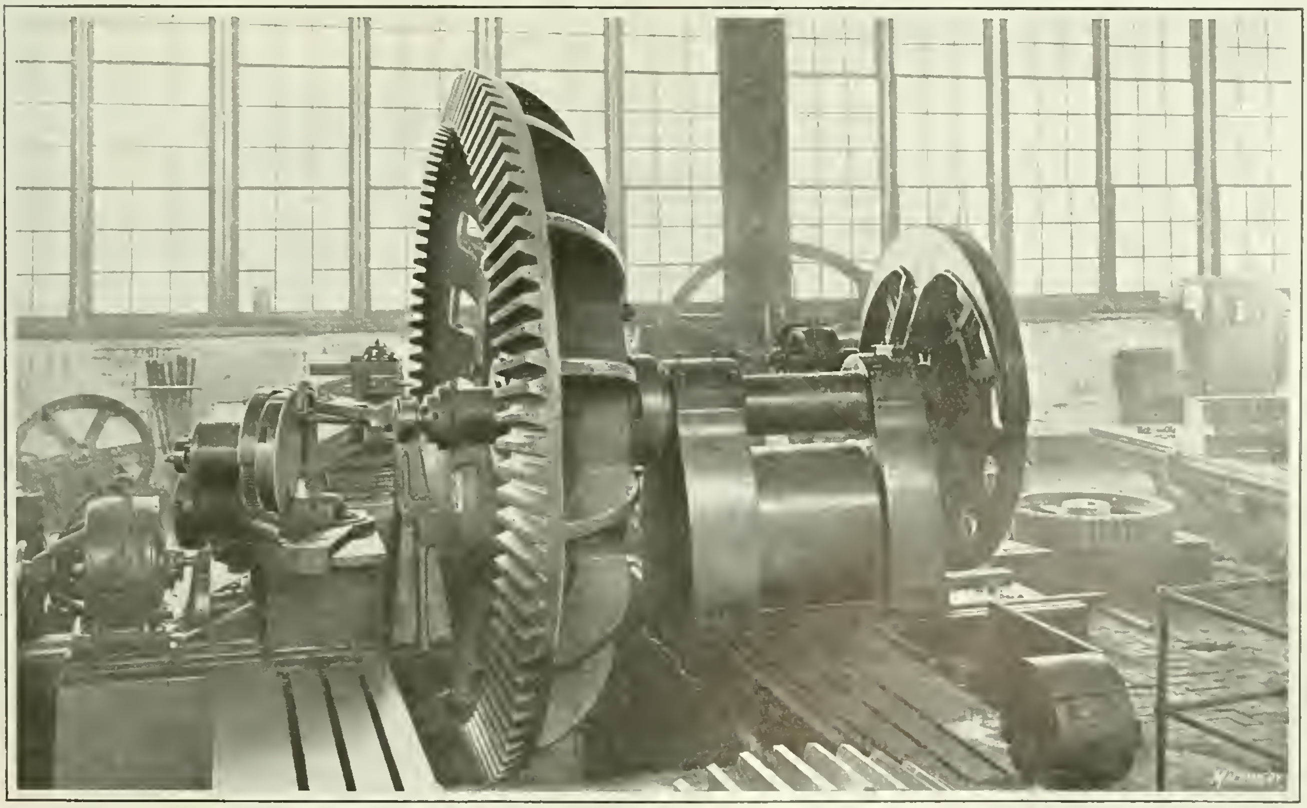


Fig. 9. Another Example of Large Bevel Gear Planing. In this Case a Pit is provided to permit swinging Gears of Large Radius

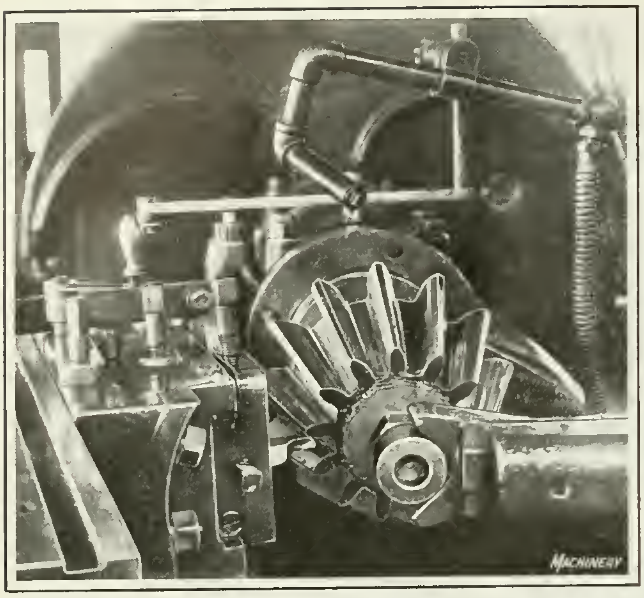


Fig. 10. Planing a Pinion having Teeth of Special Width

until graduation No. 1 on clutch *K* is one notch to the left of the zero line on the other half of the clutch. The pitch point *p* is now in the position indicated by diagram *B*, Fig. 7. After tightening the clutch lock-nut and engaging the feed clutch, a cut is taken over the upper sides of all the teeth. Then when the turret and tools are at the limit of their outer movement, the feed clutch is disengaged and graduation No. 1 on the index clutch is set opposite the zero position; finishing cuts are then taken on the upper sides of the teeth.

Before finishing the bottom sides of the teeth, it is necessary, of course, to replace the upper-cutting tool with the one used for under-cutting, and also place the form *C* (Fig. 6) for the lower sides in the working position under the roller. The gear must now be shifted, so that the pitch point on the side opposite *p* (diagram *B*, Fig. 7) coincides with the center line of the machine. The clutch *K* (Fig. 1) is again disengaged, and the two parts are shifted in the opposite direction or until graduation No. 3 is one notch to the right of the zero position. Cuts taken with the clutch in this position will leave the teeth somewhat wide.

When the final finishing cuts are taken, with graduation No. 3 in the zero position, the teeth should be about the right size, although as soon as the first tooth has been planed, its width should be tested either by using a solid gage of the right diametral pitch or an adjustable vernier gage. If a slight adjustment is necessary, this can be made by shifting a clutch on a worm-shaft which has a large number of teeth, in order to provide a finer adjustment than could be obtained with the clutch at *K*. The amount of stock that the tool will remove from the tooth when this clutch is shifted one notch depends upon the size of the gear, increasing as the diameter of the gear increases.

Examples of Bevel Gear Planing

An example of fairly large bevel gear planing from the plant of the Earle Gear & Machine Co., Philadelphia, Pa., is shown in Fig. 8. This is a cast-steel gear having a circular pitch of 5 inches, and a face width of 14 inches. The machine used is a single-tool form-copying type. In roughing out these teeth, a square-nosed or end-cutting tool was first used to remove stock from the center of each tooth space. Two roughing cuts with a round-nosed tool were then taken, and finally a finishing cut. Another example of large bevel gear planing is shown in Fig. 9, which is a gear-cutting job from the plant of R. D. Nuttall Co., Pittsburg, Pa. This gear planer is provided with a pit to permit swinging gears of large radius.

The detail view, Fig. 10, shows the cutting of a cast-steel pinion at the Philadelphia Gear Works. This pinion has thirteen teeth of 2½ inches circular pitch, but the teeth were made much narrower than standard, so that it was necessary to remove considerable stock. This was done by first taking a cut through the center of each space with a square-nosed tool. The bulk of the metal at the sides was then removed by again using the square-nosed tool set at an angle first for one side and then for the other. Finally the teeth were finished by using the general style of tool previously referred to for finishing cuts.

Two-tool Bevel Gear Planer of the Form-copying Type

While bevel gear planers of the templet type ordinarily have a single tool, the Gleason planer illustrated in Figs. 11 and 12 has two tools in operation at the same time, the machine being similar in this respect to the well-known generating type made by this company. This machine saves from 45 to 50 per cent of the cutting time, as compared with a single-tool planer. When taking roughing cuts, one tool is operating in one tooth space while the other tool works in the space following. When taking finishing cuts, both tools operate on opposite sides of the same tooth.

The head carrying the work-spindle is given a feeding movement about a vertical axis coinciding with the apex of the pitch cone or center of the machine. When the cutting tools have reached the proper depth, the work-head swings back to clear the tools for indexing. This motion is transmitted through a worm on shaft *A*, a worm-wheel segment, and a circular feed-rail *B* extending around the base of the machine to the work-spindle head. The feeding movement is automatically disengaged when the tools reach the bottom of a tooth space, and there is a dwell at this point before the gear swings away from the tools, so that the tools make one complete stroke at full depth, thereby finishing all of the teeth to the same depth. The extent of the feeding

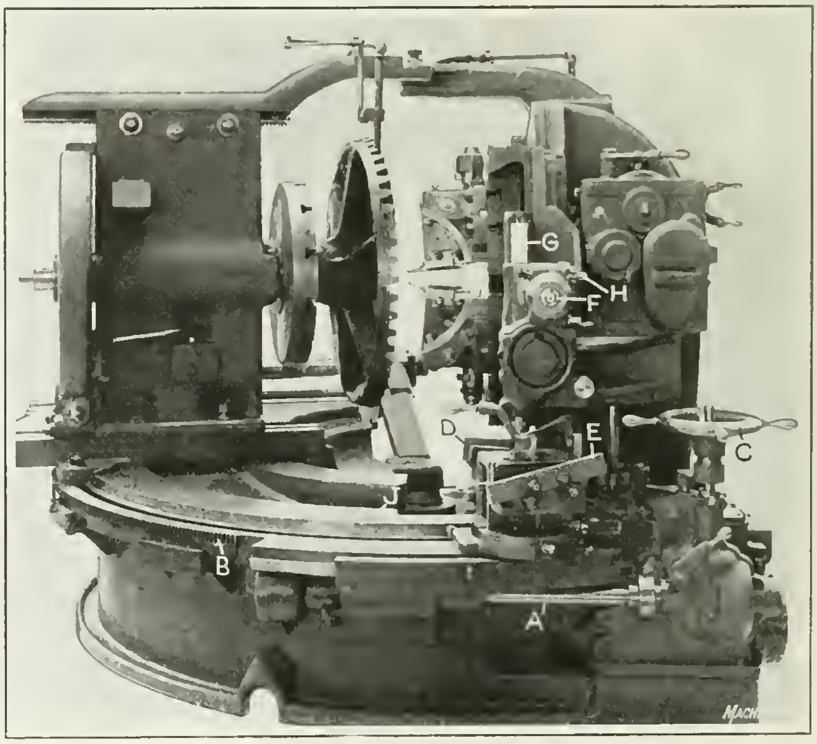


Fig. 11. Bevel Gear Planer of Two-tool Form-copying Type

movement is regulated by adjustable dogs on a graduated dial connected with the reversing mechanism. The handwheel *C* may be used for feeding by hand as, for example, when finishing the bottoms of the tooth spaces. The rear view, Fig. 12, shows part of the indexing transmission; the casing at the right contains the change-gears, which regulate the indexing movement. This machine is designed to be set up readily so that it is adapted for a variety of gear-cutting operations within its range.

Arrangement of the Tool-slides

The two tool-slides are inclined in relation to each other on account of the converging form of bevel gear teeth the angle between the slides being varied to suit the gear. The axis of the pivot or bearing about which the tool-slides are adjusted coincides with the center of the machine. The tool-holders are also adjustable about an axis coinciding with this center. This latter adjustment serves to incline the tools relative to the tooth in order to locate them in the best working position. For instance, when cutting a gear having a small number of teeth the tools are inclined more than for one having a large number of teeth.

This machine will cut miter gears up to 38 inches in diameter and flat gears up to 48 inches diameter. The maximum diametral pitch is 1, and the maximum face width 10 inches. The machine can be so arranged that the tools cut when moving away from the center of the gear instead of cutting toward the center in the usual way. This reversal of the cutting stroke is an advantage in planing gears of large pitch cone angle, which tend to spring toward the tools. When planing from the center outward, the upper and lower tool-heads are transposed. The planing speeds and feeds are regulated by quick-change-gears.

How the Form or Templet Controls the Planing Tools

A single form or templet, in conjunction with a suitable mechanism, causes the tools working on opposite sides of a tooth (when taking a finishing cut) to gradually move further apart as the gear blank feeds inward. Fig. 11 shows a form *D* used for finishing a certain range of gear sizes and angles in the operating position. This form is attached to a small turret, which has on the opposite side a straightedge *E* used for the roughing cuts, as described later. The swinging movements of both tool-slides are controlled by one form *D*. The turret holding the forms is connected with the circular feed-rail *B* extending around to the work-head, so that the form moves to the right as the work feeds inward.

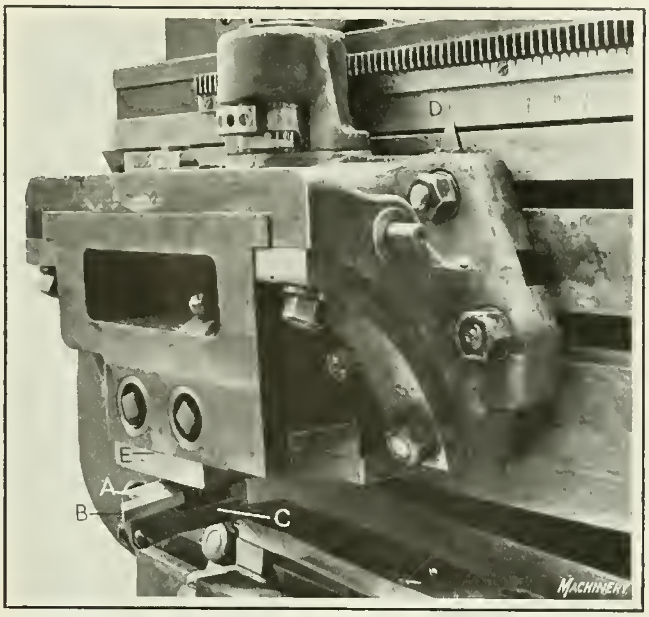


Fig. 13. Gage used for checking Position of Gear Blank

The form is engaged by a roller attached to the end of a vertical plunger *G*, which has rack teeth along one side. This rack meshes with a spur pinion which transmits motion through an adjusting worm to a bevel pinion on shaft *F*. The left-hand side of this bevel pinion (as viewed from the front of the machine), meshes with a segment gear attached to the lower tool-slide, and the right-hand side meshes with another segment gear connected with the upper slide. Consequently, as form *D* moves to the right, allowing plunger *G* to descend, the bevel pinion connecting with the segment gears is turned counter-clockwise, thus causing the tools to separate. The worm-wheel adjustment controlled by turning shaft *H* is used to regulate the initial angular position of the tool-slides in accordance with the tooth thickness required, graduated dials being used to determine the angular position.

The form is attached to a block on the turret having angular adjustment in the plane of the form. This adjustment makes it possible to use each form for a variety of gear combinations. Tooth contours differ for various sizes and angles, but by setting a form at different angles, as indicated by the graduations, the same form may be used for different sizes and angles within a certain range, and a set of twenty-five finishing forms serves for all combinations of gears for a given pressure angle. This angular adjustment is equivalent to one-half the angle subtended by lines extending from the apex of the back cone of the gear and coinciding with the sides of a tooth at the pitch line.

Adjustment of the Gear Blank

The head carrying the work-spindle is set in accordance with the pitch cone angle, as indicated by graduations on the base at *J*. In addition to the angular adjustment, the gear blank must be so located that the apex of the pitch cone coincides with the center of the machine. This endwise adjustment is obtained by shifting the work-spindle column along its base. When the gear blank is correctly located, the distance

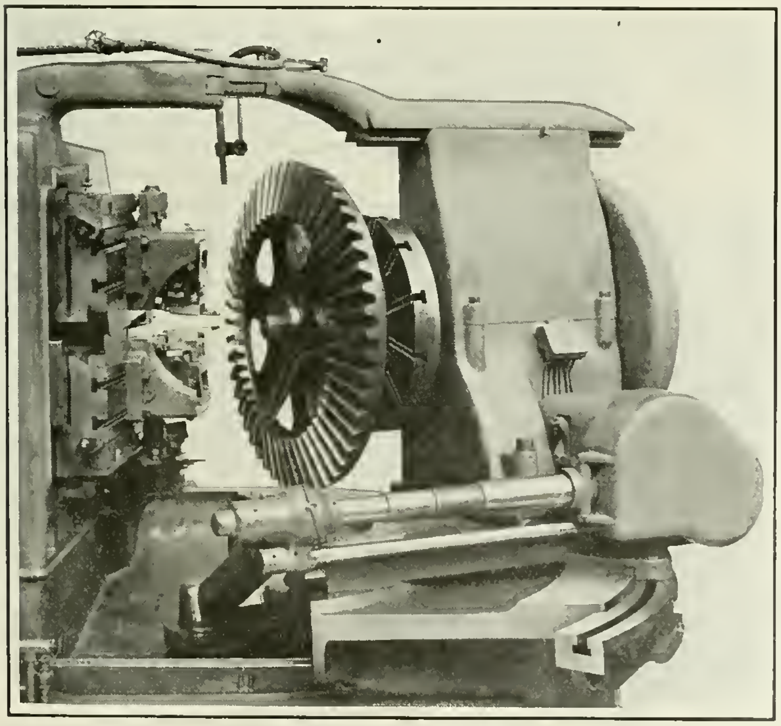


Fig. 12. Rear View of the Machine illustrated in Fig. 11

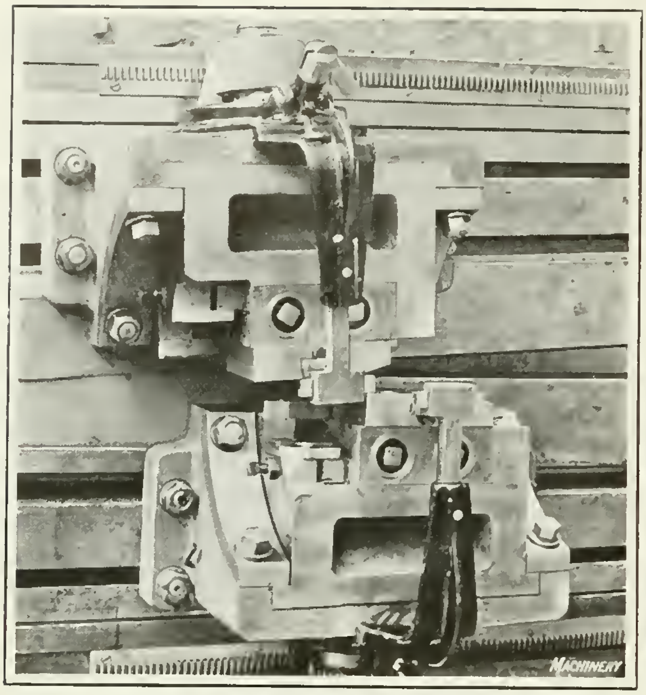


Fig. 14. Gages used for setting Tools

from the outer end of a tooth to the center of the machine, measured along the pitch line, equals the cone distance. A combination cone distance and angle gage is used to check the position of the gear blank. The gage is attached to the regular tool-holder, as shown in Fig. 13. There is a scale at *A* with a vernier on slide *B*, which connects with pointer *C*. The sliding part *B* is first set to the addendum or pitch depth of the gear to be cut. Then the work-spindle column is adjusted along its base until pointer *C* stands at zero, when the extreme outside edge of the gear is in contact with sliding scale *B*. When the gear has been adjusted in this manner, if the gear blank is not in the proper position endwise, or if it has not been turned to the correct size or face angle, such errors will be indicated by graduations at *D* and *E* representing the cone distance.

Setting the Planing Tools

With this machine a special fixture is provided for setting the tools off the machine. By means of this fixture, it is possible to locate the tools relative to the tool-holders so that when the holders are clamped in position on the clapper-box, the cutting point of each tool will be on the center line of the machine. The positions of the planing tools relative to the tool-holders may also be regulated by means of the gages shown in Fig. 14, which are placed on the tool-blocks for this purpose, and which have arms projecting down in front of the tools so that the latter can be set by placing them in direct contact with the gages. These tool gages on the machine are seldom used, because the special fixture previously referred to enables the operator to set the tools for a job at any time.

Taking Stocking Cuts on Two-tool Planer

The bevel gears ordinarily cut on this machine are finished from the solid. While it is possible to rough out the tooth spaces by the methods previously described in connection with single-tool machines, an effective method, especially for relatively coarse pitches, is indicated in Fig. 15. Square-nosed end-cutting tools are used, and these are set at angles that are equal approximately to the inclination of the sides of the tooth. One tool is inclined upward and the other downward, since they are used for roughing opposite sides of the tooth spaces. A straight form *E* (Fig. 11) is used.

When form *E* is in the working position and is moving to the right as the work-head feeds inward, it pushes plunger *G* upward, causing the tool-slides to move gradually toward each other; hence, two slots are formed as indicated by diagram *A*, Fig. 15. The gear then indexes an amount equal to the circular pitch, so that one tooth space is roughed out as shown by diagram *B*, the central part (indicated by the shaded lines) falling out after it has been separated by the tool. As this operation is repeated, a tooth space is roughed out at each indexing, to the approximate shape indicated by diagram *C*. This method of roughing would be employed for stocking out gears of the larger pitches. When it is practicable to use corrugated V-shaped tools, as when roughing cast-iron gears, especially those of the smaller pitches, two tooth spaces are stocked out simultaneously, and the indexing mechanism is set to index the gear an amount equal to twice the circular pitch.

TIME REQUIRED FOR CUTTING BEVEL GEARS ON GLEASON PLANERS OF FORM-COPYING TYPE

Size of Machine, Inches	Gear Material	Diametral Pitch of Gear	Number of Teeth	Face Width, Inches	Number of Gears Cut	Total Time,* Hours
24	Cast iron	3	54	2½	3	9
24	Steel	5	19	1⅛	6	5¾
24	Steel	12	18	1	25	18
37	Cast steel	1½	40	5	1	12
37	Steel	2½	26	2½	6	21
37	Cast iron	4	107	3	12	72
54	Cast iron	2	76	4	1	12
54	Cast iron	1¼	34	8	1	13
54	Cast steel	1½	50	6	1	17
77	Cast steel	1½	50	6	1	17
77	Cast iron	2	130	5½	1	20
77	Cast steel	4½†	47	11	1	50

Machinery

*The total time includes setting up the machine, stocking out and finishing.
†This figure gives circular pitch, in inches, instead of diametral pitch.

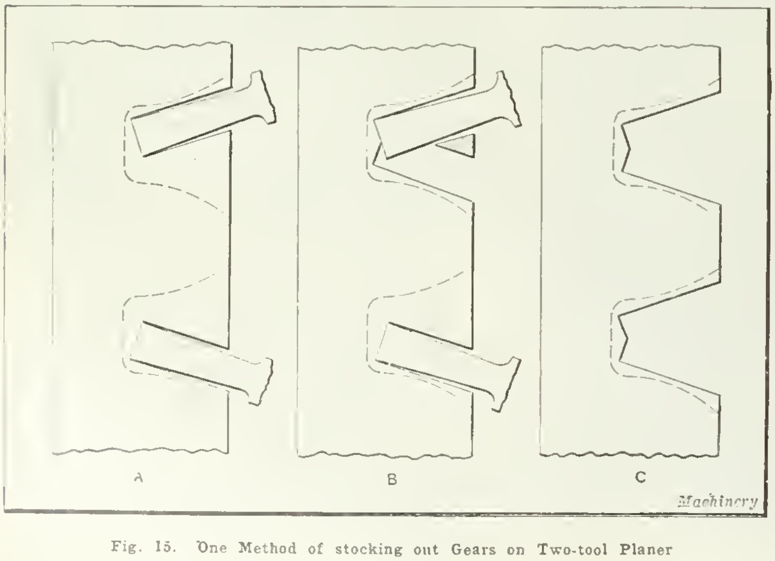
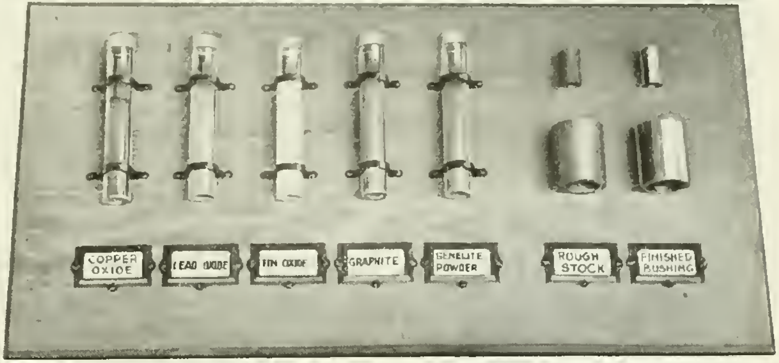


Fig. 15. One Method of stocking out Gears on Two-tool Planer

Time Required for Planing Bevel Gears

The accompanying table, containing data from actual practice, gives a general idea of the time required for cutting bevel gears on Gleason planers of the form-copying type. This table covers machines of four different sizes and includes data for cast-iron and steel gears of different sizes and pitches. The total time given in the last column includes the time for setting up the machine, stocking out, and finishing, and applies to gears that were stocked out on the same machine without removing the blank, which is the usual practice with planers of the templet type. The time necessary for setting up the machine usually varies from forty-five minutes to one hour.

Genelite—A New Bearing Material



A Bronze Material Containing Graphite Evenly Distributed Throughout the Entire Mass

By E. G. GILSON
Research Laboratory, General Electric Co.

Machines in general wear out first at the bearings, and because of this, a great deal of time and thought has always been given to bearing construction. In recent years, however, with the demand for increased output and decreased maintenance cost, bearings have received even more attention than previously. A bearing may be considered as being composed of three parts—the journal, the bushing or bearing material, and the lubricant. In improving bearings, little can be done with the journal, as it is usually a power-transmitting member and must have strength to do its work. This leaves the bearing material and the lubricant as fields for improvement in present type bearings, and while they are quite widely different, they cannot be wholly separated.

Composition of Genelite

In an endeavor to increase bearing efficiencies, the research laboratories of the General Electric Co., have produced a material called "Genelite," which is a high-grade bearing bronze, made synthetically. The novel feature of this material is the admixture of finely divided graphite with the bronze in such a manner that it is uniformly distributed throughout the mass in a volume proportion as high as 40 per cent. This uniform distribution is accomplished by mixing graphite with the powdered oxides (copper, lead, and tin oxides) composing the bronze, in a sufficient quantity to reduce the oxides and leave the desired amount of graphite after the reduction is complete. The mixture is then put through a reduction process, being kept in the powdered form known as "Genelite powder," until the final steps. These consist of pressing the partially reduced powder in heavy steel molds under a high pressure as nearly as possible to the desired size and shape, and then giving it a final heat-treatment.

When this material is polished it is similar in appearance to bronze, but it does not have the same physical characteristics. It is quite low in tensile strength, but comparatively high in compressive strength. This will be readily understood when it is considered that the material is a bronze sponge with graphite distributed through its pores. The distribution of the graphite may be seen in the photomicrograph, Fig. 1, which shows the material greatly magnified. The black parts of the illustration represent the graphite, and the white the metal. The even distribution of the graphite and the continuity of the metal structure are well shown. The graphite is so firmly held that it is impossible to wash it out; in fact, it can be separated only by complete disintegration of the metal.

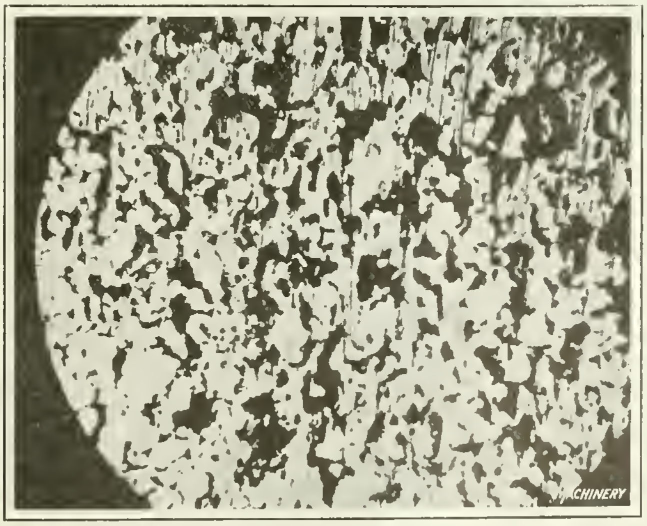


Fig. 1. Photomicrograph of "Genelite," showing the Distribution of the Graphite and Metal

Capillary Characteristics of "Genelite"

As a bearing material "Genelite" has three decided advantages: First, wear to both the journal and bearing is negligible. Second, it is impossible to melt out a bearing or to make it and the journal seize or weld together. Third, its porosity may be such as to allow an absorption of oil as high as 2½ per cent in weight. In many places "Genelite" can be taken advantage of to feed oil to the bearing surface by capillarity, the oil being brought into contact only with the outer surface of the bearing, there being no oil-holes nor grooves in the bearing.

This action is apparent from the experiment illustrated in Fig. 2, in which *A* is a cylindrical piece of "Genelite" resting in a glass vessel *B* which contains oil; *C* is a felt wick leading to the lower vessel *D;* and *E* is a weight that holds the wick in contact with the "Genelite." This arrangement will carry all the oil from the upper vessel to the lower. That this is done by capillarity through the pores of the "Genelite" part and not by creepage along the outer surfaces is shown by the facts that the surfaces remain dry and that if the "Genelite" part is replaced by a metal part, the passage of oil stops.

Bearings utilizing this principle have an advantage over wick-type bearings in that there is nothing to carbonize, like the end of a wick rubbing against a shaft—a condition which results in stopping the flow of oil. Neither does "Genelite" feed oil so rapidly that excess oil is thrown off, the capillarity holding it to the surface until it is used up. This feature makes "Genelite" ideal for application to vertical bearings which, from their nature, are difficult to lubricate, as well as to portable machinery.

In portable machinery it is usually difficult to keep oil in the bearings because of the constant change of position.

"Genelite" bearings used with high-speed spindles give results that are impossible to obtain in any other way. In one such instance, it was possible to use a soft steel spindle with greater efficiency than a hardened spindle and the old bearing. This seems to indicate that by the use of "Genelite," together with proper oil, higher spindle speeds can be attained with less attendant trouble than at present. The self-lubricating qualities of the material give it a great advantage in places that are hard to lubricate or that from their location are likely to be neglected. All applications of "Genelite" should be made with full consideration of its peculiarities. It does not machine readily, most of the machining operations being best performed by grinding. Therefore, it is most suitable for plain simple bushings. Because of its lack of tensile strength, it should be completely supported by its housing or backed up by a steel shell that will give it the necessary support. Also, for the same reason, it is not practicable to make bushings as thin in section as bronze bushings can be made.

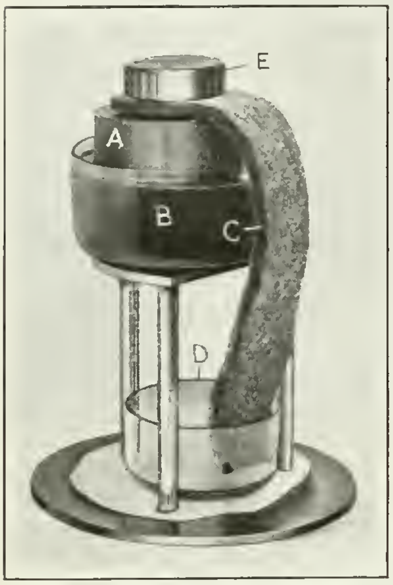


Fig. 2. Experiment that indicates the Capillarity of "Genelite"

Results of a Test Installation

Although the first cost of a bearing material having the advantages of "Genelite" may be greater than of another material, this cost is more than compensated for in all places where the cost of maintenance or uninterrupted service are factors. A test installation was made in one factory where bearing failures were so common that the cost of repair, including that of rotating parts damaged when bearings failed, and of idle machinery waiting for repairs to be made, was a high percentage of the production cost. Two "Genelite" bearings were installed, one of which was lubricated by oil-rings in the standard manner. The other bearing, as an experiment, was a solid bushing without oil-holes or grooves. It was "waste-packed," having the oil-soaked waste in contact with only a small part of its surface.

It was expected that this bearing would work all right if the temperature could be kept below the disintegrating point of the oil used. But as there was no flood of oil through the bearing to carry away the heat and only about 25 per cent of the outside bushing surface was in contact with the housing, the facilities for dissipating the heat were very poor. The temperature of the bearings ran high and at full load the oil broke down, the volatile parts evaporating and leaving the asphaltic residue behind. Of course, under these conditions lubrication failed to exist and the temperature rose so much that fire extinguishers were brought to the job for fear that adjacent parts might catch fire. But the bearing continued to function until, finally, for fear of spoiling other parts, the machine was shut down.

When taken apart, the journal was found to be blue from the heat but otherwise in perfect condition, and the bearing was also unharmed. The journal was brightened up with crocus cloth, an oil-ring put in, the bearings reassembled, and the machine started off. It has given no trouble since, although operating continuously, and the set initially installed with the oil-rings has never given the slightest trouble. This experiment demonstrates the amount of abuse a "Genelite" bearing will stand.

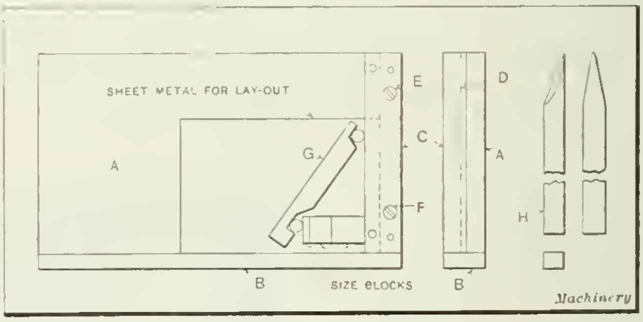
* * *

MAKING MASTER LAY-OUTS ON METAL PLATES

A very accurate and simple method of making master lay-outs on metal plates is to employ a special fixture like the one here illustrated. The fixture consists of the following parts: A cast-iron plate *A* machined on the top surface and along one edge; a steel strip *B* ground on one side and attached to plate *A* by flat-head screws; and a steel bar or straightedge *C*, which is ground on the inner edge and set exactly at right angles with the ground surface of part *B*. Bar *C* is held in place by dowel-pins and flat-head screws *E* and *F*. A recess *D* is cut in bar *C* to receive the sheet metal on which the lay-out is to be made. The two small holes on the left-hand side of bar *C* are tapped and provided with screws that can be tightened to hold the sheet metal in place.

By the use of a sine bar such as shown at *G* and standard size-blocks, angles and straight lines can be accurately laid out on the plate. A special knife-edge scriber *H*, the flat side of which can be held against the side of the sine bar, will greatly facilitate the drawing of fine lines. Very accurate center lines for locating the dividers can be struck with a needle point, using a magnifying glass to observe the work. If the knife-edge scriber and divider points are carefully stoned, very fine lines can be produced.

Sheet zinc has proved to be one of the best metals for master lay-out plates when properly prepared. To prepare this metal, first remove the coating from the side to be used, with a piece of medium grade emery cloth, and polish the surface sufficiently to remove any visible scratches. Then wash the polished surface with a solution of blue vitriol such as is ordinarily used in the machine shop, care being taken not to pour the fluid on the plate too rapidly. The best results can be obtained after a little practice by holding the plate under a stream of running water while the blue vitriol is being applied with a saturated piece of soft cotton waste or similar material. The plate is then allowed to dry thoroughly, after which a drop or two of oil is applied and rubbed lightly over the surface. This method will produce a very dark surface or one that is practically black. In drawing lines with either a needle point or the scriber shown at *H*, only a very light pressure is required.



Equipment for making Master Lay-outs on Metal Plates

Master plates produced by this method are used for complicated profile gages and similar work. These plates are ordinarily used only by the gage inspectors and are kept as a permanent lay-out record. All the necessary information, such as the title, drawing numbers, etc., is usually written on the plate with a needle point. The plates are cut to a standard size and filed like ordinary index cards.

J. E. L.

ADJUSTABLE-PLUNGER STOPS FOR FIXTURES

By EDWARD HELLER

In May MACHINERY, page 730, the design of spring plungers is discussed. The writer believes that the designs described in that article contain two objectionable features: (1) they extend above the working position when not in use; (2) they will jar loose, and although they are constructed to prevent their dropping down, they will jar up, which will affect the position of delicate work in the fixture.

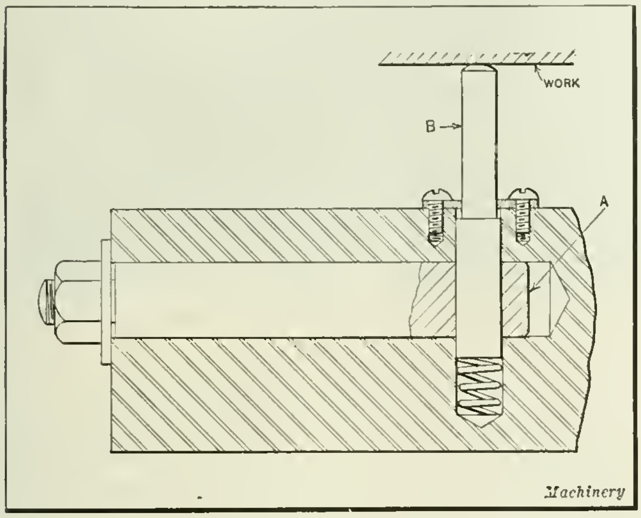


Fig. 1. Plunger Stop of Simple Design

A remedy for these two objectionable features is offered in the designs illustrated in this article.

A plunger design is illustrated in Fig. 1. The clamping member *A* is a piece of round cold-rolled stock, about 1/4 inch larger in diameter than plunger *B*. One end of the clamp is drilled to receive the plunger and the other end is turned and threaded for a nut. A slight turn of the nut exerts a shearing stress on the plunger and it "stays put." But this design goes only half way in remedying the objections raised to the design mentioned; it does not offer an improvement so far as projecting above the surface of the fixture is concerned.

A design which overcomes this difficulty is shown in Fig. 2. This design was developed by the tool engineering department of the National Cash Register Co., where it has been used for a number of years and is regarded as the best stop of any design developed by that department. It has also been incorporated in fixtures made in other shops, and wherever the principle has been used it has given satisfaction. It may be modified slightly to suit the work at hand, and the parts standardized and made up in quantities. The stop consists principally of a plunger *A*, plunger bearing *B*, wedge *C*, wedge bushing *D*, clamp pin *E*, clamp rod *F*, clamp screw *G*, and dust cap *H*. The section view of the stop in the lower part of the illustration shows how the parts are assembled by means of screws and dowel-pins.

The illustration shows the stop in the working position. Before the work is put into the fixture, the wedge *C* is withdrawn, permitting the plunger *A* to drop down as far as the small set-screw will permit. After the work has been located on its positive stops in the fixture, the wedge is pushed in under the plunger, thus raising it into contact with the work. The wedge is advanced into this position by pushing on the knurled head of screw *G*, and as soon as contact is made, this screw is given a slight turn. This causes the clamp rod *F* to advance and force the clamp pin *E* up, jamming it against bushing *D*.

The enlarged views of pin *E* show that the spot in which the rod engages is drilled about 1/32 inch below the center of the clamp rod. The result is that when the rod is forced forward, it raises the pin and locks the entire mechanism in place. The pin is flattened on the lower end to fit into a slot in the lower side of the bushing *D*, to prevent turning. The construction also serves as a stop for the wedge *C*, preventing it from being entirely removed from its bearing in bushing *D* when withdrawn.

The main point in favor of this stop is the fact that the tightening is not done on the plunger directly. The tightening of the screw does not distort the set-up, but simply locks the whole mechanism in the required position without exerting any pressure in addition to that applied when advancing the wedge. The first impression may be that the design is expensive, but when one considers the details it will be apparent that this is not so.

The plunger is simply a piece of drill rod with the ends finished to length and machined with a flat for the set-screw. The wedge member is also a piece of drill rod with one end cut away from the center line at an angle of 10 degrees and the other end drilled and tapped to receive the parts contained in the operating end. Bearing *B* and bushing *D* do not need to fit very accurately in the fixture casting, nor do the drill rod members which work in them need to fit very accurately. In fact it is desirable to have a liberal working clearance for these two members. The dust cap *H* is made of any soft metal and pressed on the plunger.

When such a stop is made a standard construction, all fixtures are built so as to keep the work a certain height *J* above the fixture base. Every part of this stop can then be made up in quantities. The only variation that must be taken care of in a standardized application of this plunger is the distance *K*, and this is done by making the wedge *C* in two pieces, as shown at *L* and *M*, and making these of standard size. A variable connecting link *N* is then used to take care of the variation in length. Of course, the link must be made to suit each case.

The nicety with which this stop works is difficult to describe. It is more sensitive than anything that the writer has encountered in many years of experience. When clamped in position it is as solid and reliable as a solid stop. The writer has seen milling fixtures for handling various flat and delicate castings equipped with as many as twenty of these stops, arranged all around the fixture. The time required to tighten up all these stops was well spent, as the work produced was practically perfect.

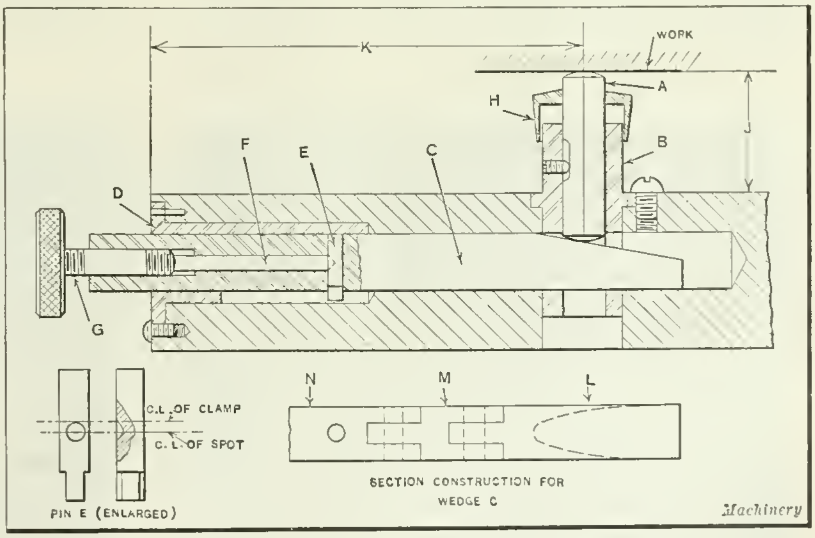


Fig. 2. Design of Plunger Stop that contains Special Features

Grinding in Foundry and Steel Mill

Types of Grinding Machines Used in Foundries—Wheel Selection for Snagging—Arrangement of Cleaning Room—Wheel Efficiency and Grinding Costs—Records of Wheel Costs—Billet Grinding

By the Engineering and Educational Departments
of the Norton Co., Worcester, Mass.

ALL castings poured in foundries must be "cleaned" before shipment. In this cleaning process, grinding is very important, both in the cast iron as well as in the steel foundry cleaning room. This grinding or "snagging," as it is usually called, consists of removing from the surface of the castings any irregularities and projections left after the gates and risers have been broken or cut off. In addition, many castings have a protruding fin which is formed when the molten metal flows into the parting line between the cope and nowel of the molding flask.

Because of the efficiency of the modern special-purpose grinding wheel in removing metal rapidly and cheaply, it has often replaced pneumatic chipping (cold chiseling) hammers for this class of work, except for large castings of comparatively soft material and large irregular-shaped castings on which it is impossible to use a grinding wheel. Manganese steel and some other alloy steel castings, because of their extreme hardness and toughness, must be ground. Every foundry, therefore, has a cleaning room containing grinding equipment.

In the very largest foundries, as many as sixty machines of the various types, having grinding wheels from 6 to 24 inches in diameter and from ½ inch to 4 inches wide, are used. Some idea may be had of the scope of this phase of grinding from the fact that for every ton of steel castings produced, one dollar's worth of grinding wheels is consumed. The expense is less for cast iron, as would be expected, because of the greater ease with which this metal can be machined.

Grinding Machines Used in Foundries

The grinding machines of a foundry cleaning room are not of the precision type, because they are used only for rough offhand grinding. Four types are employed: Floor stands, bench stands, swing-frame, and portable grinding machines, each having its field of operation.

The floor stand (Fig. 1) should be of very rigid construction. Its mass should be great enough to absorb inherent out-of-balance conditions of the grinding wheel. Its bearings, if of journal construction, should be long and self-oiling with covers to protect them from grit and dust. The stand should be equipped with adequate wheel guards to protect the operator against wheel breakage, which can at the same time act as dust hoods if properly connected to an exhaust system.

Since machines of this type are generally equipped with two wheels, one on each end, it is of great advantage to have ample distance between wheels, that is, to have a long spindle so there will be a minimum of interference between operators and boxes containing castings. Floor

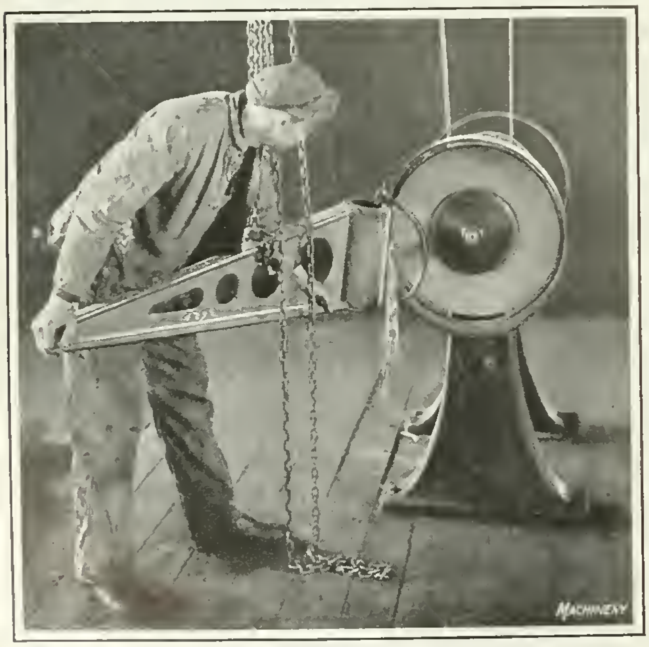


Fig. 1. Use of Floor-stand Type of Grinder for snagging a Casting which is supported by a Chain Hoist

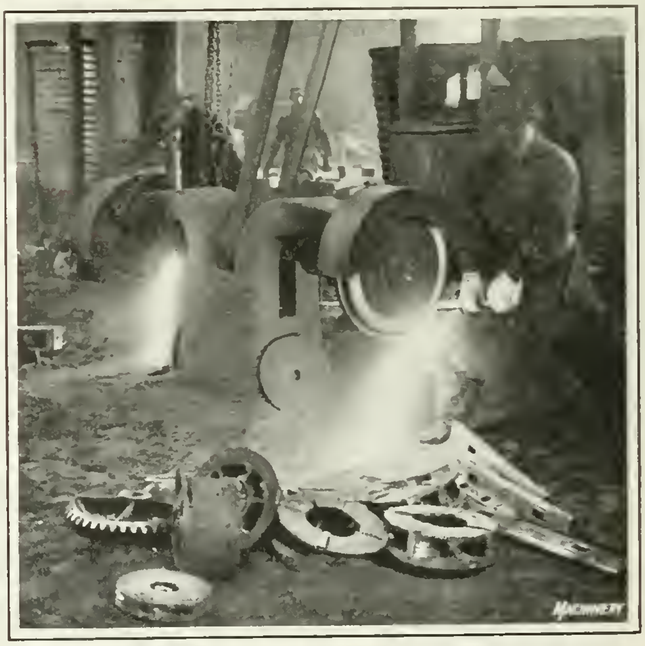


Fig. 2. Snagging Castings with Floor-stand Grinder having Ample Clearance between Wheels and Column

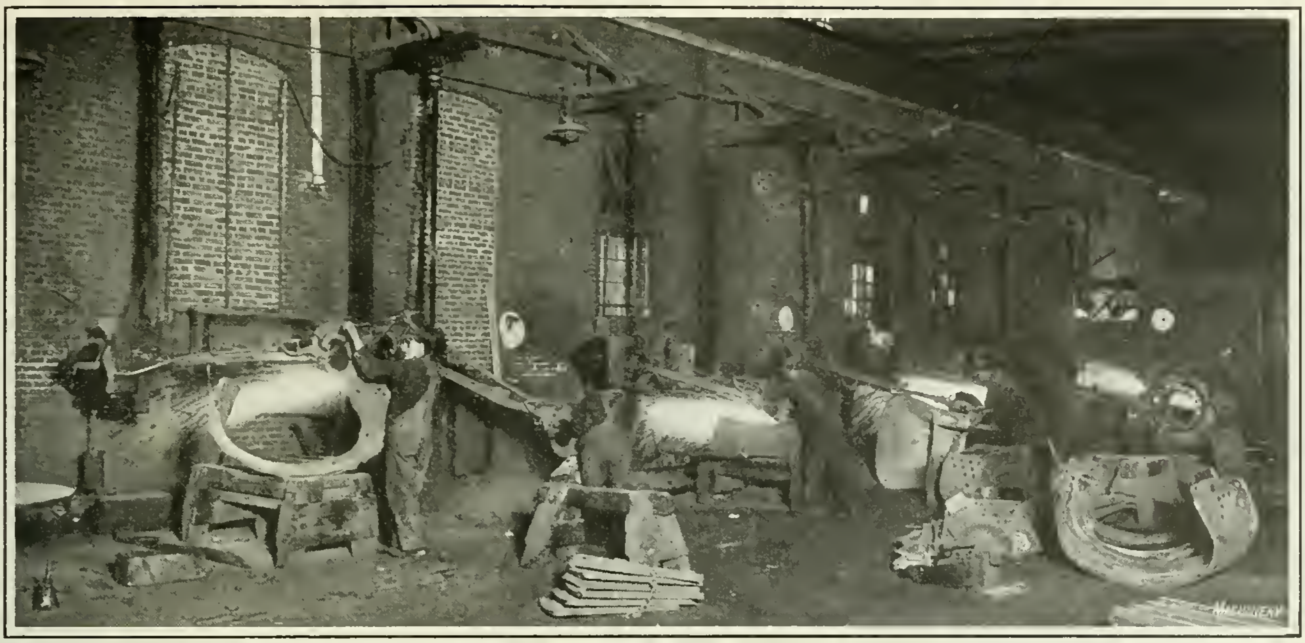


Fig. 3. Grinding Machines of the Swing-frame Type used for the Snagging of Castings

stands generally have grinding wheels from 12 to 24 inches in diameter and from 2 to 4 inches thick. The spindle may be driven by a belt or the stand may be a self-contained machine, with an electric motor at the center, the shaft of which is also the wheel-spindle. Castings weighing from 2 to 50 pounds are usually snagged on floor stands on account of the rapidity of production and the ease of handling work, of which mention will be made later. The floor stands that are shown in Fig. 2 are designed to provide ample clearance between the wheels and the frame of the grinder.

For smaller work on pieces weighing two pounds or less, it is more economical to use bench stands. These are similar in construction in every way to floor stands, but are smaller and have no pedestal.

Swing-frame Grinding Machines Portable Grinding Machines

The swing-frame grinding machine was designed for the purpose of removing the fins, gates, and wires left by and in molding, from castings too heavy to be conveniently lifted by hand. One wheel only is mounted on a machine, and the arm on which the wheel is mounted has a large radius of swing and is designed, in some cases, to travel laterally on a track. Swing-frame machines are the heavy-duty machines in the foundry and are rigidly constructed. Great pressure of the wheel on the work is possible, because the operator bears his whole weight at times on the handles of the machine (see Figs. 3 and 4). Wheels from 12 to 18 inches in diameter and from 2 to 3 inches thick are commonly employed.

When on account of the size or the irregular shape of the castings, it is easier to bring the grinding machine to the work, portable grinding machines are employed. These machines are of such weight that they can be handled easily. The wheels used are generally from 6 to 10 inches in diameter and from ½ to 1½ inches thick. Although the driving power is usually electricity or compressed air (see Fig. 5), a flexible shaft is sometimes used for transmitting the power as shown in Fig. 6.

Wheel Selection for Snagging

Modern grinding wheels are especially prepared and made in a variety of forms and compositions to meet the requirements of different kinds of work. For every class of grinding there is some wheel made different from others that will best perform the work. This difference in wheel make-up is due to the following factors that can be varied by the wheel manufacturer: (1) Size of grain; (2) grade of wheel (bond strength); (3) combinations of grains; (4) processes, materials, and different bonding methods, such as vitrified, silicate, elastic (shellac) and rubber; (5) abrasive temper. There are, however, certain wheels that have become practically standard for the snagging of castings. The characteristics of these wheels are: (1) Size of grain, 10 to 30; (2) grade of wheel, P to U; (3) process, vitrified; and (4) abrasive, regular alundum or crystolon.

This makes the selection for the foundry field less difficult; yet the range is still so wide that a thorough analysis of the material to be ground must be made. The choice of a wheel depends on: (1) Kind of casting (material); (2) type and condition of machine; (3) contact or size and shape of castings; (4) personal factor of operation; and (5) speed and size of wheel.

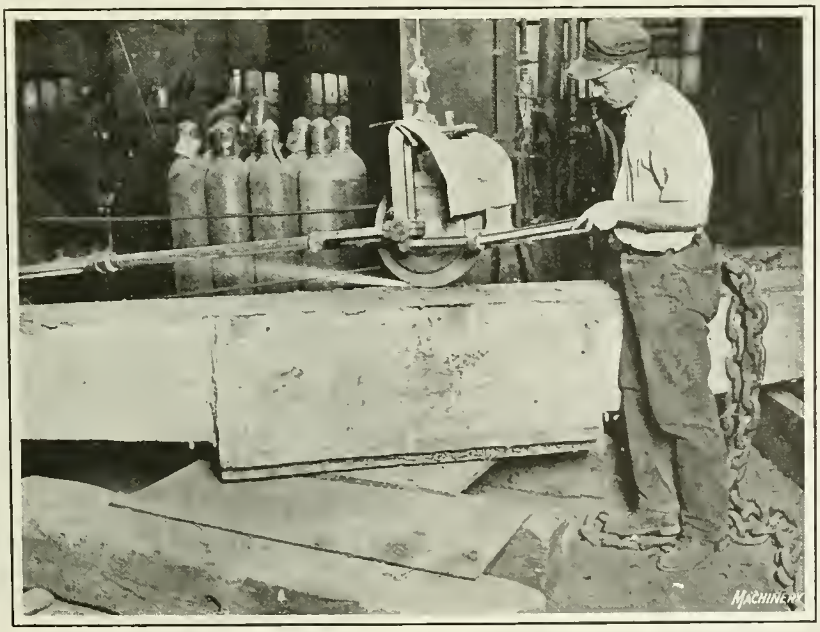


Fig. 4. Another Example illustrating Application of Swing-frame Grinder

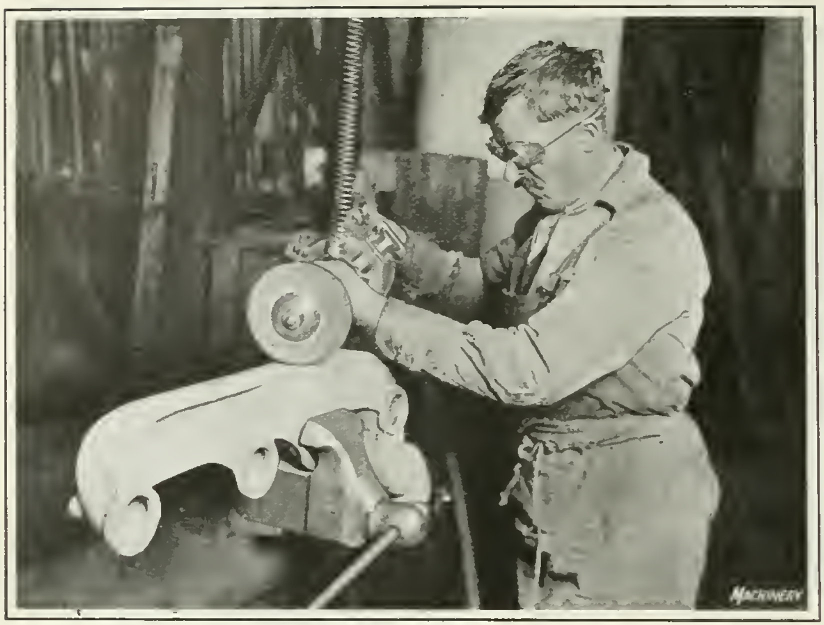


Fig. 5. Pneumatic Grinder with Spring Suspension

Cast iron is a metal of comparatively low tensile strength. Because of this and other physical properties, carbide of silicon, a very hard and comparatively brittle abrasive should be used in grinding it. On the other hand, steel castings require the use of aluminous abrasives which are hard and tough, because steel is a tough metal of high tensile strength and comparatively high ductility. Ductility of the material to be ground is an important consideration in wheel selection. The more ductile the material is, everything else being equal, the harder the wheels must be in order to perform efficient grinding.

Castings that present a narrow contact on the wheel face, such as stove castings and similar parts, require harder and finer wheels than castings that have a medium-sized or broad contact. The reason it is necessary to use harder wheels is that the effect of the narrow contact results in a dressing action, which causes the wheels to wear away more rapidly. Large sized castings are more efficiently snagged with wheels that are coarse, provided all the other conditions are equal.

The type and condition of the machine used is a factor that influences wheel selection. A heavy floor stand in good condition can use a softer wheel than a less rigid or a badly running machine. The latter will vibrate excessively, and this continual hammering of the wheel on the work disintegrates the wheel rapidly, unless it is hard. In either case, however, it is obvious that the efficiency of the machine is lowered.

A swing-frame grinding machine generally requires a harder wheel than a floor stand, because of the great pressure exerted by the operator, and the lack of rigidity of the wheel and work. The manner in which an operator uses a wheel brings in what is called the "personal factor." Some operators exert more pressure on the wheel than others, are more aggressive, treat the wheel more roughly, or in grinding language "punish the wheel." Operators paid on a piece rate plan are more likely to "punish the wheel" than those under other systems of payment.

A wheel running at a comparatively slow speed (5500 feet per minute is normal) acts softer than if run at the proper speed, and if the slow speed cannot be changed, this factor must also be taken into consideration. If quality of finish enters into the question, then quantity production must be sacrificed and a finer wheel employed.

Lay-out of Cleaning Room

Lost motion is waste in all classes and kinds of work. In processes of manufacture, the product should move in a continuous and prescribed path until completed. If machine equipment and general plant lay-out can be so arranged that the trucking is reduced to the shortest possible distance with least interference, then the arrangement is efficient, as is exemplified in some of the largest automobile plants. The lay-out of the grinding equipment in the foundry is of importance, because, with the proper arrangement, excessive handling and trucking of material can be prevented. The whole object is to keep the wheels of the grinding stand in contact with the castings during as large a part of the day as possible. The time spent in getting castings to the grinding wheel and disposing of them after grinding should be kept at a minimum.

The two important considerations are, first, the feeding of the castings to the grinding machines and, second, the removal of the finished pieces without interruption and interference, so that the work can be kept going continuously. To effect the first object, the castings must be placed within easy reach, so that the operator can grasp them with one hand and deposit them into a container with the other hand, the bodily motions being reduced as far as possible. This applies to small and medium sized castings only. To effect the second object, the machines must be so arranged that there is ample space for truckways. An electric lift truck, traveling on a suitably paved floor, and the use of boxes furnishes, perhaps, the best and quickest method of transporting castings. The boxes containing the castings should be of convenient size, so constructed that they can be handled easily by the lift truck, and mounted on wheels so that the grinding operators can move them without difficulty.

An ideal arrangement is shown in Fig. 7, which was primarily designed for a cast-iron foundry cleaning room. Here the bench stands are conveniently arranged along a well lighted wall, and the floor stands located near the center of the room, with ample trucking space around them. Good practice in the design of a cleaning room for steel castings is to have the castings enter at the middle of one side of the room. The heavy castings are then sent by a track or overhead rail system to one end of the building where the swing-frame machines are located; the lighter and small castings are carried in trucks to the other end of the building where the bench and floor stands are located.

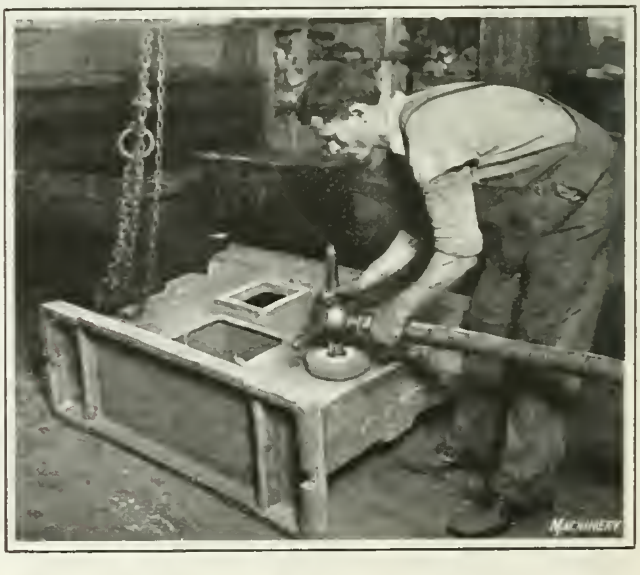


Fig. 6. Grinder of the Flexible Shaft Type

After cleaning, all castings are conveyed to the center of the room opposite the point of entrance, where they can be inspected and shipped.

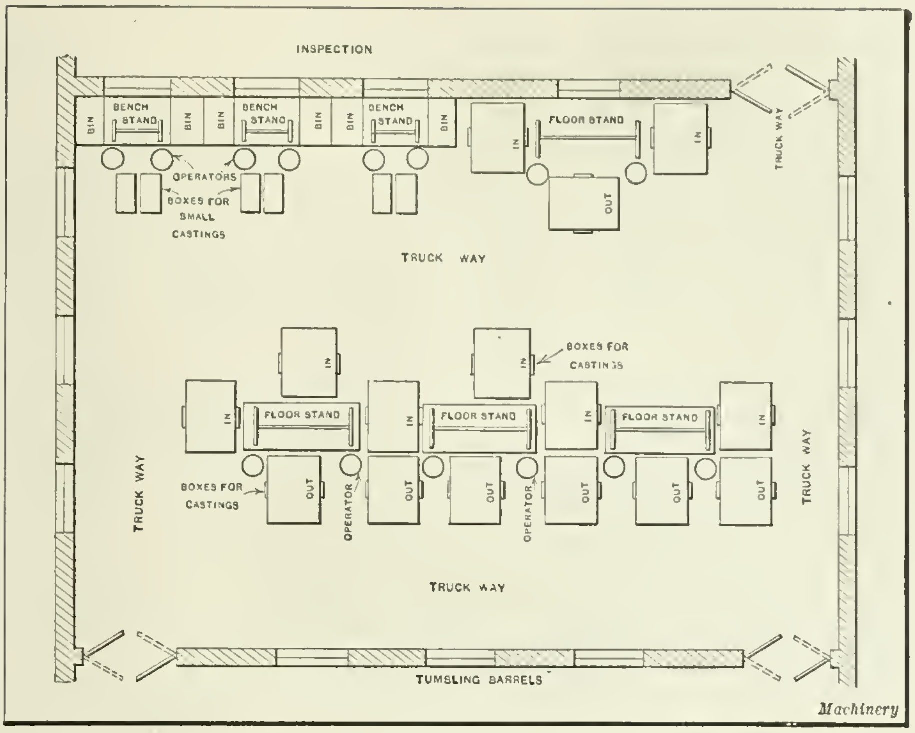


Fig. 7. Plan View, showing Arrangement of a Foundry Cleaning Room

How to Determine what Grinding Wheels Give the Best Results

In order to use grinding wheels most efficiently, all the necessary factors should be considered. To some purchasing agents, the best wheel is the one that lasts longest; to the operator and foreman it is the one that cuts most rapidly, regardless of wheel life; but to the engineer and cost department it is the wheel that removes the most material in the shortest time and with the minimum wear. Other things being equal, production cost is the governing factor, and the best wheel is therefore the one that does the work at the lowest cost per unit of output.

To reduce this general statement of wheel efficiency to a working basis, three factors, namely, wheel wear, work done, and time consumed must be combined so that the best balance between them can be quickly recognized. This can be accomplished by reducing each to a "dollars per unit of product turned out" basis. The time element is introduced as an overhead variable. Thus if normal overhead is obtained per man and machine per hour, we can calculate the normal overhead cost per unit of product. Any increase in production due to a faster cutting wheel will decrease the normal overhead cost per unit of product and vice versa. The three cost factors to be added to obtain the total grinding cost per unit of product are then: Wheel cost per unit of product; labor cost per unit of product; and overhead cost per unit of product.

The wheel that makes the total cost per unit of product least, is the best wheel. A concrete example of the calculation of factors affecting wheel efficiency is shown by the accompanying table. From this table it will be noted that, although wheel No. 1 was used longer than the others (36 hours), and removed 72 pounds of steel, the cost per pound of steel removed was high as compared with wheel No. 3. The conclusion is that wheel No. 1 was too hard and slow-cutting to be economical. Wheel No. 2 was used only 6½ hours, removed 22½ pounds of material, and the cost per pound of steel removed was highest ($0.494). This wheel was so soft that the abrasive particles did not remain in the bond long enough to cause the wheel to cut efficiently. The gain of this wheel in speed of cutting over No. 1 was not enough to counterbalance the excessive wheel cost.

EXAMPLES ILLUSTRATING METHOD OF DETERMINING GRINDING WHEEL EFFICIENCY

Wheel No.	Hours in Use	Diameter of Wheel when Removed, Inches	Wheel Wear, Cubic Inches	Net Production, Pounds	Material Removed, Pounds
1	36	11½	194	3021	72
2	6½	10	245	789	22½
3	14½	14¼	203	1825	62½

Wheel No.	Cost of Wheel Consumed, Dollars	Labor Cost, Dollars	Overhead Cost, Dollars	Total Cost, Dollars	Total Cost per Pound of Material Removed, Dollars
1	4.42	12.60	18.00	35.02	0.486
2	5.59	2.27	3.25	11.11	0.494
3	4.63	5.08	7.25	16.96	0.271

Dimensions of wheels used: Diameter, 16 inches; face, 2 inches; diameter of center hole, 2¼ inches.
Wheels may be worn down to 7½ inches in diameter, giving a possible wheel wear of 314 cubic inches.
Overhead (normal), $0.50 per hour per man and machine.
Net price of wheel, $7.16.

Machinery

Wheel No. 3 was in use about twice as long as No. 2 and two-fifths as long as No. 1, but it cut at a very high rate, and removed material at a cost of only $0.271 a pound. Obviously this wheel is the most economical, and the saving which would be effected by its use in a year's time would be worth many times the cost of tests to determine the most efficient wheel. The form of data sheet shown in Fig. 8, for use by the workmen in comparing results obtained from different wheels, has been found to be practical and easily understood. The data used in calculating the table previously referred to was obtained from record sheets of this kind.

The Grinding Wheel in the Steel Mill

When molten steel is poured into molds, the resulting ingots almost invariably contain imperfections in the form of blow-holes, checks, slag inclusions, etc. These imperfections become very evident when the ingot has been rolled into a billet, and are then visible in the form of seams and cracks on the outside. Unless these seams and cracks are removed, they will appear as defects in products made from the billets, such as structural shapes, automobile parts, etc., and will make them dangerously weak. In the removing of these imperfections, large quantities of grinding wheels are consumed, and grinding is an important factor.

The seams and cracks in soft low-carbon steel billets are now being removed, for the most part, by means of pneumatic chipping hammers (cold chiseling). Although this method is very rapid it has disadvantages. The chisel of the chipping hammer has a peening action, and while the crack may appear to be entirely removed, actually the bottom of the crack may not have been reached. The seams in all alloy steel and high-carbon steel billets are removed by grinding. The general practice is to surface-grind the entire billet lightly, so as to remove the scale and make the seams and cracks visible, after which they are ground out. Grinding insures the removal of the entire crack, because there is no peening action to cover up the fissures. Billet grinding, therefore, reduces the amount of grinding that would otherwise be necessary later on, after the billets have been rolled into bars. The swing-frame grinding machine is practically the only type used in the steel mill for billet grinding.

Machine Number.....................................
Wheel ....
Size ....
Time Mounted.......................................
Hours Run...
Diameter when Removed..........................
Wheel Wear...
Weight of Billet before Grinding...................
Weight of Billet after Grinding.....................
Material Removed...................................

Fig. 8. Data Sheet used for checking Results obtained from Different Grinding Wheels

Cost-keeping is more important in connection with billet grinding than in the steel or cast-iron foundry, because of the larger amount of grinding done. An average billet has about 2 per cent of its weight ground off, and sometimes the amount of the material removed is as great as 10 per cent. When one considers that an average billet weighs about 200 pounds, it can readily be understood that, to remove 20 pounds of steel by grinding, necessitates a large consumption of wheels and makes it essential that efficient wheels be used.

Wheel Cost Records

Not many years ago wheels were purchased because of their lasting qualities, but exhaustive tests have conclusively proved that the purchase of wheels governed solely by length of life results in a loss of thousands of dollars yearly to consumers. The loss is due to the fact that labor and overhead rates per hour are constant, and that long length of wheel life is secured from the use of very hard wheels which may be inferior as regards cutting action. It is cheaper to buy softer wheels that last fifteen hours and produce rapidly, than to buy very hard wheels that last fifty hours and cut very slowly. Obviously there is a limit to the degree of softness of the wheel—a critical point so to speak—beyond which the cost of production will be increased.

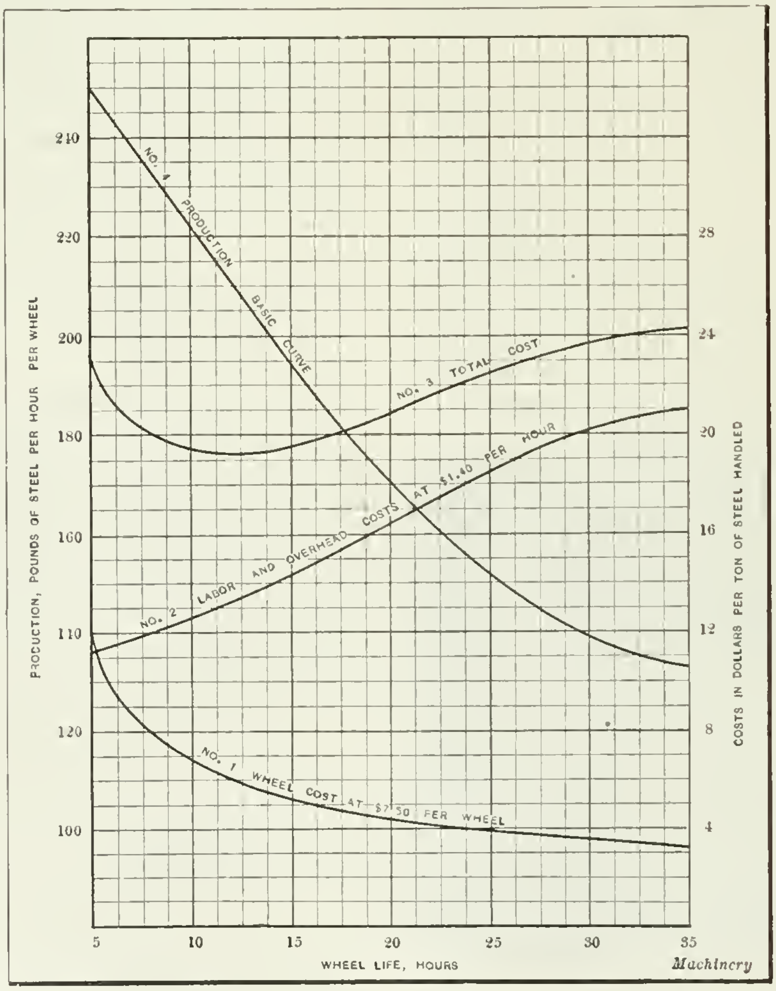


Fig. 9. Chart showing Relations between Costs and Production when grinding Steel Billets

Fig. 9 shows these facts in graphic form. Curve No. 1 shows how wheel costs per ton of steel handled decrease with increased wheel life. Curve No. 2 indicates how labor and overhead costs per ton of steel handled increase when harder or longer lived wheels are employed. Curve No. 3, the summation of curves Nos. 1 and 2, represents total grinding costs and shows that they are lowest when wheels that have a life of about twelve hours are used. This, then, is the critical point. Curve No. 4 shows how production decreases when wheel life increases.

Owing to the fact that an operator can grind only about fifteen billets per day, the manner of arranging and transporting the billets for the convenience of the operator, so as to eliminate actual loss of grinding time, is not of great importance. Billet grinding wheels average about 16 inches in diameter by 1½ inches thick, and range from No. 12 to No. 20 in grain size and from Q to T in hardness. They are made of an aluminous abrasive, since the material ground is steel of high tensile strength and comparatively great ductility.

* * *

PREHEATING CAST-IRON THERMIT WELDS

In order to compensate for the lower melting point of cast iron, as compared with steel, the Metal & Thermit Corporation recommends that, in preheating cast-iron sections preparatory to thermit welding, these sections be heated only a little more than is necessary to show color, such as a dull red heat. This practice has now been tried successfully in numerous cases, the most important of which was that of a thermit weld on a large cast-iron press head which required 1100 pounds of thermit. The weld was perfect, with good fusion to the edge of the collar, although the cast-iron section was heated only to a dull red heat.

It is believed that this point is very important to bear in mind and that operators will find that it will overcome difficulties which they may have experienced in welding cast iron. One might suppose that as the cast iron of the parts being welded is not quite so fully expanded at the lower temperature used, there might be a slightly greater tendency for hair line cracks to appear in the thermit steel collar, perpendicular to the line of break. In actual practice, however this has not been found to be the case, probably because the expansion curve is much greater up to a red heat than it is from a red to a white heat, and the sections are fully expanded at the dull red heat. It is also true that the thermit steel heats and expands the sections with which it comes in contact, and therefore, the slight difference in preheating is negligible.

RELEASING MECHANISMS AND ADJUSTABLE STOP

By C. M. LINLEY

The disengagement of a toothed clutch can be accurately accomplished at a predetermined point in the traverse of a sliding machine member by an arrangement similar to that shown at *A* and *B* in Fig. 1. This design enables disengagement to be accomplished so quickly that wear on the clutch teeth is reduced to a minimum. The mechanism consists of a weighted lever *D* connected at one end to two links *E* which control the axial movement of the driven clutch member. When the clutch is engaged as shown at *A*, the opposite end of the weighted lever is supported by trip-lever *F*, but when lever *F* is tripped during the operation of the machine, the weighted lever falls, and thus forces the driven clutch member away from the driving member. The relative positions of the various details when the clutch is disengaged are illustrated at *B*.

A similar mechanism for releasing a worm from a worm-wheel is shown at *C*. The weighted lever has a surface at *G* that is concentric with the fulcrum of the lever. When the worm is in engagement, a lug on the bottom of the worm-box rests on surface *G* so as to hold the box in place. When the mechanism is tripped, surface *G* is pulled away from the worm-box, which drops and disengages the worm.

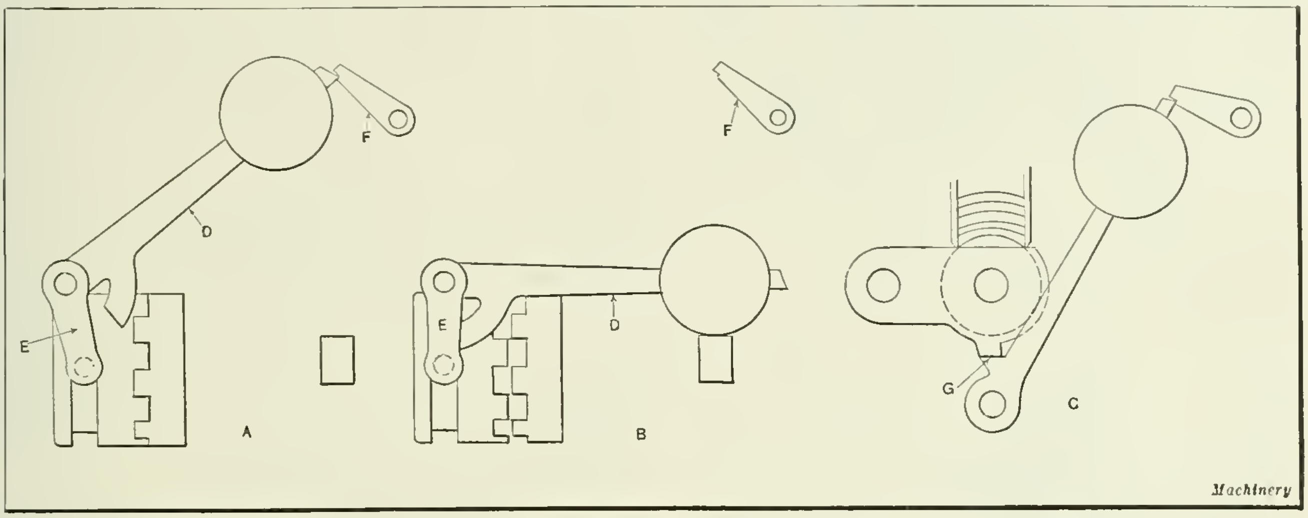


Fig. 1. Releasing Mechanisms in which a Falling Weight disengages either a Toothed Clutch or a Worm Drive

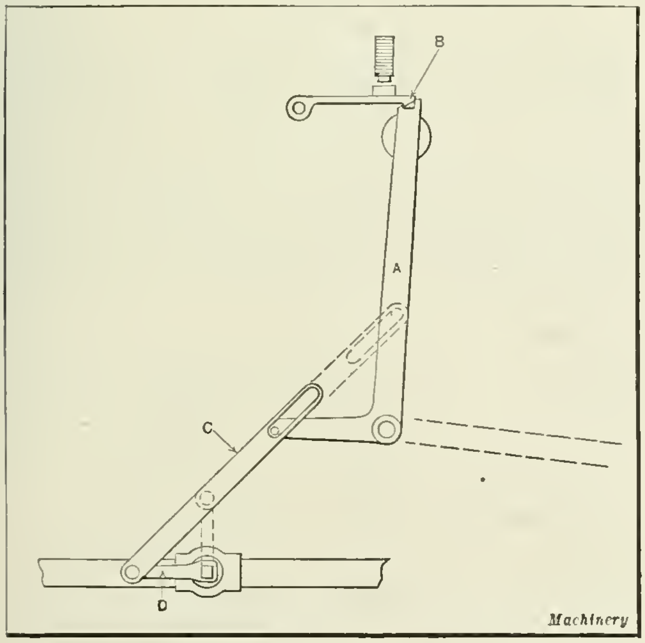


Fig. 2. Falling Weight Principle applied to closing a Gas Cock

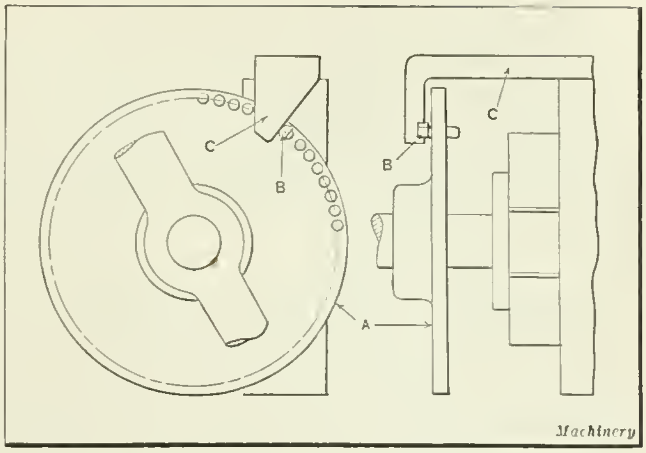


Fig. 3. Arrangement permitting Accurate Control of a Slide by inserting a Dead Stop in Holes of a Disk on the Screw

Fig. 2 illustrates the manner in which the same principle has been applied in an electric alarm clock to close a large gas cock at a certain time. The weighted lever *A* is held almost in a balanced position by catch *B*, the result being that the pressure on the catch is so slight that the feeble power of an electromagnet on the bell of the clock is able to move the catch sufficiently to release the weighted lever. As lever *A* swings on its fulcrum it pulls rod *C* upward and so operates wrench *D* on the cock. The dotted lines indicate the position of the different parts when the cock has been shut off. In each of the mechanisms described the falling weight causes a sudden and complete movement of the part to be operated, but one disadvantage of the principle is the difficulty of providing an automatic arrangement for resetting the weighted lever.

Dead stops are hardly practical in designs where automatic action alone is relied upon, and even when the sliding members which they control are operated by hand, they are not always as efficient as desired. Especially when the slide is actuated by a screw, one operator may force the slide against the stop harder than another and spring some parts so much as to cause appreciable differences in the dimensions of the work. Coarse or quick pitch screws are sometimes provided to obviate this trouble, but even then the results are not always satisfactory. In Fig. 3 is shown a dead stop that has been found to function well. Disk *A* is mounted on the lead-screw of the slide, and is provided with a number of holes spaced equidistantly around a circle near the edge. A stop *B* is placed in one of these holes to govern the movement of the slide, this being accomplished through arm *C* which is attached to the slide and makes contact with the stop after the slide has been moved to a predetermined point. The disk revolves with the screw but has no axial movement. This method of placing stop *B* in a circle of holes provides a large selective range of fractional revolutions of the lead-screw. The head of the stop is so machined that a movement equal to one-half the distance between two holes can be secured by turning the stop 180 degrees. It will be evident that the head of the stop must not project a greater distance beyond the disk face than the lead of the screw.

* * *

INCREASED PRODUCTION FROM IMPROVED TOOLS

By D. A. NEVIN, Chief Engineer, Watters Corporation, St. Louis, Mo.

One of the surest and most economical methods of reducing manufacturing costs is to make improvements on those jigs, fixtures, and tools which are used in machining parts that are made in large quantities. It is the purpose of this article to show how closely production, or rather the cost of production, is related to tool design. Three types of drill jigs are illustrated, each better than the preceding one for the purpose set forth. The cast bronze spool, Fig. 2, is made in large quantities, and is finished all over on the outside and tapped in a turret lathe. The keyslot *A* is then cut on a hand milling machine. The last operation on the spool consists of drilling two 5/32-inch holes located diametrically opposite each other, as shown.

Fig. 1 shows the two-part jig which was first designed for drilling these holes in the spool, the position of which is shown by heavy dot-and-dash lines. Twenty of these jigs were constructed. The body was built up of machine steel and the cradle or base of cast iron. It was considered a very good tool, but would have cost less to construct if the body had also been made a casting, considering the large quantity of work required. The work is located in the pocket of the hardened plate *A*, pin *B* engaging the 5/32-inch keyslot. It is clamped by the threaded stud *C* which is operated by the pin-lever *D*. After one hole has been drilled, the body is removed from the cradle and inverted for drilling the other hole, in which position it remains while unloading and loading.

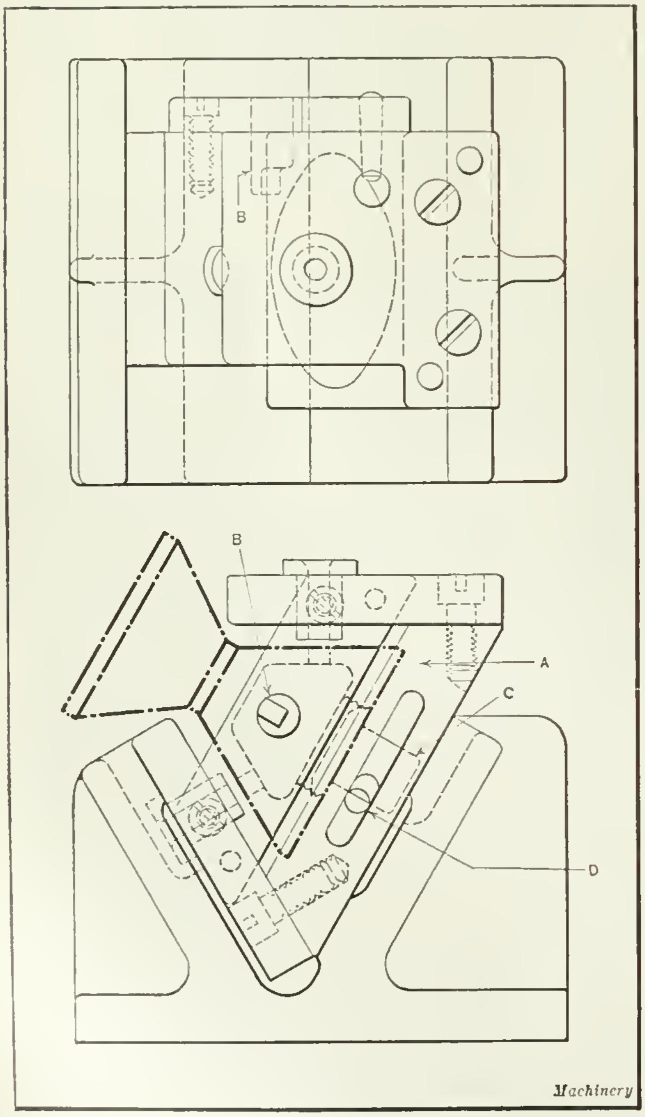


Fig. 1. Early Type of Jig used in drilling the Spool shown in Fig. 2

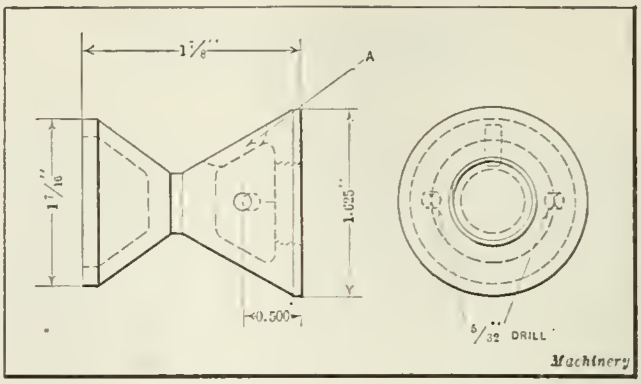


Fig. 2. Special Shaped Spool in which Two Holes are drilled, using Any of the Jigs shown in Figs. 1, 3, or 4

The type of jig illustrated in Fig. 3 was designed for the purpose of increasing production without employing additional drilling machines. It is a faster operating jig, has a better clamping device, and will remain more free from chips than that shown in Fig. 1. The operation of the jig is obvious, as the locating and clamping means are practically the same as in the jig shown in Fig. 1. Only two of these jigs were completed, this design then being superseded by the tilting jig shown in Fig. 4 of which fifteen were constructed. The production from these fifteen jigs was slightly greater than that obtained with twenty jigs of the type shown in Fig. 1.

The work is located in the same manner as in the other jigs. The nest plate *A* is made of steel and hardened. The base *B* provides bearings for the rocker or hinge pin *C* which supports the body *D* to which the work is clamped. The body is provided with liner bushings *E*, which are a sliding fit for the drill bushings, and which also serve to clamp the work. The bushings are operated as clamps by the equalizing levers *F* and are connected to the levers by the pins *G*. Slots for these pins in the heads of the drill bushings allow for the rotary movement of the clamping levers *F* which are pivotally mounted, as shown, on the jig body. The large end of the clamping lever is slotted and carries the large pin *H* through which is threaded a clamp screw with a knurled head. This clamp screw extends through the body and has a right-hand thread on one end and a left-hand thread on the other. A stop-pad *J* is threaded into the base of the jig on each side, and the corresponding stop in the body is in the form of a screw as shown at *N*.

This style of jig may be clamped to the table of the drilling machine. Its operation is rapid, as only a touch is required to rock it from one drilling position to the other. The clamping mechanism permits rapid operation and the drill bushings and other parts do not wear rapidly, as there is not sufficient variation in the finished diameter of the work to require much equalizing movement of levers *F*.

The efficient design of a tool of this class should be the result of an analysis of all the movements necessary to operate it, including loading and clamping, drilling, reaming, counterboring, etc., as well as unloading and cleaning. Much waste movement could be eliminated if drilling jigs

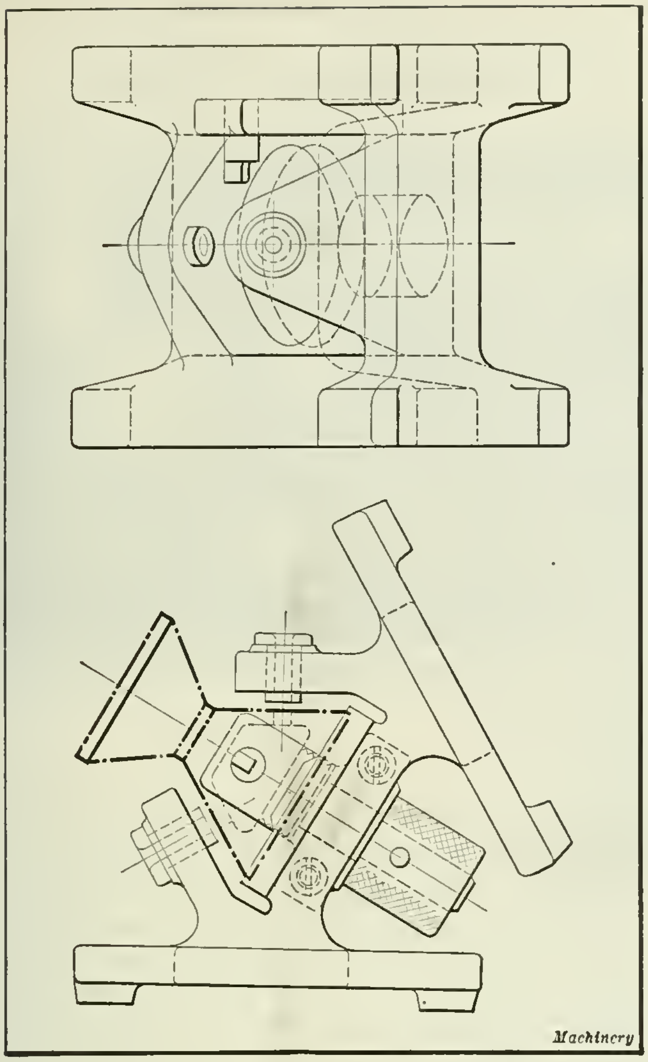


Fig. 3. Later Design of Drill Jig used for machining the Spool illustrated in Fig. 2

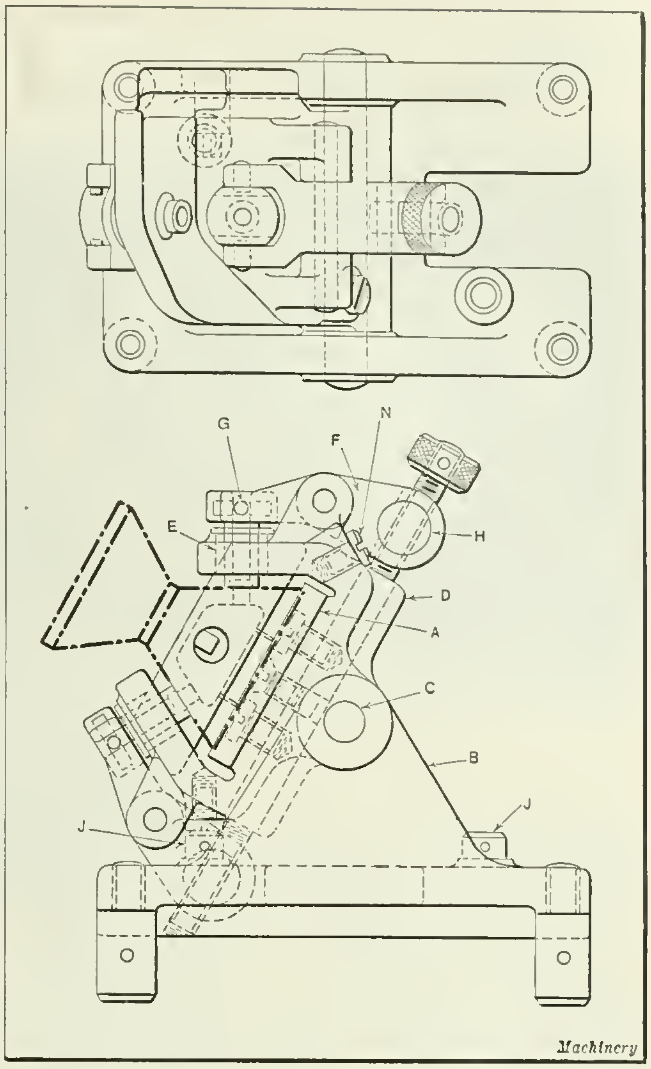


Fig. 4. Improved Design of Jig by Means of which Production was greatly increased

were clamped to the table when possible, and in some cases it pays to divide a number of drilling operations between two jigs to provide for this. When the jigs are fastened thus it is well to provide some quick method of removal for the purpose of cleaning, and on some classes of work it has been found to be advantageous to make use of compressed air for clearing out the chips.

* * *

TROUBLES WITH SPANNER WRENCHES

By DONALD A. HAMPSON

Round nuts drilled for pin wrenches or spanners continue to be used by the designers and builders of machinery. This type of nut, necessitating the use of a spanner, is very unpopular with the machine operator. Because of the difficulty of using a spanner, workmen often resort to a hammer and punch, which, of course, ruins the nut. The type of nut on which the spanner is used is of neat appearance, and this probably accounts for its continued use. If the spanner were made to encircle half of the nut, it would be more effective, but it would have no range of action and would be difficult to apply.

As now made, the spanner encircles about one-fourth of the nut and the handle is made short, which reduces the leverage and tends to raise the pin out of the hole in the nut. Therefore a hammer is frequently used on the end of the spanner in an effort to force the nut. The time lost due to this effort to start a nut with a spanner is considerable, and the loss in ruined spanners and spoiled nuts that have to be replaced makes the whole proposition expensive and unsatisfactory.

Then there is the adjustable spanner, which is as unsatisfactory in use as the solid type. Not long ago the writer saw a foreman throw one of these tools out of the window after a workman had unsuccessfully tried to hold it in place with one hand and move the nut with the other. Both the spanner and the nut were new. In place of the spanner, the foreman used a piece of 1/4- by 3/4-inch steel, 15 inches long, and in one end he drove a 5/16-inch pin which he then cut off so that it projected 3/8 inch. This improvised tool was of a shape that could be used in the rather inaccessible place where the nut was located. With this bar held tangent to the nut at the hole, one light hammer blow at the end of the bar loosened the nut that had successfully withstood the attempts of the workmen to move it. It is understood that this type of tool has since replaced the adjustable spanner in that shop.

In the case of a round nut, which is notched instead of drilled, a similar difficulty is encountered. The edges of the notches and the spanner key become tapered off, so that the wrench is ineffective. Workmen usually prefer the hammer and punch method of starting or tightening a notched nut, and the only thing in favor of the notch is that it presents a greater surface for the punch, which is ultimately used. In addition to the difficulty of using a spanner, it is also likely to become mislaid and lost, just when it is most needed. The spanner has probably remained in use because of its simple construction and neat appearance. Its inefficiency, while known to all who use it, has apparently been overlooked by the designers and manufacturers of machines. If round nuts, requiring spanner wrenches, were not used, one of the troubles of the machine shop would be eliminated.

Properties of Glue for Polishing Wheels

By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

ONE of the chief factors in a metal polishing room is the quality of glue employed; another is the manner in which it is prepared and used. Glue is susceptible of rapid deterioration and loss of holding power; this fact is not as well understood by polishers as it would be if mechanical rather than chemical action only were involved.

Failure to select, prepare, and use glue properly gives unsatisfactory results no matter what kind of polishing wheel is used or what the general working conditions are. This should not be taken to mean that polishing cannot be done with an inferior grade of glue, because in polishing rooms where this most vital element has not been duly considered glue of inferior quality is often used. But since glue is the tying element between the wheel and the abrasive it stands to reason that the real success of the operation depends on the glue and the method of using it.

Kinds of Glue Used in Polishing Rooms

There are three kinds of glue, namely, bone, hide stock, and fish glue. Hide stock glue is most generally used in the polishing industry. It is made from the skins of cattle, rabbits, and other animals. The stock is first limed to remove the hair, which causes it to swell and insures rapid extraction of the glue; liming also frees the hide of material which would impair the quality of the glue. The lime that is often in water in which glue is soaked preparatory to using, in addition to that already contained in the glue from the preparation process, reduces its value as a bonding agent.

Glues are often blended; for example, a sheep stock and goat stock glue make an exceptionally strong holding medium, and, when mixed with ox fleshings, form a glue which has more strength than a glue made entirely from rabbit or some other similar stock. The cheaper grades of glue are usually mixtures of bone and hide glues.

The color of glue, which is usually dark and hazy, may be lightened by the use of oxide of zinc, chalk, or talc, and these will produce a white or opaque fluid. Sometimes the use of these and similar substances in glue is an advantage in the polishing room, if the moisture or humidity is high, as when the factory is near a body of water. Under these conditions glue containing the substances mentioned will set easier and retain its strength longer. The use of such combinations for polishing wheels, however, should only be undertaken under the direction of those understanding the conditions.

Fish glues are not suitable for use in metal polishing, in spite of the fact that the most powerful adhesive known (isinglass) is a fish glue. Isinglass is marketed in various solid forms, and is sometimes mixed with hide stock glue to make belting cement and to bond bullneck polishing wheels in which disks of this kind of leather are glued together to construct a wheel. It is not used, however, to hold the abrasive to the face of polishing wheels.

Properties of a Good Glue for Polishing Wheels

The qualities which glue should possess in order to be valuable in the polishing industry are jelly strength, viscosity, and flexibility. Flexibility is the most important of these three qualities, because 95 per cent of all polishing wheels are flexible, or should be, on the surface. If the glue is brittle, it will break from the wheel. Jelly strength is determined by placing glue jelly at a certain temperature in a glass and allowing a wire weighted at the upper end to pass down through the jelly a predetermined distance in a certain time. The weight that is required to meet the predetermined conditions of distance and time is a measure of the jelly strength. Viscosity is determined by the time required for glue to flow over a given area, as compared with the time that water will flow over the same area. For example, the best grades of glue may require forty-five seconds to flow over an area that water will flow over in fifteen seconds. The viscosity is a measure of the adhesive power of glue.

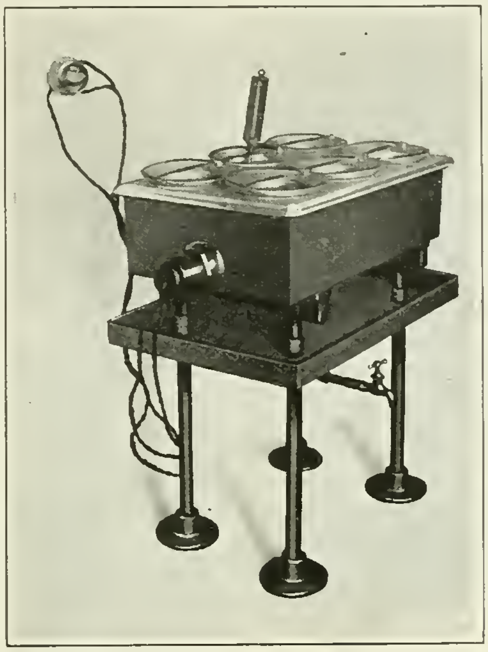
Importance of High-quality Glue for Polishing Wheels

The importance of using a good quality glue to hold the abrasive grains on polishing wheels cannot be emphasized too much. The heat generated in polishing has a tendency to melt the glue, and as a result the emery is lost from the wheel face. This point is of special importance in automatic or semi-automatic polishing machines, although designers of these machines have not always paid sufficient attention to it. Some provision should be made in such machines to keep the wheels cool so that the glue will remain hard and retain its holding power.

In combination with the crushing point of the abrasive, the melting point of the glue controls the permissible wheel speeds, so that with the use of a high quality glue, wheel speeds may be greatly increased. It is because of the fact that no standards have been adopted for using or making glues of a definite holding ability, that standards have not been established for the working speeds of polishing wheels.

Glue cools in two or three hours, but it does not set, so that wheels should not be used within forty-eight hours after gluing. If artificial means are employed to hasten the hardening of the newly set up wheel-head, the glue draws away from the abrasive grains, forming a pocket in which the abrasive soon becomes loose, instead of firmly holding the grain in bond as it should and will, if permitted to set in a mild atmospheric temperature. Artificial heat used to hasten the setting of glue on polishing wheels soon causes the glue to become useless as a dependable bonding material.

The character of the work to be polished should be considered in selecting the glue, as well as the grain and kind of abrasive and the size and speed of the wheel. For the coarser abrasives a heavy glue is required, while for the finer grains (above No. 80) a thin glue made by diluting the heavy glue works to better advantage. When surfaces are to be polished by using first a coarse abrasive below No. 46 and later a finer grain, say No. 120, the wheels should be set up with glues of proper consistency taken from separate pots, because putting the fine grains into the heavy viscous glue that is necessary for the coarser numbers will not produce a good working surface on the wheel. It is difficult to embed the fine emery properly in heavy glue; the abrasive tends to rest on the surface instead of penetrating it, thus giving the face of the wheel a packed appearance. For the best polishing, high-grade hide stock glue should always be used. There are now on the market a number of specially blended glues for setting up polishing wheels—glues that will hold the abrasive satisfactorily under normal working conditions.


Satisfactory Type of Glue-heater

Preparation and Use of Glue

Commercial glue is furnished in a cake form, in flakes, or pulverized; it should be kept in a dry place so that it will not mold. No matter what the form of the glue is, it should be soaked in cold water for several hours before it is heated. The water used for this purpose ought to be distilled; the drip from steam radiators may be utilized, if desired. The use of distilled water guards against chemical action due to impurities in the water, which may contain sulphur, lime, or iron, all of which are injurious to glue. If glue is soaked in hot water, it quickly decomposes and its strength is impaired. The amount of water that should be used varies with different makes and qualities of glue and should be stated by the maker of the glue.

Glue cake, ¼ to ½ inch thick, requires about twelve hours to dissolve; it should be broken into small pieces before being put to soak. Flake glue requires from six to eight hours, according to the thickness of the flake. Pulverized glue may be dissolved in from three to three and a half hours. The soaking process should not be hurried.

Glue should not be heated until it has been absolutely dissolved by soaking in cold water. After being heated, the glue may be diluted with hot water to obtain the required consistency. Glue should never be heated sufficiently to make it boil. It is also bad practice to prepare large quantities of glue at a time, because it loses its strength rapidly after being under heat for about four hours.

Satisfactory Type of Glue-heater

A satisfactory glue-heater should have ample accommodations for all the glue that will be prepared at one time, say, six or more glue kettles, as shown in the illustration. The kettles in which the glue is heated should be made of aluminum, and their size and number should provide for handling glue of various consistencies in sufficient quantities to last not more than four hours. Aluminum is the most suitable metal for glue pots because the scum on the glue does not adhere to the inside of the pots, so that they are easily cleaned.

A thermometer should be part of the equipment of a glue-heater, for the temperature at the bottom of a pot 6 inches deep should not be over 150 degrees F., which will bring the temperature at the top to about 140 degrees F. Higher temperatures than this destroy the adhesive power of glue. The pots should be thoroughly cleaned at least once each day. The glue that has become cooled should never be reheated, as reheated glue loses about fifty per cent of its strength. It is good practice to have a new lot of glue ready for use before the glue already prepared is consumed.

The heater shown has recently been placed on the market, and is intended to meet the requirements that have been established by research work on glue in polishing work. This heater is provided with a thermostat for the regulation of heat. A wheel-stand is also a necessary piece of the equipment; this stand should be so placed that there is but a small space between the glue pots and the wheel that is to be set up. Both the heater and the wheel-stand are adjustable for height.

Proportions of Glue and Water

The glue should be diluted more and more as the abrasive grain decreases in size. For instance, suppose that the glue has been melted in the glue-heater in the proportion of two pounds of water to one pound of dry glue, and that this is suitable for a coarse grain; then for finer abrasive grains, hot water can be added to give the right consistency. It is possible to perform practically all the operations included under the head of flexible grinding and polishing by using a glue of the jelly strength, viscosity, and flexibility necessary for the coarser abrasives and thinning it for the finer abrasives. Properly diluting this quality glue by the addition of water does not cause the heavy glue to lose its strength sufficiently to prevent it from holding the finer abrasives used in the finishing operations.

* * *

The Bureau of Standards has made some interesting investigations on reclaiming lubricating oils. The experiments show that with a commercial type of oil reclaimer oil can be reclaimed so it will be similar to new oil except as regards sediment. Further investigations are necessary to develop means for removing this sediment, which is probably carbon.

COLLECTING AND FILING DATA

What the Trade School can do to Aid its Students

By WILHELM KAUFMANN

As an example of how the trade school can bring its students into closer touch with the conditions in industry, we may consider in some detail just one phase of a draftsman's work. Most draftsmen find it indispensable to have a source of information to which they can refer when necessary and with which they are very familiar. This information is usually contained in a file of some sort, and the method of filing data for this purpose will be referred to as an example of how the trade school can acquaint its pupils with practical methods.

In every case where a graduate really studies the principles underlying his work he should be able to apply formulas and other data in a satisfactory way. For that reason handbooks and methods of filing data for use while at work should be among those subjects studied by the prospective draftsman near the close of the school term. Some practical hints cannot fail to bring results, and the last few weeks of school can be profitably given to work of this kind.

Any such data should be collected and segregated and be understood well enough to be applied correctly. The data should be checked by the prospective user before selecting it and he should refrain from making use of it until its accuracy and adaptability have been ascertained. The data in some handbooks may not conform to the standard practice in a particular factory, and this makes it necessary for the graduate to use caution in applying such data. Additional data of great value is constantly being printed and compiled which is not contained in handbooks. Some of this information can be applied immediately, and this should be kept close at hand as a ready reference. Some will be used only occasionally, while a certain portion possesses great potential value for future use. The student should be taught how to handle this data in a practical way.

In this connection there are three questions that the student should consider, namely, what to select for filing, where to file it and how to find it. There are three classes into which all data can be divided and filed—daily use, occasional use, and future use.

What to Select for Filing

Many men of ambitious nature make the mistake of starting to save data too far in advance of their mental and physical training. For example, an apprentice machinist may be ambitious to become a superintendent. If he starts saving data regarding systems, fire protection, laws, employment, etc., he will make a great mistake, for data gathered too far in advance is forgotten by the time it is needed or else becomes obsolete. While he is still an apprentice and is working on a lathe he should make a special study of lathes, and should keep his eyes and ears open and note facts about the tool-room and its machinery and thus prepare himself for the next step while becoming an expert lathe hand. This, in principle, is good advice for a beginner in any vocation.

Reading all kinds of valuable news and filing it is not the best aid to advancement. The mind should not be crowded with data, but should be given time to absorb important matter. The answer to the question of what to file is then: File thoughtfully, for application, all data pertaining to your present occupation and your next possible undertaking.

How to File

Each person must decide upon his own system for filing data. A very good one for the draftsman is given here to show the advantages of having the data arranged in files for daily, occasional, and future use. It is not necessary to have all the data in some standard form. This would take much time, and increase the chances of error. No material, not even a single data sheet, can be prepared in such an order or on such a size sheet that everybody and all conditions will be satisfied. If the questions "Is it understood?" "Can it be applied?" and "Is it correct?" can be answered in the affirmative, then the data should be filed. Material should be taken as it is found and left in that form unless enough time can be saved immediately to pay for condensing or otherwise preparing it for filing purposes.

Filing for Daily Reference—Some data clipped from magazine articles can be filed in a loose-leaf book of convenient size even though the data itself does not conform to that size. The data in this loose-leaf book should be that which is frequently used. In most cases an index is not necessary for the daily reference file, because frequent use enables the user to find the sheets desired without difficulty, especially since they are usually few in number. Material prepared in this way and for constant use is a great help in enabling a man to fit himself to solve the problems met with in business.

Filing for Occasional Reference—The data for occasional use should be put into a second loose-leaf book. These two books and a standard handbook are about all that the draftsman needs, except perhaps a small vest pocket index, if a drawer and portfolio file (the use of which is described in the next paragraph) is found necessary. Entire catalogues and other books should not be preserved for reference when only one or two pages are required; instead the information should be photographed or otherwise reproduced for filing in the loose-leaf book.

A handy method for the chief draftsman or designer is a single drawer letter file, ledger size, carried on a wheelstand and containing portfolios for the data. The portfolios can be suitably marked for data relating to certain subjects. This form of file makes a good ready reference and can be used also to file unfinished work, order memoranda, etc. This type of file is cheaper than many loose-leaf books.

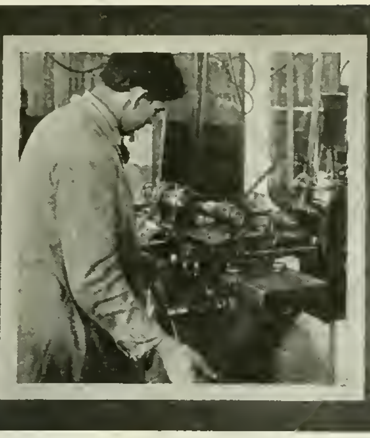
Filing for Future Reference—Inasmuch as magazine articles are not always of immediate application and are often used for occasional and future reference, it is advisable to clip the entire page where the article appears and file it in a portfolio marked "For Future Reference." It is also a good plan to draw a colored pencil line around the article in question; that is time enough spent upon an article of doubtful value. The file for future reference material, consisting of a drawer with portfolios for the data, should be kept in the home. All there is to filing is simply clipping the articles and dropping them into a portfolio.

How to Find the Data

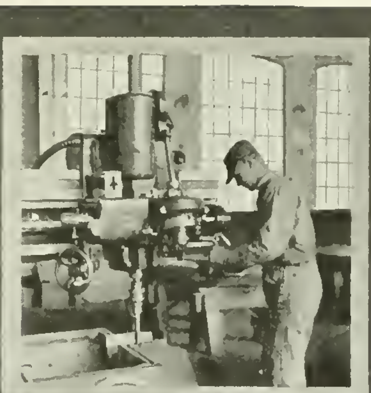
It is understood, of course, that an index is not needed for any file but that containing data for future use which is not often referred to except, perhaps, when taking up new work. However, to aid in locating data filed in portfolios, suitable titles should be indexed in a small pocket-size book, loose-leaf preferred, and the portfolios numbered. Although a card index may be used, it is not as convenient as the book. When prepared in book form, it does not require much time to look over several hundred titles, if they are carefully listed with about twenty titles per page. The index is especially handy for a draftsman who travels, because, when away, he can carry the small book in his pocket and refer to it to select material that he may need. The need for such data can be anticipated nearly every time, and it may be obtained promptly by telegraphing home, giving the portfolio number and the subject of the data.

* * *

The South African Government has recently announced an ambitious scheme of railroad construction which is receiving general approval in the country. The plans provide for 850 miles of new railroads in various parts of the Union, involving an expenditure of about $20,000,000.



Letters on Practical Subjects



SPEED-CHANGING MECHANISM

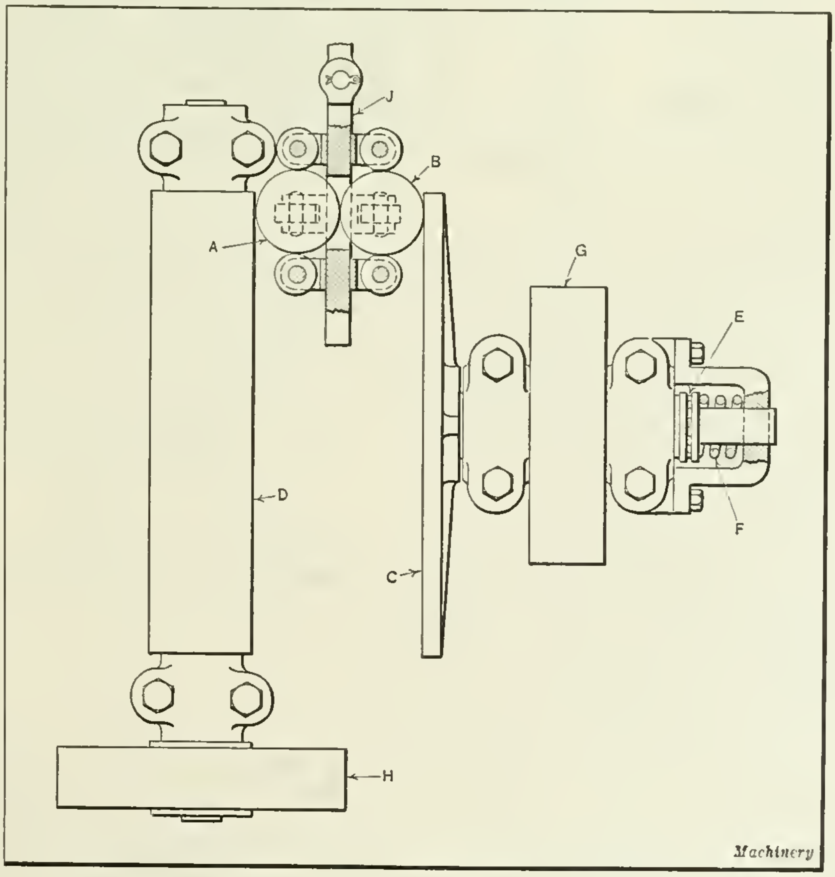
It is often necessary to change the speed between the driving and the driven elements of a machine, and various kinds of mechanisms have been invented for this purpose. Change-gears, such as used on automobiles and lathes, are perhaps among the best known types of speed-changing mechanisms. Another type of speed-changing device which has been used to a considerable extent, consists of a friction driving disk and a roller which is driven by frictional contact with the driving disk. In this type of mechanism the speed of the driven roll is changed by moving the roll toward or away from the center of the disk, so that it is possible to obtain an infinite number of speeds within the range of the mechanism.

In the accompanying illustration is shown an interesting speed-changing mechanism of the friction type which was designed in 1915 for use in naval nautical instruments, about twenty being in actual use. In this application of the device the power transmitted is very small, say about 0.01 horsepower. The design is based on principles incorporated in an old English device, and mechanically considered, it is the most perfect mechanism for the purpose for which it is used that has ever come to the writer's notice. It has also been applied to mechanical fuel stokers, the power transmitted in this service being from one to two horsepower. At one time it was tried out in an automobile main drive, but even with glass-hard contact surfaces it would not stand up properly.

The writer has not made any tests to determine the heaviest duty for which a mechanism of this type could be used, but experience would indicate that it should not be built in sizes larger than two horsepower. For transmitting up to two horsepower, however, excellent results may be obtained. It is particularly useful when frequent changing of speed is required under conditions that would preclude the use of gearing for the purpose. A remarkable feature of this device is that the force required to effect a change from full speed in one direction to full speed in the reverse direction is so small as to be negligible, and this operation is unaccompanied by any jar or shock.

As will be noted from the illustration, the device consists essentially of two balls *A* and *B* revolving in contact with each other between a driving disk *C* and a driven roller *D*. The shaft of the driving disk is mounted in a ball thrust bearing *E* back of which there is a spring *F*. The disk may be driven by a gear or pulley *G* or it may be connected directly to an electric motor or gasoline engine. The power is transmitted from the driven roller by pulley *H*. The two balls employed to transmit the power from disk *C* to roller *D* are mounted in a carrier *J* in which they are loosely held by small rolls mounted in brackets. The carrier is so mounted as to be capable of movement across the face of the disk.

The balls *A* and *B* are capable of two movements; that is, they may rotate on their own centers and also roll across the disk and roller between the two latter members. The disk, the balls, and the roller are all made of hardened steel. When the balls are near the edge of the disk the roller runs at its highest speed. Upon moving the ball carrier nearer the center of the disk, the roller gradually loses speed, until at the center it will cease to rotate. As the carrier continues to move, passing the center, the roller rotates in the opposite direction.



Friction Disk Speed-changing Mechanism by Means of which a Great Variety of Speeds can be obtained

The pressure of the spring *F* is not excessive, and while the tractive force between the balls would appear at first to be small, there is actually no slippage in practice. This is in accordance with the law of friction which states that the amount of friction is independent of the amount of surface in contact but depends entirely upon the pressure. An illustration of this law may be observed in the case of locomotive driving wheels, where the tractive force of, say, six points of contact with the rails, is sufficient to draw a heavy train.

Norfolk Downs, Mass. R. E. Bates

TOOL RACKS AND TABLES OF PEDESTAL DESIGN

Wooden cupboards, lockers and other machine shop equipment used for mechanics' tools and machine accessories, often present an unsightly appearance. Tool racks and shelves are of course indispensable in the shop, but the commercially manufactured product is often expensive and frequently not the best suited for the individual requirements, particularly as regards space. These tool racks and tables are usually designed with four legs or a closed bottom sometimes in the form of a cupboard. This construction presents another objection to machine shop furniture of this kind; namely, the unclean appearance of the floor surrounding the rack or table as well as underneath it. It makes it difficult for the sweeper to clean, and things are likely to be shoved under the bottom.

A serviceable and rugged tool rack of neat design, intended to overcome some of the objections noted with the closed-bottom four-legged type of equipment, can be constructed inexpensively as illustrated in Fig. 1. A section of scrap pipe *A*, 4 inches in diameter and 30 inches long, is threaded on each end and fitted with two flanges, one for the floor and the other for the top shelf. The lower flange is screwed to the floor with lag screws and if the floor is of cement, expansion shields are used for the screws. The shelves *P* are then made and provided with cross cleats nailed on the under side, as shown. The shelves are stripped over the pipe and supported by a top shelf to which the top flange is fastened with screws. Short pieces of small pipe *C* are used to space the shelves, through which ½-inch tie-rods or bolts are passed to hold the shelves firmly together.

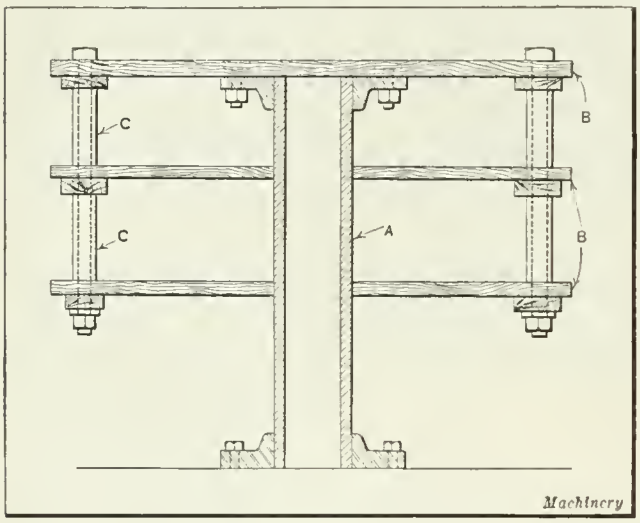


Fig. 1. Tool Rack with Supporting Column of Pipe

A tool rack like this is easily constructed, inexpensive, and presents a neat and sanitary appearance. The space surrounding it may be cleaned easily, as the rack stands high above the floor, and light is not obstructed by any part.

The principles of construction shown in Fig. 1 are also applicable to tables for mounting small bench machines such as drilling machines, tapping machines, millers, and lathes. Wooden tables often used for this purpose are constructed with the aid of heavy angle-irons and they are of more or less clumsy appearance. They are not as compact and attractive as the pedestal type and are inherently dirt-catchers. The writer has often mounted small bench machines on tables made with pipe column bases, using single-pipe construction for the smaller machines and two-pipe construction for the larger ones. A table of the two-pedestal type on which is mounted a tapping machine, is shown in Fig. 2 The pipe is 4 inches in diameter, the table top 30 by 48 inches, made of 2-inch stock and the cross sills are 8 inches wide and 30 inches long, also of 2-inch material. This construction may also be used for assembling benches.

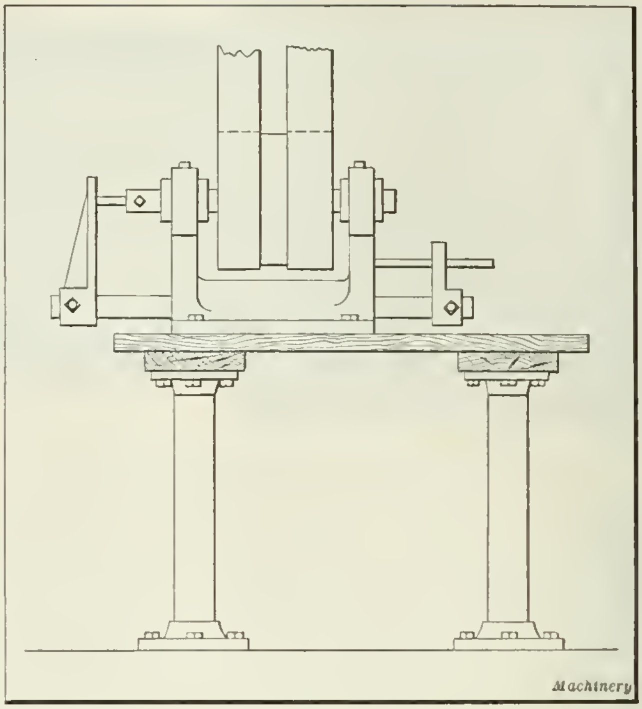


Fig. 2. Table of the Two-pedestal Type for Bench Machines

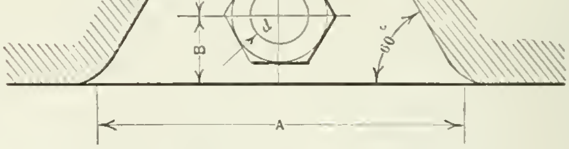
Allentown, Pa. Joe V. Romig

DIMENSIONS FOR WRENCH POCKETS

The table containing dimensions for wrench pockets which is presented herewith was made up by the writer for use in the drafting-room. It was formerly the practice to make a lay-out drawing and cut out new wrench templets each time a wrench pocket was to be shown on a drawing. The accompanying table makes this process unnecessary, and thus saves considerable time. The shape of the wrench pocket, as usually designed, is shown by the sectional view accompanying the table. The dimensions given in the table were worked out to give ample clearance for the drop-forged wrenches made by J. H. Williams & Co.

Groton, Mass. V. Charushin

DIMENSIONS FOR WRENCH POCKETS



d	A	B	C	d	A	B	C
½	3¾	⅝	⅝	1⅜	8⅛	1⅝	1⅝
⅝	4	¾	¾	1½	8½	1⅝	1⅝
¾	4¼	⅞	⅞	1⅝	9¼	1¾	1¾
⅞	5½	1⅛	1⅛	1¾	10	1⅞	1⅞
1	6¼	1¼	1¼	1⅞	10¼	2⅛	2⅛
1⅛	7	1⅜	1⅜	2	10½	2¼	2¼
1¼	7¾	1½	1½				

Machinery

By exercising care in laying out the die-blocks and keeping the blocks properly centered on the point of intersection of the center lines *M-M* and *N-N*, all the members can be machined from one piece at one setting, the piece being parted to make the required number of die members. The same practice, of course, applies to the punch-blocks.

Streator, Ill. WILLIAM DAUBLE

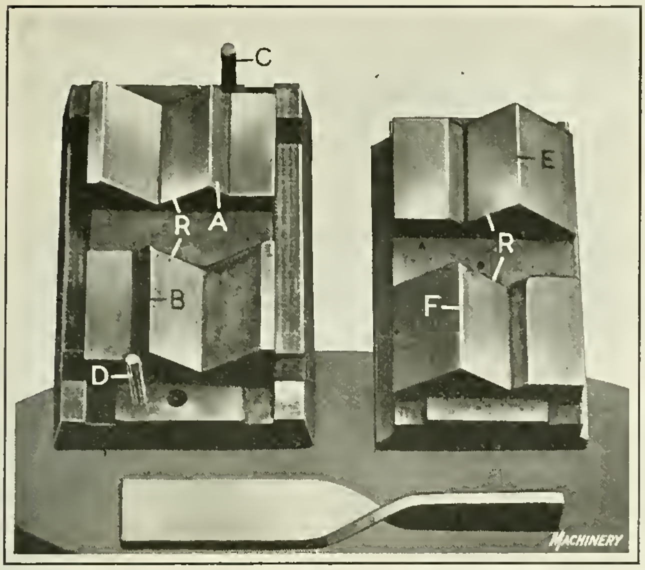


Fig. 1. Die and Punch for twisting Flat Stock

TWISTING DIE FOR FLAT BAR STOCK

The die shown in Figs. 1 and 2 was designed and made to twist flat bars, although the principle can be applied in other types of dies, for twisting blanks of various shapes and sizes. The die is very rugged and will withstand any strains that an ordinary V-shaped forming die will stand. It is very simple in construction and action, and can be designed to give the stock either a right- or a left-hand twist of any desired amount. The work is laid on the die in a horizontal position so that it rests on the edges *A* and *B*, Fig. 1, and against the gage pins *C* and *D*. A stop (not shown) is employed to locate the work endwise. When the punch descends, the points or edges *E* and *F* strike the work, forcing the edges downward.

At *G*, Fig. 2, is shown diagrammatically, a section of the work in the position it occupies at the completion of the stroke. The dotted lines at *H* show the position of the same section at the beginning of the stroke. The lengths of the different sections of the work can be varied by changing the lengths of members *A* and *B*. The length of the twisted part can be varied by changing the distance *J* between the members *A* and *B*. Although the die here described was designed to make but one twist, any number of twists can be obtained by adding more members such as *A*, *B*, *E* and *F*.

The inside edges *R*, Fig. 1, of the die and punch members over which the different sections rub when being twisted, should be rounded. This rounding of the edges must be considered when designing the dies if the twisted parts are to have the correct length. The dimension *K*, Fig. 2, should be the same as the width of the work so that the edges of the work will be automatically kept in proper alignment.

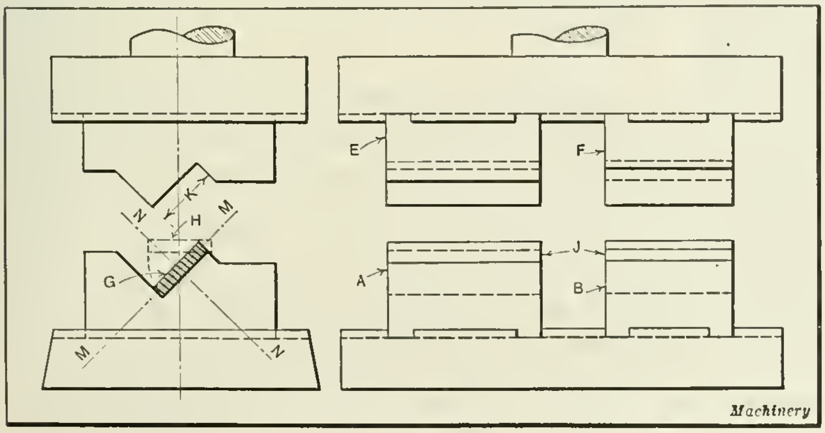
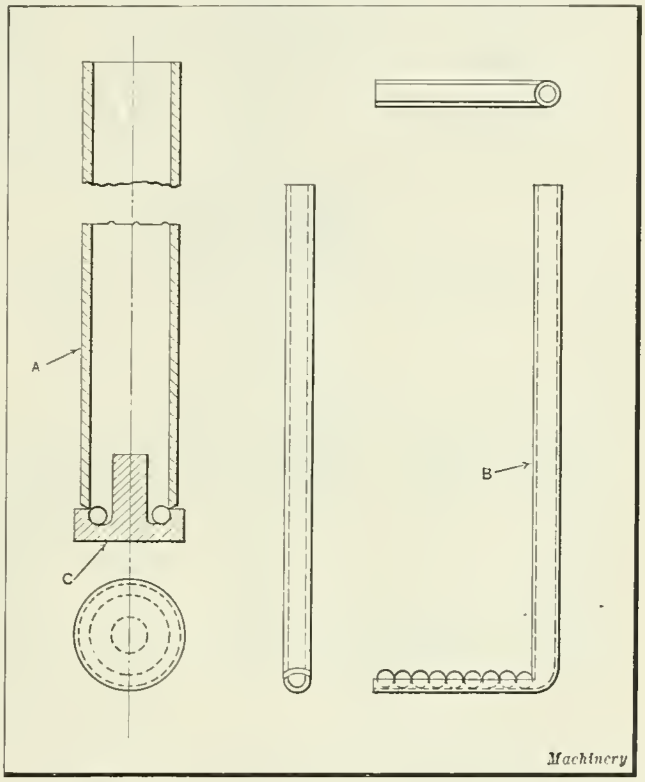


Fig. 2. Assembly View of Die for twisting Flat Bar Stock

ASSEMBLING BALLS IN BEARINGS

The assembling of the balls in the race of a built-in ball bearing often proves a time-consuming job. A special mechanism, the manufacture of which was under the writer's supervision, had an inaccessibly located bearing of this type in which nine steel balls were assembled. In order to facilitate the assembling operation, the writer designed a device for automatically counting or selecting the correct number of balls and conveying them to the ball race. The counting out device was designed on the old-time "powder-flask" principle, and a long trough was employed to conduct the balls to the desired position. The complete device was built at a cost of about $25 or $30, and gave fairly satisfactory results when carefully operated.



Equipment used in assembling Balls in Ball Race

Several days after the assembler had been provided with the new device, it was noted that it had been discarded in preference to one of his own construction which consisted of a straight tube *A* and a bent tube *B* as shown in the illustration. The tube *A* served simply as a ball conveyor, the lower end being placed on the ball race as shown at *C*. The tube *B* is bent at a right angle at one end. The inner side of the bent portion was cut or filed away to make a trough of just the right length to hold nine balls when the outer end was slightly elevated.

When employing this device 25 or 30 mechanisms were placed on a bench so that the ball races were in a horizontal position. Holding the tube *A* and a box of balls in the left hand, the assembler placed one end of the tube *A* over the ball race and with his right hand dipped the bent end of tube *B* into the box of balls, and brought out the required number, emptying them into the upper end of tube *A*. This operation was repeated at each of the mechanisms until all the bearings were supplied with balls. This simple method of assembling proved accurate and rapid.

T. Covey

TRANSMISSION CASE MILLING FIXTURE

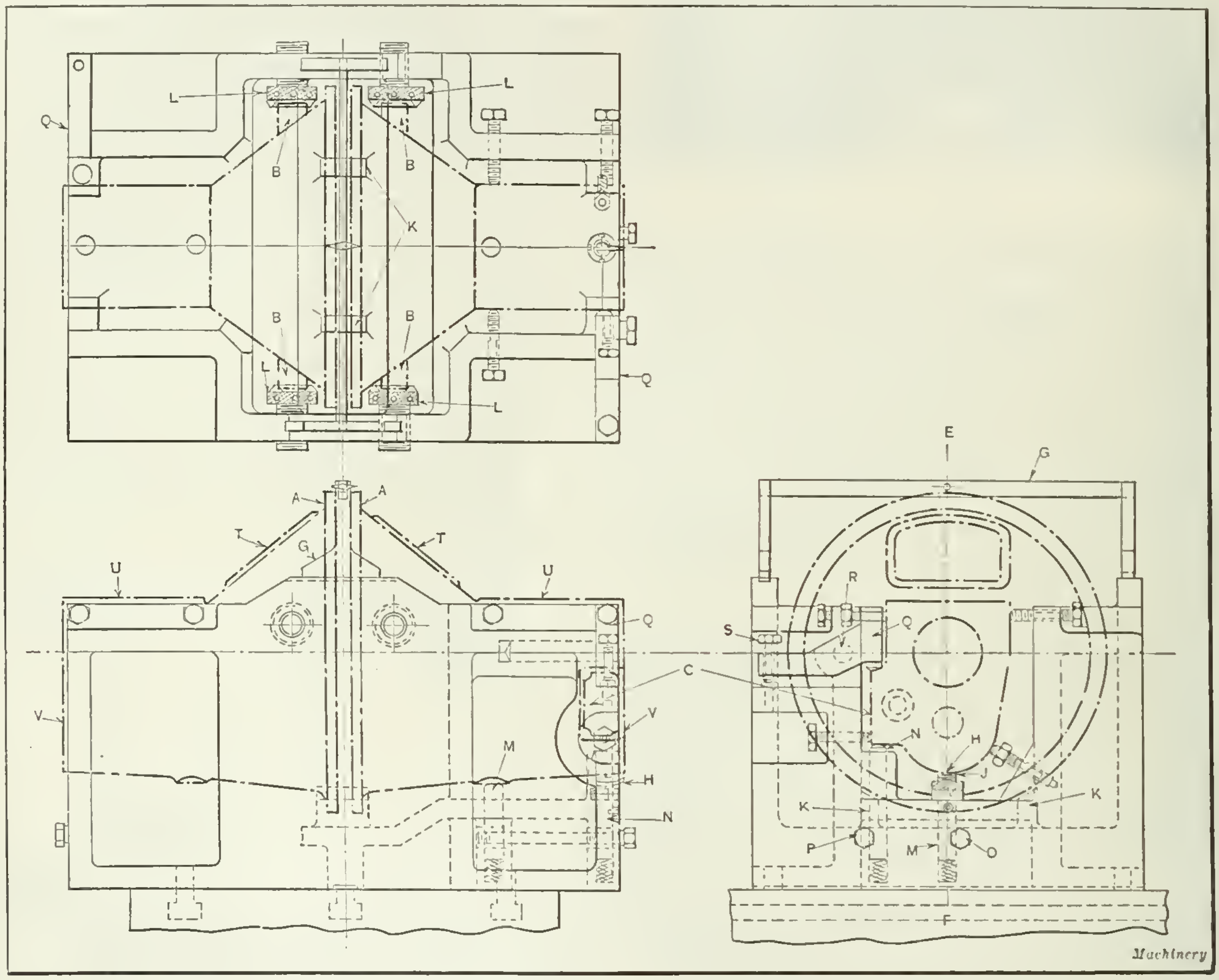
The transmission case milling fixture shown in the accompanying illustration was designed to be used on an Ingersoll six-spindle slab milling machine. It holds two transmission cases *A* (shown by the dot-and-dash lines) while milling the three faces *T*, *U*, and *V* on each casting. The design embodies several unique ideas relative to the clamping, locating, and adjusting of the work. It will be seen from the illustration that the position of the faces to be milled and the odd shape of the work are such as to require a fixture of unusual design.

The flange end of the transmission case is round, with two bosses *B* cast on the sides, while at the opposite end is an air pump bracket boss *C*. It will be noted that most of the clamping is done at these two points. The transmission case first has a center line scribed on its face along line *EF*. This enables the operator to set the case in the fixture in a central position by means of a "bridge sighter" *G*, and the sighter *H* held in the end support *J*. After alignment, "sighter" *G* is removed from the fixture.

The work, when first placed in the fixture, rests on the stop-blocks *K* and the set rests *J*. In clamping the work, the cup-centers *L* are screwed out and the castings lifted up and adjusted to the correct position by using the "sighters" *G* and *H*. The stops *M* and *N* are then released by means of the screws *O* and *P*, so that they make contact with the work, after which they are locked in place. The clamp *Q* slides on the pivot-pin *R* and is actuated by screw *S*. The clamping action forces the pump bracket boss *C* against the stop *N*.

The sliding clamps *Q* enable the cases to be dropped directly into the fixture. After the cup-centers have been tightened on the bosses *B* and the clamps *Q* slid into place and clamped firmly, the other clamping screws are brought up tight so as to prevent chatter and take the thrust of the cutters. This fixture is of heavy construction, as it is designed for gang milling with heavy feeds. Accurate and speedy production is obtained with four of these fixtures set up on one machine.

Pittsburg, Pa. William Owen



Milling Fixture for holding Two Transmission Cases while machining on a Six-spindle Slab Milling Machine

STANDARDIZING CATALOGUE SIZES

While great efforts are being made toward standardization in every field, very little has been accomplished along this line as regards the size of catalogues. A short time ago the writer attempted to arrange a few dozen catalogues which he keeps on his desk. In a total of seventy-two catalogues on seventeen different subjects, there were thirty-two distinct sizes, ranging from 3½ by 6 to 8½ by 11¼ inches. It seems possible that catalogues could be standardized to, say, three sizes, 8½ by 11, 5½ by 8½ and 4¼ by 5¼ inches. These sizes are all derived from the 8½- by 11-inch size, and would undoubtedly be found sufficient for all purposes.

Standardization of catalogues would not only make them handier for filing and reference, but it would also in time make catalogues cheaper. The various engineering and manufacturers' societies could render a great service by taking up this matter and pushing the adoption and use of standard sizes.

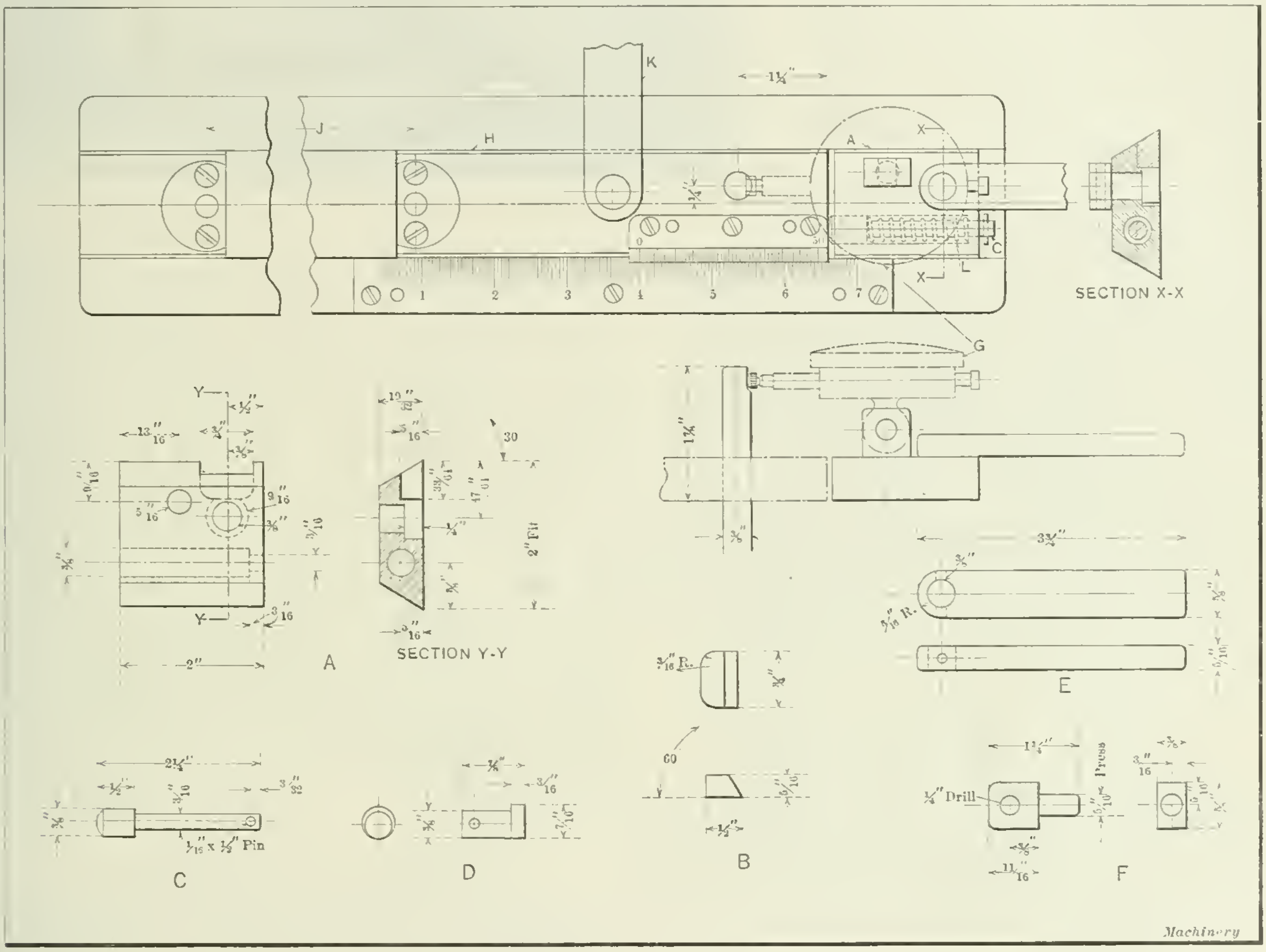
Cleveland, Ohio EDWARD HELLER

PITCH LINE INDICATOR ATTACHMENT

Users of the Brown & Sharpe No. 0 gear-testing machine will find the pitch line indicator attachment here illustrated of great assistance in testing small gears. The details of the various parts of the attachment are shown so as to enable anyone who wishes to construct a device of this kind to do so readily without having to go to the expense of laying out the design.

The slide shown at *A* is machine steel and is fitted with a hardened tool-steel clamping gib *B*. The spring plunger *C* is cold-rolled steel, and the eccentric clamping stud *D* is hardened tool steel. The clamping lever *E* and the post *F* that supports the indicator are both made of machine steel. An Ames indicator shown by the dot-and-dash lines at *G* is used with the attachment. In using the attachment, slide *H* is first set to the required center distance *J* and locked by means of the lever *K*. The indicator slide *A* is then moved up until the indicator reads zero. Slide *A* is next locked in place. Plunger *C* is now pushed back, compressing spring *L*. Upon the release of slide *H* plunger *C* holds the master gear and the gear under inspection in contact at their pitch lines. By turning the gears, any eccentricity or unevenness in the rolling action is instantly shown by the indicator.

Eastwood, N. Y. ELMER C. COOLEY



Details of Pitch Line Indicator Attachment for testing Small Gears

PERFORMANCE TEST QUESTIONS IN HIRING EMPLOYES

The so-called "trade test," under which an applicant for a job is asked a standard set of questions that are supposed to bring out his fitness for the job for which he is applying, has many advocates. A great deal can be said for this method, when applied in a practical and common sense manner; but it should not be forgotten that the trade ability of a worker is his ability, not to answer questions, but to step right in and do an average job in the line of work for which he is hired, without special instructions. He should be able to select and call for the necessary tools appliances, and supplies for doing the work, and to set up the machine and make necessary adjustments, even though these may be slightly different from those to which he has been generally accustomed. Now, how is it possible to determine in conversation with the applicant whether he is able to do this, or not?

Mere oral tests by the foreman are insufficient, and may be misleading or unjust, or both. For instance, he may put a question that was actually asked in army trade test examinations: "When using top and bottom dies in making a forging, what is the waste material called, that forms around the workpiece?" One answer was "fin," which would have satisfied the writer, for example; but another was "flash"—an expression which the writer had never heard in that connection; still another was "scale," which he would have ruled out; while a fourth answer was "flange," which almost no one would have accepted. Yet all four terms were found to be correct and proper usage in different parts of the country.

A safer test would be, in the case of a power-hammer man, for example, to put him to work and say, "Run this piece down to 1¾ inches on the Shaw hammer. If he did not at once ask, "Where is the gage?" (or "snap block," or even "peg") he could be turned down at once as not suited to be entrusted with a power hammer. Also, the man who on being given a performance test doesn't first look over the machine and appliances to see that they are ready to work properly, and next lay out all the work-pieces and the tools and supplies handily, so that no hunting will be required to find them when needed, might as well be laid off before being hired. The man who, upon being given a wrong or defective tool with which to do a certain piece of work, does not ask for something better, or at least look askance at it or raise his eyebrows in a deprecating manner, might as well not be taken on.

As a rule, trade ability is determined most quickly and safely by preliminary questions that would show the most thorough acquaintance with the work to be done, the way to do it, and the means to employ. The great difficulty with oral tests, as applied in large organizations by men who examine prospective employes, is, that the questions have to be such that they can be put by an intelligent examiner who has no specific knowledge of the trade. It is difficult for a man who himself is unfamiliar with the trade to conduct such an examination, but it has been suggested that in most manufacturing establishments the foreman can furnish the employment man with questions to which he can also supply every possible correct answer, so that the tests may be fair. The honesty of the applicant might sometimes be tested by asking him, not "Can you run a Lincoln milling machine?" because to this question he can answer "Yes" without any chance of being found out if he is not telling the truth; but by asking, "Can you run a Broynton milling machine?" If he answers "Yes," then the interview can be discontinued at once because there is no such milling machine.

New York City ROBERT GRIMSHAW

MILLING CONNECTING-RODS

The connecting-rods used on the Reading-Standard motorcycle are of the solid and forked type common to the V-type engine. In the following is described a special machine used in milling the forked rod at the crankpin end. The solid rod works between the prongs produced by this milling operation. A front view of the machine with a rod set up to be milled is illustrated in Fig. 1. The rod is clamped on a driving plate *A* by means of a special clamp through which the cutter may be passed to bring it into position for feeding the work transversely. The faceplate or driver is then revolved, as required to sweep the rod around in milling the gap. The driving plate also carries a pin *B* against which the rod bears while it is being revolved by handwheel *C*. The cutter is ¾ inch wide and produces an opening of sufficient width to accommodate the solid rod.

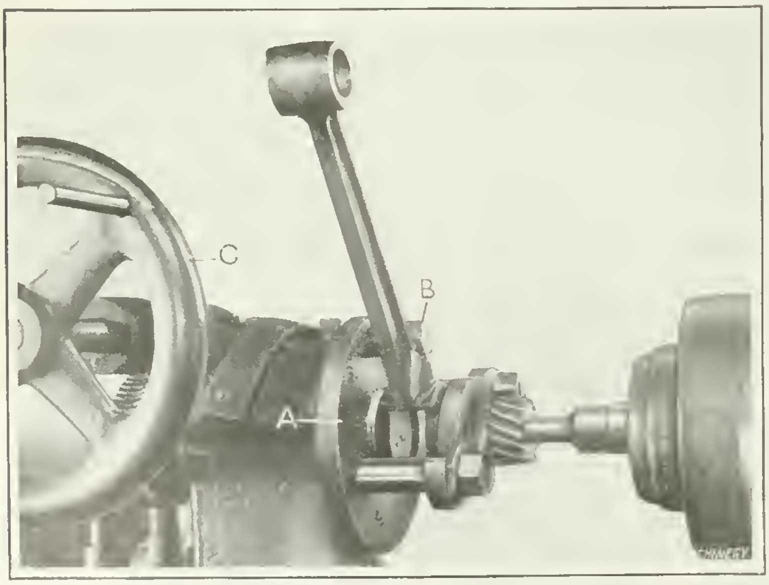


Fig. 1. Connecting-rod set up for milling Gap at Fork End

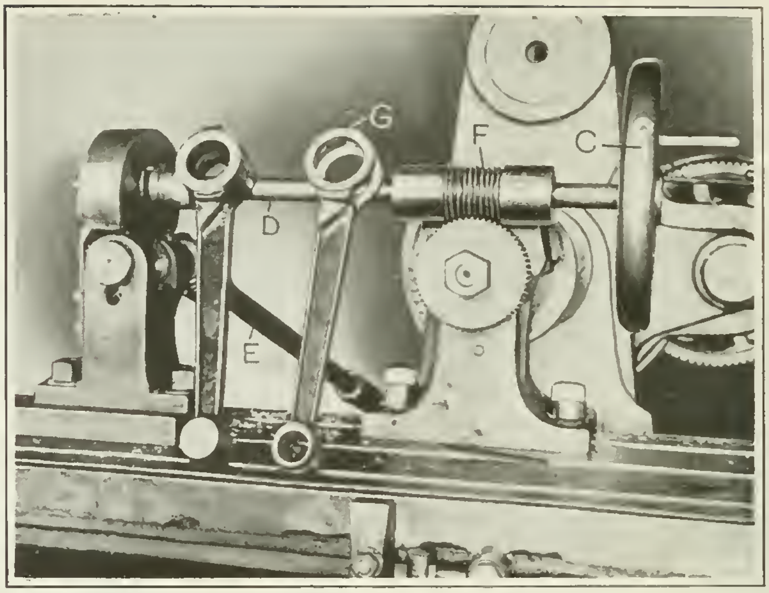


Fig. 2. End View of Machine, showing Hand Feed for Faceplate

The arrangement for revolving the faceplate is illustrated in Fig. 2. A worm-wheel on shaft *D* is driven by a worm through universal joints and shaft *E*. Worm *F*, which is also mounted on shaft *D*, drives a worm-wheel which is attached to the shaft on which the faceplate is carried. As the connecting-rod is revolved by handwheel *C* it is fed slowly past the revolving cutter. During this operation the entire amount of metal is not removed, there being a narrow tie-bar left at *G* to prevent the rod from springing out of shape while being milled. This connection is of course subsequently removed.

Providence, R. I. ROBERT MAWSON

* * *

AIR-DRIED AND KILN-DRIED WOOD

It is sometimes claimed that kiln-dried wood is not as strong as wood that has been air-dried. Others again have advanced figures indicating that kiln-dried wood is much stronger than air-dried. In order to settle this question, the forest products laboratory of the United States Forest Service at Madison, Wis., made some 150,000 comparative strength tests on specimens from twenty-eight different common species of wood. The results of these experiments showed conclusively that good kiln-drying and good air-drying have the same effect upon the strength of wood.

The belief that kiln-drying produces stronger wood than air-drying is usually the result of failure to consider differences in moisture content. The moisture content of wood on leaving the kiln is usually from 2 to 6 per cent lower than that of thoroughly air-dried stock. Since wood increases in strength with loss of moisture, higher strength values may be obtained from kiln-dried than from air-dried wood; but this difference in strength has no practical significance, since in use a piece of wood will come to approximately the same moisture condition whether it is kiln-dried or air-dried.

Questions and Answers on Practical Subjects

PROPORTIONING CONE PULLEY STEPS TO GIVE CONSTANT BELT TENSION

L. M. H.—Please show how to calculate the diameters of the unknown steps on the larger of a pair of cone pulleys so that the tension on an open belt will be the same on all steps. The diameters of the steps of the smaller pulley are 3, 4, 5, and 6 inches, respectively, and the largest step of the large pulley is 8 inches in diameter. The distance between the shaft centers is 18 inches.

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

The accompanying illustration shows diagrammatically at *A* the conditions of the problem, dimensions *X*, *Y* and *Z* being unknown. The length of belt required to pass over two pulleys is obtainable by a formula given in MACHINERY'S HANDBOOK on page 722 which is as follows:

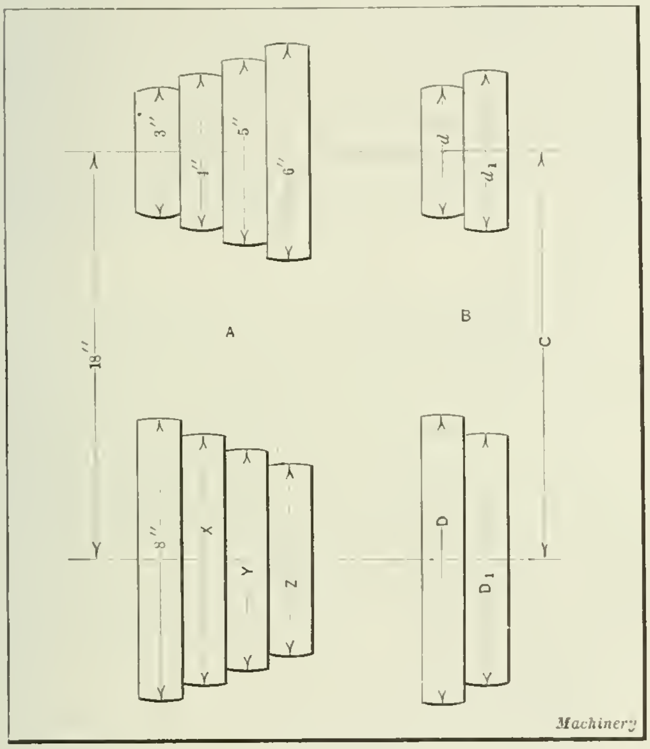


Illustration showing Conditions of Problem on Cone-pulley Design

$$L = 2C + \frac{11D + 11d}{7} + \frac{(D - d)^2}{4C} \qquad (1)$$

in which

L = length of belt;
D = diameter of large step;
d = diameter of small step; and
C = center distance between pulleys.

By substituting $\frac{\pi}{2}$ for $\frac{11}{7}$, this formula may be written as follows:

$$L = 2C + \frac{\pi}{2} \times (D + d) + \frac{(D - d)^2}{4C} \qquad (2)$$

From this a formula can be derived for finding the diameter of any unknown step on either pulley that will cause the belt tension to be the same on any pair of steps. This is, of course, due to the fact that the proper belt length for any pair of steps will be constant. In the following formulas, *L* and *C* equal the same values as before, and

D = largest step on larger pulley;
d = smallest step on smaller pulley;
D_1 = any step on larger pulley; and
d_1 = corresponding step on smaller pulley.

Then, from Formula (1) and *B* in the illustration,

$$L = 2C + \frac{\pi}{2} (D_1 + d_1) + \frac{(D_1 - d_1)^2}{4C}$$

Equating this with Formula (2)

$$2C + \frac{\pi}{2} (D + d) + \frac{(D - d)^2}{4C} = 2C + \frac{\pi}{2} (D_1 + d_1) + \frac{(D_1 - d_1)^2}{4C}$$

Arranging according to powers of $D_1 - d_1$,

$$(D_1 - d_1)^2 + 2\pi C\ (D_1 - d_1) + 4C \left[\pi d_1 - \frac{\pi}{2} (D + d)\right] - (D - d)^2 = 0$$

Solving this quadratic equation for $D_1 - d_1$ and taking the plus sign before the radical,

$$D_1 - d_1 = \sqrt{(\pi C + D + d)^2 - 4\ (\pi C d_1 + Dd)} - \pi C \qquad (3)$$

From this formula D_1 or d_1 can be found when either one is known. Substituting the known values,

$$D_1 = \sqrt{(18\,\pi + 8 + 3)^2 - 4\ (18\,\pi\, d_1 + 8 \times 3)} - (18\,\pi - d_1)$$
$$= \sqrt{4562.8404 - 226.1952\ d_1 - 96} - (56.5488 - d_1)$$
$$= \sqrt{4466.8404 - 226.1952\ d_1} - (56.5488 - d_1)$$

Now solving for diameter *X* in the illustration, in which case $d_1 = 4$ inches,

$$X = \sqrt{4466.8404 - 226.1952 \times 4} - (56.5488 - 4)$$
$$= \sqrt{3562.0596} - 52.5488$$
$$= 59.683 - 52.549 = 7.134 \text{ or } 7\tfrac{1}{8} \text{ inches}$$

Solving for *Y* in which case $d_1 = 5$ inches,

$$Y = \sqrt{4466.8404 - 226.1952 \times 5} - (56.5448 - 5)$$
$$= \sqrt{3335.8644} - 51.5448$$
$$= 57.757 - 51.549 = 6.208 \text{ or } 6\ 13/64 \text{ inches.}$$

Finally, solving for *Z*, in which case $d_1 = 6$ inches,

$$Z = \sqrt{4466.8404 - 226.1952 \times 6} - (56.5488 - 6)$$
$$= \sqrt{3109.6692} - 50.5488$$
$$= 55.764 - 50.549 = 5.215 \text{ or } 5\ 7/32 \text{ inches.}$$

TRANSMISSION FOR MOTOR DRIVE

E. B. M.—When a machine is to be motor-driven, what is generally considered the most satisfactory and efficient method of transmitting motion from the motor to the machine? Is it preferable to use a belt, chain, or gear drive?

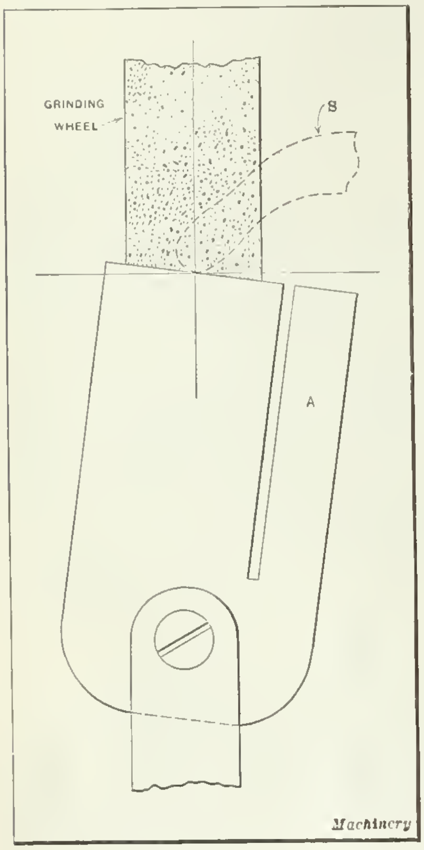
A.—The best and most efficient drive depends upon conditions subject to wide variation. Thus belting, chain drives, gearing, and the direct drive are all satisfactory under different conditions. The distance between the driving and driven shafts, the speed ratio and the importance of having a compact drive or self-contained machine are factors to be considered.

Ordinarily, leather or other belting is used for the longer center distances; some type of chain drive is used when the center distance is too short for belting and too long for gearing; and gearing is used when the motor can be placed quite close to the driven shaft, except on machines which can have the motor connected directly with the driven shaft as, for example, machines not requiring a reduction of speed between the motor and the driven shaft. Sometimes belts have been applied to motor drives where the center distance was rather short and the speed ratio high, so that there was insufficient arc of contact, and in order to prevent excessive slipping, either an idler pulley is used to increase the arc of contact or the belt is tightened excessively. Such a drive is detrimental both to the belt and also to the bearings, and a positive drive, such as a silent chain, is much more efficient in such cases because slippage is prevented and there is no initial pressure on the bearings.

GRINDING SPIRAL MILLING CUTTERS

F. E. S.—In grinding the teeth of spiral milling cutters, should the upper edge of the finger that supports the cutter conform to the angle or inclination of the tooth being ground, and where should this supporting finger be attached?

A.—In grinding a spiral milling cutter the tooth-rest should remain in a fixed position relative to the wheel, and it should be somewhat wider than the wheel face so that the cutter will be supported before the grinding begins. The top of the tooth-rest should preferably incline so that it has an even bearing on the tooth. A good form of tooth-rest is shown in the accompanying illustration. It has a flexible part *A*, which permits indexing the cutter from one tooth to the next by simply springing this flexible part and without removing the cutter from the tooth-rest. When setting the tooth-rest a height gage, which conforms to the height of the wheel center, should be located so that the end is opposite the center of the wheel face, the end of the gage being indicated by the dotted lines *B*. The tooth-rest is then adjusted until it is contact with the gage and at the tooth angle. After this has been done there is a vertical adjustment between the wheel and the cutter, the amount depending upon the desired clearance angle.



Tooth-rest for Use in grinding Spiral Milling Cutters

PLASTER MOLDS

Can plaster molds such as described in June MACHINERY in the article "Plaster Molds for Small Castings" be used for more than one pouring? If new molds have to be made for each heat does not the cost of plaster molds become high as compared with sand molds? Would plaster molds be economical for quantity work?

ANSWERED BY FRANK LUX, NEW YORK CITY

Plaster molds cannot be used for more than one pouring. Their cost is higher than sand molds, but the results obtained are far superior, and their use is recommended where a good finish is required. In appearance, the product made resembles a die-casting, and fine detail can be brought out clearly. Tablets, medals, and nameplates have been made by the writer, but this process is useful for many other products as well. Automobile hardware with ornamental design has been produced in this way on a production basis. Generally speaking, this method of producing castings is for a special class of work. In some cases it is cheaper than sand-molding, as machining operations can be eliminated on such parts as small gears which do not require close limits. These parts have been made to limits of plus or minus 0.003 inch.

DETERMINING LENGTH OF ROLLED BELT

A. F. S.—What is the rule for finding the length of a belt or tape when rolled up, assuming that the outside diameter, diameter of hole, and the number of coils are given?

A.—The length, in feet, of a closely-rolled belt may be determined by the following rule: Find the sum of the outside diameter and the diameter of the hole in inches. Multiply this sum by the constant 0.1309, and the result by the number of complete turns of the belt. The rule is based on the rule for obtaining the length of a plane spiral. In order to obtain the length of the spiral, the sum of the inner and outer diameters is divided by 2, and the quotient is multiplied by 3.1416. The product is again multiplied by the number of turns made by the spiral. In the application of this rule, if the inner and outer diameters are in inches, the length of the spiral will also be in inches. If instead of dividing by 2 and multiplying by 3.1416, the sum of the inner and outer diameters is multiplied by the constant, 0.1309, as previously mentioned, the result will be obtained in feet, since 3.1416 ÷ 2 × 12 = 0.1309.

HORSEPOWER AND TORQUE

S. J.—What is the meaning of "torque," and how is the relation between torque and horsepower determined?

A.—When applying power by rotation, the pull required on a pulley varies inversely as the radius at which the pull is applied, and when power is expressed as "torque" it generally means the pull required at 1 foot radius. Thus the torque of a motor is its turning moment or the number of pounds of effort exerted at a radius of 1 foot.

To find the horsepower that is equivalent to a given torque and speed of rotation, the following formula may be used, in which

H = horsepower;
T = torque at 1 foot radius; and
R = revolutions per minute.

$$H = \frac{T \times R \times 2 \times 3.1416}{33\,000} = \frac{T \times R}{5252} \qquad T = \frac{H \times 5252}{R}$$

TANKS FOR STORING FUEL OIL

L. S.—What precautions are necessary in the construction of monolithic cement tanks for the storage of fuel oil in order to prevent the oil from penetrating through the walls?

A.—It is not necessary to use waterproofing material for the walls if the viscosity of the oil is high, because thick oil, after it has penetrated through two or three inches, will fill the pores and offer an excellent resistance to further penetration. For this reason the walls of the tanks should be comparatively thick, say 8 or 10 inches, depending upon the capacity of the tank.

For light oils, such as gasoline, which are very penetrative and which do not possess the sealing quality of the heavier oils, the porous walls of the tank must be sealed. For this purpose, a ½-inch coating of plaster should be used. This plaster may be made from equal parts of cement and fine sand, mixed with a waterproofing compound. The coating should itself be treated to a solution of silicate of soda applied with a brush.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, September 14

TANGIBLE evidence of improvement in several of the metal-working trades is accumulating and is particularly noticeable in the textile, engineering, automobile, and railway shops. As far as the machine tool industry is concerned, the limited demand has been met for many months by second-hand machines and the abundant stocks of new machines that were accumulated at the beginning of the slack period. A big business is still going on in second-hand machine tools. The increasing sales of new machines by well-known makers is a welcome sign. One of the best known makers of turret and capstan lathes sold sixty machines during last month, the most popular size being 16-inch swing; another well-known maker reports similar business. Heavy and medium capacity machine tools for the electrical trade are in good demand, and there is a demand for machine tools for machining turbine castings, and equipment for cutting turbine reduction gears. Special machine tools designed for the reduction of manufacturing costs are also being bought.

A very satisfactory feature in the present position of the machine tool industry is the growing demand from abroad. France, in particular, is a steady buyer and has taken a large number of the reconditioned machine tools. Dealers in France are able to import machine tools from this country and sell them at much below the price quoted for similar machines offered by continental dealers. Colonial railways are resuming buying, and India and South America are prominent among the prospective buyers.

The small tool industry continues to improve, and in the Sheffield district large Russian orders have recently been shipped to Siberia; the tools include cross-cut saws, hand saws, files, threading equipment, and various types of edged tools. The order was received through an agency in London on behalf of the Soviet Government, the suppliers receiving cash on acceptance of the order. The total value of the order is supposed to be in the neighborhood of £200,000.

Textile machinery makers have been particularly busy, and the demand is becoming more and more insistent from all parts of the world. Platt Bros. & Co., Ltd., Manchester, one of the largest textile engineering firms in the world, have orders in hand to the value of over £8,000,000, and another well-known firm of textile engineers, Dobson & Barlow, Ltd., have orders to the value of £3,000,000. A fair proportion of these orders are from China for the equipment of new cotton mills in that country which are being erected by Japanese capitalists. The first-mentioned firm has supplied in all something like 80 per cent of the cotton machinery used in Japan. The recent undertaking of the Japanese at the Washington Conference to abolish night work in their mills has caused the Japanese to increase greatly their textile equipment in existing works, so that their gross output shall not be reduced by the reduction in the working hours.

The Automobile Industry

The automobile industry continues to show a great deal of activity. As has been mentioned in previous letters, the small car is attracting many of the well-known manufacturers, who up to now have concentrated on more elaborate vehicles. Several of these makers are endeavoring to market a small car capable of carrying two, or at the most three people, at about £200. Several of these cars will be shown at the forthcoming Olympia show in November.

There has been much c mment in the past on the extent to which America has captured the trade in light automobiles in several of the British Colonies, and it has frequently been said that it is due to want of foresight on the part of the English manufacturer in meeting the special needs of the Colonies. It has been pointed out, however, that the conditions in America are very similar to those in many of the Colonies and the normal home demand in America has therefore brought forward a type of car that is eminently suitable for a wide overseas market. The accuracy of this line of thought is shown in the fact that America's high-grade cars are practically unknown in the Colonies, whereas many makes of the better grade of English cars find their way into these markets.

Overseas Trade in Machine Tools

During July the exports of machine tools corresponded very closely with that of June, the total value of the exports being £75,549. Imports, however, showed a sharp rise, the total value amounting to £43,706. The value per ton of exports was £140, and that of imports £121. Drilling machines lathes, planing and shaping machines, presses, and miscellaneous machine tools not coming under any general classification were most prominent in the export figures, whereas lathes and milling machines were large items in the import returns. It is interesting to note that during July 109 lathes were exported and 91 imported.

It was thought at one time that Germany would rapidly build up a trade in machine tools in this country, and until March of this year the returns appeared to lend weight to this view; in fact, attempts were made to have machine tools placed on the list of imports coming under the Safeguarding of Industries Act. Since that date, however, the imports of German machine tools into this country have shown a distinct falling off, and both in value and weight the figures now correspond with those of October last year. At the highest point, however, the tonnage import was only 209 per month, the value being £13 500. In June the tonnage was only 85, and the value £6500.

Before the war Germany had the monopoly of the manufacture of tungsten and was England's best overseas customer for high-speed steel. Germany, however, developed her steel production to such an extent during the war that she is now able to manufacture practically all of her own requirements in high-speed steels. She has now become a large buyer of tungsten and her steel-makers are buying more of this material than was previously sent to all of the British steel makers.

New Machines and Developments

Mention was made in a previous letter of a 120-foot bed lathe recently sent to Japan by Thos. Shanks & Co., Johnstone. Some very stringent requirements had to be met, and an accuracy of plus or minus 0.002 inch was required, regardless of the weight of work on the faceplate or between centers. As the machine was constructed to carry work weighing up to 100 tons, the exacting nature of this specification can be realized. Another very large machine tool sent to Japan is for installation in the naval shops at Tokio; it is for grinding armored plate and weighs 60 tons. The grinding wheel weighs 2 tons and is 54 inches in diameter, and the machine requires 120 horsepower for driving; the makers are Taskers Engineering Co., Ltd., Sheffield.

Nut-tapping Machine of Belgian Design

By A. L. VALENTINE*

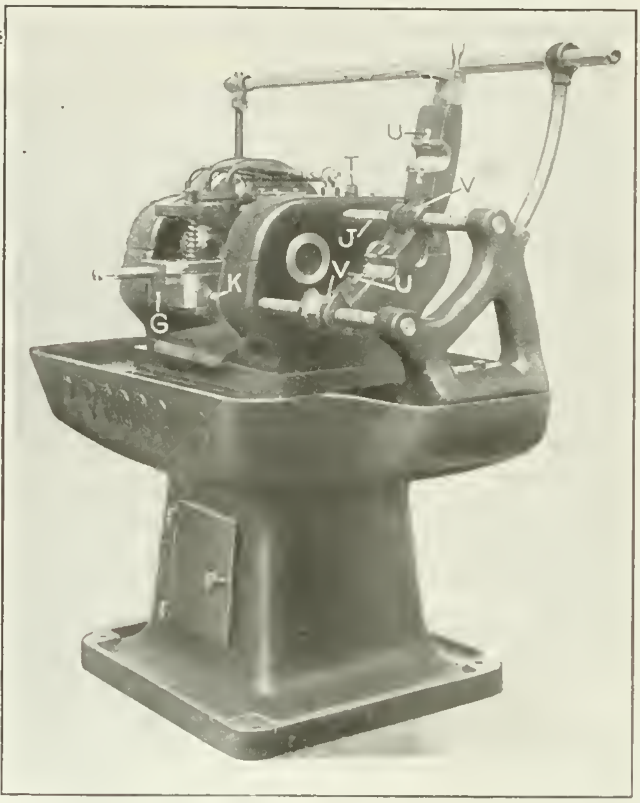


Fig. 1. Machine designed for tapping Deep Threads of Coarse Pitch

A NEW principle in tapping machine design is shown in Fig. 1. The tap, instead of being held in a chuck in the usual manner is supported and driven by hollow spindles located on each side of the work. The spindles do not advance, but drive or rotate the tap in such a manner that it is permitted to feed itself through the work. A lead-screw is employed in starting the tap, but is disengaged as soon as the tap has entered the work far enough to become self-feeding. Thus any errors that might result from a difference between the lead of the tap and that of the lead-screw are avoided. The work remains in a fixed position near to and between the ends of the hollow spindles during the tapping operation.

Referring to Fig. 2, at *A* and *B* may be seen the noses of the hollow spindles that support and drive the tap *C*. The tap becomes self-feeding after being started in the work *E* by the lead-screw *D*. In this case the work is held in a special fixture *F*, shown in Figs. 3 and 4. The work *E*, Fig. 3, is a steel casting about 6 inches long, with an opening in the center approximately 2 inches in length. The tapped hole is about 1⅞ inches in diameter, and the pitch approximately 5/16 inch. The time required for tapping this piece is ninety seconds. As further examples of the production rates obtained on this machine, it may be mentioned that the time required in tapping a nut of steel 4 inches long with a continuous thread of ¼ inch pitch, and a diameter of 2⅛ inches, was eighty-five seconds, and the tapping time for a nut of steel 2½ inches long with a continuous thread 1⅝ inches in diameter, and ¼ inch pitch, forty-five seconds.

Referring to Fig. 4, it will be noted that work *E* fits loosely in the pocket of the fixture, and that there is considerable clearance between the work and the retaining latch *H*. The method of mounting the fixture on the bars *J* and *K*, Fig. 2, permits a limited crosswise movement. Thus the work is permitted to float a sufficient amount to allow the drilled hole to be aligned properly by the pilot section of the tap. The tap enters the work through the spindle nose *B* and after passing completely through, is removed from the spindle on which nose *A* is mounted.

Design of the Tap Used

The design of the tap used with the machine here described is shown diagrammatically in the upper view of Fig. 5. The enlarged sectional view in the lower left-hand corner shows the method of driving the tap. The three deep grooves or flutes which extend the entire length of the tap are engaged by the two driving noses of the spindles, as indicated. Driving noses having openings of the correct size and shape to accommodate taps of different sizes can be readily and quickly attached to the spindles in place of those shown at *A* and *B*, Fig. 2. Lead-screws and lead-screw nuts of the same pitch and lead as the taps are supplied.

Referring to the upper view, Fig. 5, section *A* of the tap serves as a combination pilot and reamer. This section passes through the work and enters the driving nose *A*, Fig. 2, before the tapered and threaded part *B* of the tap enters the work or before the tap actually begins to cut. The full-thread part *C* of the tap brings the thread to the exact size and form. The squared end at *D* fits into a square hole in the end of the lead-screw *D*, Fig. 2, which controls the feeding movement until the tap is well started in the work, at which time the tap is disengaged from the lead-screw in a manner to be described later.

Operation of the Machine

The actual operation of the machine is very simple. The operator drops the work into the fixture *E*, Fig. 2, swings the latch *M* into place, inserts the reamer in the work as far as it will go, and places the lead-screw *D* in the position shown, after which he starts the machine. The spindles are driven from the same shaft, and exert an equal driving force on the tap. As the tap is connected with the lead-screw *D*, the lead-screw feeds it inward until the unthreaded part at *N* rests in the split nut mounted in

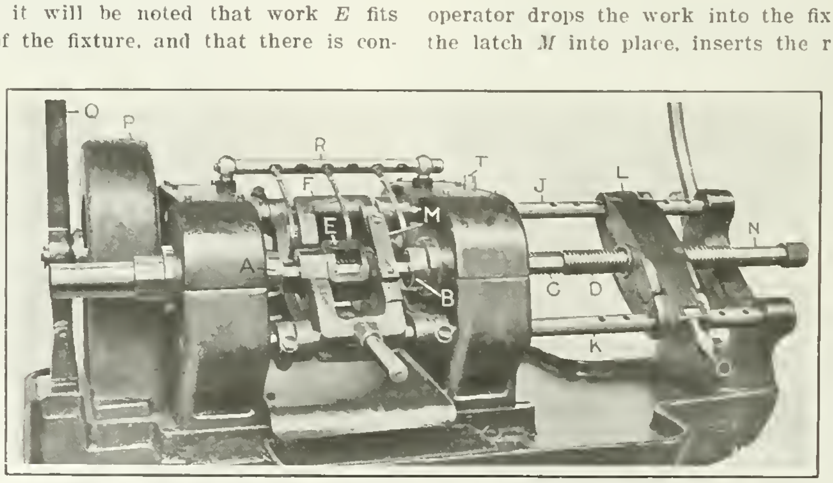


Fig. 2. Tapping Machine equipped with Special Work-holding Fixture shown in Figs. 3 and 4

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*Address: P. O. Box 706, Hartford, Conn.

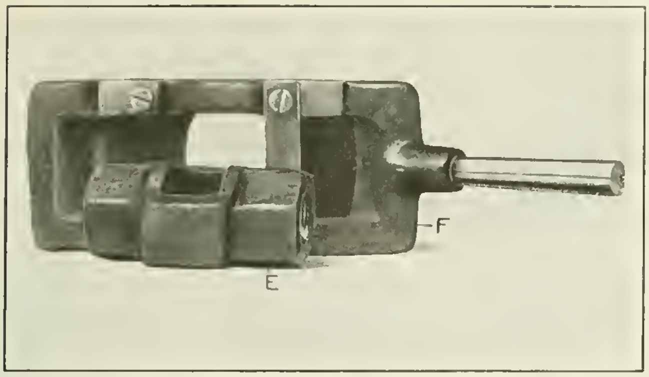

Fig. 3. Tapping Fixture with Work removed

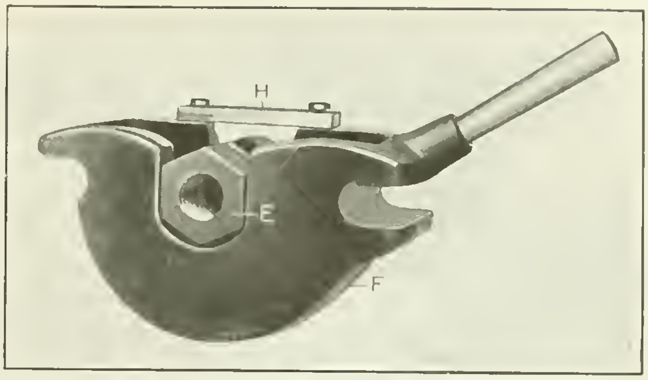

Fig. 4. Fixture with Work in Place

the holder *L*. At this point the tap becomes self-feeding. When the tap has passed completely through the work, it is removed from spindle *A* by the operator. The work is then removed and replaced by a new piece. The split-nut holder *L* is next unlatched by a movement of lever *O*. The upper half of the holder is swung upward so that the lead-screw *D* can be removed to permit the tap *C* to be inserted. The lead-screw is then returned to the position shown in Fig. 2, and the holder *L* closed and locked, after which the tapping operation is repeated.

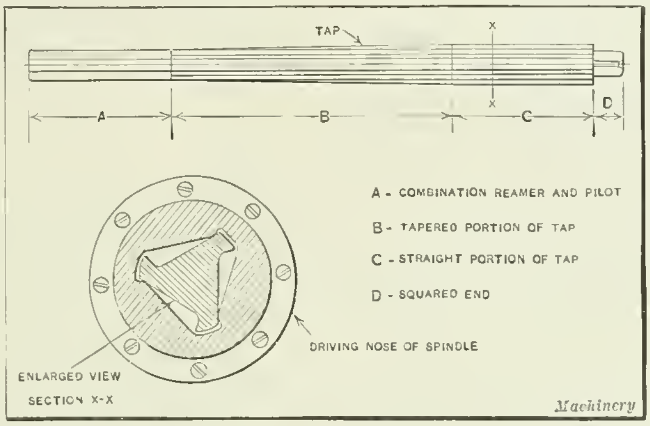
TAP
X
X
A
B
C
D
A - COMBINATION REAMER AND PILOT
B - TAPERED PORTION OF TAP
C - STRAIGHT PORTION OF TAP
D - SQUARED END
DRIVING NOSE OF SPINDLE
ENLARGED VIEW
SECTION X-X
Machinery

Fig. 5. Diagram showing Tap and Driving Nose of Spindle

The regular machine is belt-driven, but can be easily arranged for motor drive. The driven pulley is enclosed by guard *P*, Fig. 2, and is engaged with the pinion shaft, which drives the spindles by means of a clutch operated by lever *Q*. An idler pulley provided with a belt-tension adjusting device is secured to the left side of the machine base. A gear-driven pump located in a reservoir in the base feeds the cutting compound to the work through the bent pipes leading from tube *R*. The work-holding fixture shown at *G*, Fig. 1, is the type regularly supplied with the tapping machine. A transverse adjustment of the holding clamp is permitted by the gibbed slide, and a vertical adjustment of the clamp can be effected by pivoting the fixture on the bar *K*.

The split-nut holder *L*, Fig. 2, is held in place on bars *J* and *K* by screws *V*, Fig. 1. This permits the holder to be located in whatever position is best adapted for the work being done, or, in other words, so that the tap can disengage itself from the lead-screw when it is once properly started. By locating the holder *L* farther to the left, the lead-screw will remain engaged with the tap for a longer period. A finer adjustment of the point of disengagement of the lead-screw is obtained by the pinion stud *T*, which meshes with rack teeth cut in bar *J*. Bar *J*, with holder *L* attached, can thus be moved in or out by adjusting stud *T*. The two halves of the split nut are held in place by small clamps *U*, Fig. 1, and can be readily changed to accommodate the lead-screw that is used.

The tapping machine shown in Fig. 1, which is a product of the firm of Le Progres Industriel, Loth, pres Bruxelles, Belgium, has a capacity of 2 inches; a smaller machine of similar design having a capacity of 1 inch is also made by the same company. These machines are designed primarily for tapping deep threads of coarse pitch, particularly those of the Acme, square, and similar forms.

A great variety of irregular-shaped pieces can be handled by the tapping machines described. Pieces of unusual shape often require special fixtures, as in the case of the part shown at *A* in Fig. 6. The fixture *B*, with the work and tap in position, ready for the tapping operation, is shown in Fig. 7. The work in this case is allowed a certain amount of float, being brought into alignment by the pilot of the tap. It will be noted from the illustration, however, that the fixture is designed to hold the work in such a manner that the trunnions projecting from its sides will be at right angles with the tapping spindle.

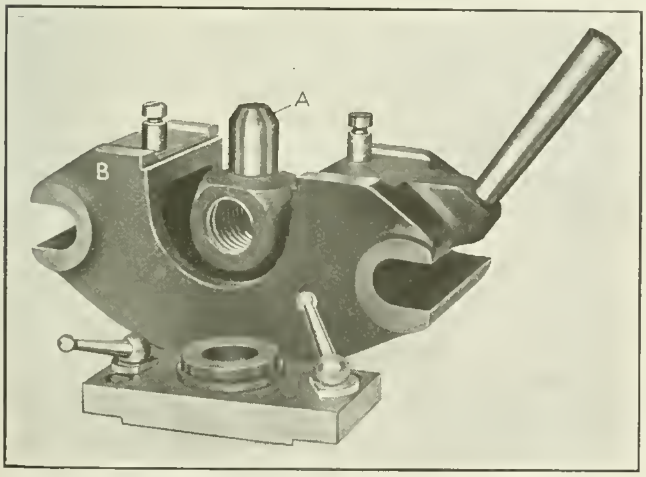

Fig. 6. Special Work-holding Fixture with Clamp removed

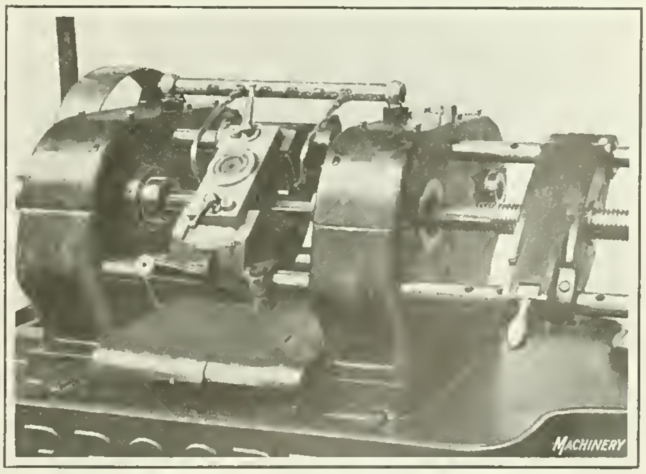

Fig. 7. Tapping Machine equipped with Fixture shown in Fig. 6

Production Rates

The high production rates obtained with this machine are due chiefly to the method of driving the tap. As will be evident from the preceding description, taps of unusual length may be employed, when necessary. This permits a thread to be cut with only one tap, in many instances where the depth of thread required would necessitate the use of two or more taps of the usual type. It may be mentioned here that the breakage of taps in this machine is almost an unknown occurrence. By driving the tap from both ends and adjusting the spindles so that the driving noses are close to the work, the torque or stress imposed on the tap is reduced to a minimum. This permits running the taps at exceptionally high speeds, which, of course, results in a high rate of production.

* * *

GREAT TELESCOPE BUILT BY WARNER & SWASEY CO.

One of the largest telescopes in the world—a sixty-inch reflector—has just been completed at the plant of the Warner & Swasey Co., Cleveland, Ohio, for the Argentine National Observatory. This telescope will be the largest in the southern hemisphere, and there are only two telescopes in the world which exceed it in size.

The tube of the telescope is built in three sections—the cast-iron mirror cell, which contains the mirror; the center-piece casting, which is fastened to the declination trunnions; and the tube proper. The latter is made up of structural steel members, and is 6 feet in diameter and 17 feet long. Its weight is 2400 pounds. Two forged steel trunnions, running in double thrust and radial ball bearings support the tube. The trunnions are, in turn, supported on a large fork mounted on the end of the long forged-steel polar axis. The polar axis is a hollow steel forging with a large flange and taper nose at its upper end to which the fork is attached. It is 15 feet long and 20 inches in diameter at its upper end.

The circles and gears for setting and rotating the telescope in right ascension are found at the lower end of the polar axis. Directly beneath the gears is the gear-box and mechanism for sidereal drive. The final drive in this mechanism is obtained through an accurate worm and worm-gear, the latter being 9 feet in diameter. The teeth of this worm-gear are very accurately spaced from a master circle divided on the Warner & Swasey automatic dividing engine. The worm-gear is operated by a gear-box mounted directly underneath, the gears of which were cut on a special machine accurate to one two-hundred-and-sixty-thousandth part of a circle. This machine in turn, is dependent for its reliability on the 40-inch dividing engine previously mentioned, which is exact to nearly a three-millionth part of a circle the most precise dividing engine in the world.

The main or parabolic mirror is 61 inches in diameter and 8½ inches thick at the center. It weighs about 2100 pounds. The focal length of the mirror is 25 feet, forming an image of any celestial object at the upper end of the tube. At the upper end an adapter is attached for holding photographic or spectrographic apparatus to receive this image. This telescope is to be used for photographic and spectroscopic study of the stars, rather than for visual observations. The new instrument will be able to detect some 150,000,000 distinct bodies, compared with the bare 5000 within the range of the unaided eye. The camera attached to a telescope of equal size showed in a photographic plate 50,000 stars in a part of the sky occupying about as much space as the full moon.

Among other great telescopes designed and constructed by the Warner & Swasey Co. are the 40-inch Yerkes, 36-inch Lick, and 26-inch United States naval refractors, and the 72-inch Canadian and 36-inch Arizona reflectors.

BUYING TOOL STEEL ON ANALYSIS

In recent years several of the large companies using tool steel have prepared specification analyses of tool steels and are buying steel according to these analyses. It is quite generally agreed, however, that tool steel cannot be classified or standardized by analysis. This subject was dealt with in a thorough manner in an address made by Roy H. Davis, general manager of the Firth Sterling Steel Co., before the National Association of Purchasing Agents. He pointed out that metallurgists, chemists, and heat-treaters are as yet unable to identify definitely the virtues or characteristics that make one bar superior in quality to another bar which is of apparently the same composition. In view of this, it is safer to buy tool steels by brands rather than by specifications.

Contrary to the general impression, there is nothing mysterious or secret about the chemical contents of a bar of steel. The analysis is free to the public, and the manufacturer will gladly give full details. Under the "specification" policy, the steel maker finds little difficulty or complication in melting tool steel to a special analysis, provided he is willing to sacrifice quality. He has complete control over the steps in melting. Melting is the only operation that influences analysis; but, in addition to melting, each subsequent step in manufacture has its influence on the quality. If the specification calls for a steel of unusual chemical composition the melter will add or subtract certain elements to or from the mix; or he will so manipulate the slags as to create reactions that will help him to the result specified.

Under the "brand" policy the custom has been established of holding the maker of the steel wholly responsible for its quality and suitability. Should the steel fail, when it is properly treated, and the tools or dies are properly designed and used, the custom has been to require the maker to replace the steel without charge. If this old established practice be abandoned, and the analysis policy substituted (either by individual steel companies or by the steel trade generally), there would necessarily follow a decided shrinkage in the steel maker's responsibility and a decided increase in the buyer's responsibility regarding the quality and suitability of the finished steel. It is therefore safer to buy on the "brand" policy, because brands represent a measure of quality, a standard, and a character established over a long period of years.

Tool steel may be purchased on an analysis basis with one of two objects: First, the specification may be broad and one easily met as regards analysis. In this case a low price will be the object. Price competition in place of quality competition will result. As a consequence a low price and a low quality will be obtained, because to meet the price the manufacturer will use the cheapest raw materials and the cheapest melting and manufacturing methods that will produce steel within the specification. Cutting and wearing quality will be sacrificed, since analysis and price will be the standards of measurement.

In the second case the specification may be drawn along narrower lines with the object of obtaining more uniformity and better quality. In order to meet the narrow limits, the steel manufacturer may use extraordinary methods in melting that will not help the quality, but that will probably be a detriment; and there will also be losses in manufacture, increasing the cost. The increased cost will not be the result of his effort for quality, but of his effort to meet the narrow specification.

It is therefore not advisable to purchase tool steel on a price consideration or to an analysis specification. What should be purchased is steel-making ability. The success of the steel maker's brand in the customer's shop is as vital and necessary to him as the customer's success in his own business.

German Industrial Conditions

From MACHINERY'S Special Correspondent

Berlin, September 7

THE entire German industry, including the machine tool industry, has shown a high rate of activity during the summer months, in spite of the lack of coal and raw materials, increased prices, and many other difficulties. The low value of the mark has made it impossible for a large number of the population to buy even necessities, and has forced them to restrict their consumption entirely to the home market. There has, however, been practically no unemployment, the general activity in the industrial field being such that there is a lack of skilled workers in all trades. In the middle of the summer only 0.6 per cent of all the members of the trade unions were reported as out of employment, and in one instance a record was taken of 100 positions to be filled, for which the total number of applicants was only 103. Nevertheless, all the industries are not working at their full capacity, because of the scarcity of coal and raw materials. Twenty blast furnaces are shut down on this account, and English coal and pig iron is being bought.

The Machine Tool Industry

Reports from the machine tool industry are contradictory. In some cases one hears complaints of the decline of foreign orders and statements to the effect that the time has come when it is no longer possible to compete in foreign markets. On the other hand, some manufacturers report many orders on hand and a great number of new orders coming in. The greatest difficulty is probably to be found in the fact that the domestic buying power of the mark is rapidly decreasing. The buying power of the mark in the home market has always been much greater than in foreign markets, and this has made the conditions within Germany more tolerable. The favorable conditions in industry during the past year have been largely due to the difference between the domestic and foreign buying power of the mark, which meant that production costs were low, while selling costs were based more nearly upon the world's market conditions. Now this difference is less noticeable and the prices in the home markets are rapidly increasing, so that they approach those in the world's markets. As soon as an equilibrium is reached in this respect, it would appear that a great economic crisis must take place in Germany, and the social consequences of this are feared by many. The dropping of the mark to the point where it is practically in the same class as the Austrian crown, is a very serious condition.

Prices and Terms of Payment in the Machine Tool Industry

There has been no such thing as stable prices in the machine tool industry during the past year. Last fall a sliding scale was established, two methods being adopted for determining the variations in the scale. One method was determined upon by an agreement between the manufacturers and dealers of machine tools, in accordance with which the German Machine Tool Builders' Association each month settled upon a certain percentage by which previously quoted prices should be increased, for machines delivered during the month. According to this method, a machine quoted at the price of 250,000 marks in December, 1921, with the understanding that the price was subject to a sliding scale, would cost, by the end of March, approximately 350,000 marks, and by the end of May, 550,000 marks

According to the other method adopted, the selling price increased automatically 0.4 per cent for each per cent increase in raw materials, and 0.5 per cent for each per cent increase in wages, up to the time of delivery. In accordance with this scale, a machine quoted in December at 250,000 marks would have been sold in May for approximately 350,000, a price much lower than that determined by the other sliding scale.

These sliding prices have made it very difficult to buy with any assurance as to what the cost would be at the time of delivery. Some machine tool manufacturers took orders toward the end of last year at fixed prices, and they have suffered great losses on account of the increased cost of materials and the increases in wages. There is no expectation of any decrease in the prices of machine tools for a long time to come, but on the other hand, a steady increase is almost a certainty.

More rigid terms of payment are being stipulated at present. Usually one-third of the total amount is required with the order, one-third when the machine is ready for shipment, and one-third within ninety days. In many cases the last third is requested within thirty days after delivery.

Organization of the German Machine Tool Industry

The whole German machine industry is now divided into twelve principal groups or trade associations, of which the Association of German Machine Tool Builders is one. This association, in turn, is divided into smaller groups, each devoted to some specific line or type of machines. The formation of these groups have proved very useful in determining upon export prices for different classes of machines to different countries. Much technical work has also been done within these groups, one outstanding example being the standardization activities in the drilling machine field. During the past year the association has also maintained a special news service for its members through which any news that seems to be important to the machine tool builder is quickly forwarded to him. This service is said to have been very successful.

The association decided, beginning in October, 1921, to sell for export in foreign currency. The machine tool dealers also agreed to this decision, and the machine tool industry has been the first German industry to sell abroad in foreign currency. It is stated that the exports have been considerably aided by this method.

General Prospects in the Industry

One of the serious drawbacks for the future development of German industry is the shortage of working capital. The banking interests have requested all industrial works to restrict their activities, if their present working capital does not allow them to maintain the production on the same scale as in the past. There appears to be plenty of foreign capital in countries adjacent to Germany waiting for an investment opportunity; but as yet no one ventures to invest in Germany because of the uncertainty of the political aspect and general economic conditions. The trade unions are constantly acquiring greater political influence, and are using it in a way that makes many fear for the peaceful solution of all the difficulties that at present beset German industrial life. There is considerable fear of a Soviet movement in Germany, which would mean industrial ruin.

The Machine-building Industries

THE industrial improvement manifested since the beginning of the year rests upon solid foundations; otherwise, there would have been a collapse from the strain upon the industrial structure during the summer months, as a result of strikes in two of the most important fields of activity. "The outstanding feature of the month," says the Federal Reserve Board, "has been the inherent soundness which the general business situation has manifested in the face of the difficulties encountered. This has been shown by the continuance of activity at a relatively high level despite labor disturbances." The Department of Commerce voices the same opinion by saying that "No clearer demonstration could be asked to indicate the soundness of the fundamental conditions underlying the present business revival than the persistence with which commerce and industry have progressed in the face of recent serious obstacles. The extremely serious labor difficulties through which we are now passing would, under many conditions, have completely demoralized business; instead, real progress continues to be made." Direct observation of conditions in the machine-building field bear out the truth of these statements; but at the same time it must be understood that business must necessarily proceed under handicaps for some time to come as a result of the fuel shortage and transportation difficulties.

The Machine Tool Industry

The demand for machine tools, which fell off somewhat in August—much of the falling off being seasonal—showed an increase in September. Buyers of shop equipment no doubt have held back purchases, expecting further price reductions; and finding themselves, instead, in a rising market, there is no longer any reason for delay in buying. Several manufacturers of engine lathes, turret lathes, and shapers have increased their prices, and further price advances are expected in these and other lines. These advances are necessitated by changed conditions. The cost of materials has increased considerably; and wages, instead of coming down, are in many instances being increased in the machine shop field. The level of wages in the machine industries has been lower than in other fields, which has made adjustments necessary. All this tends to force an increase in machine tool prices.

Conditions in the machine tool industry vary considerably according to the types and sizes of machine tools built. We find shops—especially those whose product directly or indirectly serves the automobile industry—working full time and even employing night forces. One manufacturer of heavy machine tools finds the improvement so marked and steady that normal business in his line of machinery is expected early in 1923. Another manufacturer of a standard line of high-grade machine tools states that the amount of business for 1922 will equal that of 1915, and in several other instances the pre-war level of production has been reached, with a steady improvement reported. On the other hand, we find shops where the improvement up to the present time has been very slight, and prospects as yet do not promise any large amount of business for some time to come; but fewer machine tool builders now say that there is no business at all than at any time during the last eighteen months. The resumption of work in the machine tool shops is retarded in some instances, not by lack of orders, but by the large stocks still on hand of certain types of machines. However, these stocks have been gradually reduced, as have also those in the dealers' hands, and when conditions today are compared with those of a year ago, optimism should be the keynote.

On the whole, the fact is that in the machine tool industry business is picking up, and there will be a fair amount of railroad buying as soon as the strike is settled, the railroads having already placed several orders. The Pennsylvania Railroad is said to be planning a large increase of its Altoona shops and the re-equipment of many of the smaller shops, which, by itself, would provide a large volume of business in railroad shop machinery.

Orders placed by the railroads for locomotives and freight and passenger cars during the last two months are quite large, and the locomotive builders are well employed. This, in turn, has resulted in orders for machinery used in locomotive building. The present unfilled orders for domestic locomotives are the highest recorded since November, 1920.

General Conditions in Allied Fields

The small tool business has not improved as rapidly as was expected, but it must be remembered that in this field business never receded to as low a level as it did in the machine tool field. Several small tool concerns report that their business is now from 50 to 60 per cent of normal. In the case of some of the largest manufacturers, the percentage is not quite so high. Railroad buying is more active in the small tool field, because, while railroad shops can get along with the old machine tools, they must replenish their small tools, for these will break or wear out.

Higher prices for small tools are expected for two reasons: The price reductions made were too great, and tool steel prices are expected to increase. Certainly, they will not be any lower, and this should be a good time to stock up with tool steel at low prices. Aside from the railroads, the automobile industry has been the chief customer of the small tool shops.

The file business is steadily improving, and some of the largest plants in this field operate at from 70 to 75 per cent of capacity. The price situation in this field is also more satisfactory. Price increases have placed the selling price on a more rational basis, as compared with production costs. The same is true of the gear business. One of the largest firms in this business in running at 75 per cent of capacity. Other gear manufacturers are occupied all the way from 45 to 100 per cent of normal. The business in gear-cutting machinery is also improving, the demand having steadily increased for the last six months.

One firm engaged in making transmission equipments states that the present business is equal to the volume handled before the war, but due to increased facilities this is only from 50 to 60 per cent of present capacity; a steady improvement is noted. The bearing metal business is from 65 to 75 per cent of normal.

The crane and hoist business is good. One of the well-known firms engaged in this business states that August brought more business than any month since March, 1920, and that September promised to exceed the previous month.

The Labor Situation in the Machine-building Field

One of the difficulties encountered by the machine tool industry is the scarcity of skilled labor, which is now very apparent. Good machinists and toolmakers are scarce, a fact which is reflected in wage advances. The cost of training new men in the machine tool shops will run high. Skilled mechanics formerly employed in this industry are now generally employed in machine shops building other lines of machinery or apparatus, and many have entirely left the machine-building trade and turned to other occupations. Hence, the actual cost of production is bound to be materially higher.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

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Chambersburg Punching and Shearing Machines

The distinguishing features of this line of power-driven punching and shearing machines are an automatic electric clutch control and an adjustment for the stroke of the sliding head. The clutch control is operated from the front of the machine, and so the operator need never leave his working position. The machine can be stopped at the end of each stroke or operated continuously. The stroke adjustment is effected through the control head, without the use of cams.

A line of vertical punching and shearing machines on which settings and adjustments of the sliding-head stroke are quickly made by means of a patented electric clutch control has recently been developed by the Chamhersburg Engineering Co., Chambersburg, Pa. A double-end machine equipped with the electrical control is illustrated in Fig. 1. This line of equipment is so designed that machines of different capacities may be operated end to end, as well as machines of like capacity. Belt-driven machines may also be provided with a mechanical pedal control, as illustrated in Fig. 4, instead of the electric control. However, this control is recommended to be used only when proper electric current is not available.

The stroke adjustment is made at the head end of the machine when the control head *A*, Fig. 2, is in the adjusting position shown, at which time the electric circuit has been automatically opened, and the clutch disengaged. The stroke adjustment is then made by positioning around cap *B*, a headless set-screw which is exposed. Cap *B* has graduations which indicate the position at which the stroke will be ended when the set-screw has been brought to that graduation.

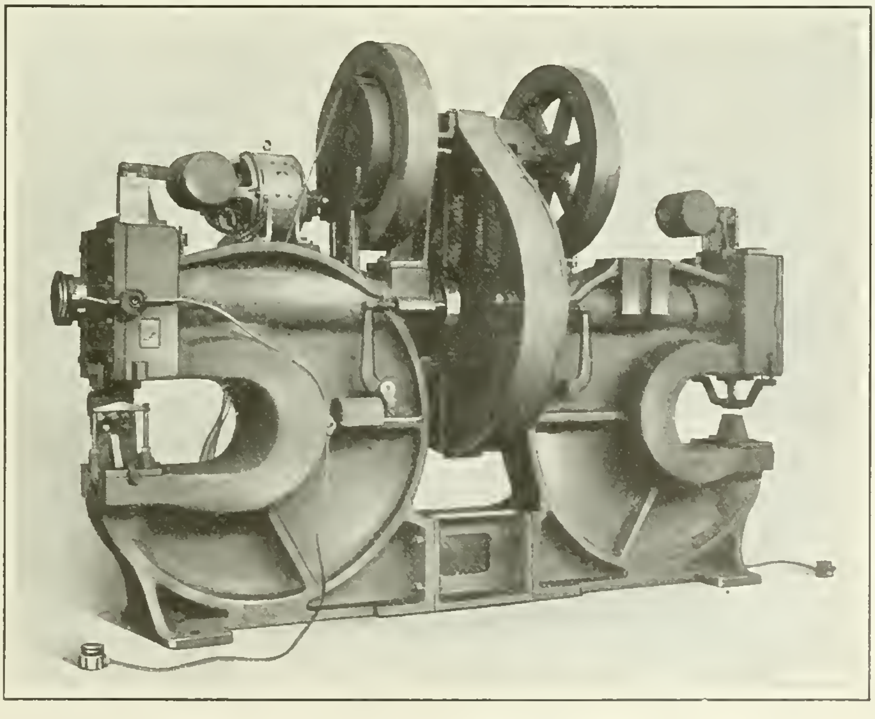


Fig. 1. Chambersburg Double-end Motor-driven Punching and Shearing Machine arranged with a Patented Electrical Control

Fig. 3 shows the control head in the position it occupies when the machine is in operation. A momentary depression of button *C* causes the engagement of the clutch, and this member is automatically disengaged as the sliding head reaches the point indicated by the setting of control head *A*. The machine may also be operated continuously. A portable push-button switch is also provided for operating by either hand or foot. The clutch disengages as a safety measure in case the electric circuit fails. With this automatic control it is unnecessary for an operator to leave the front of the machine while punching or shearing work.

The clutch is of the solid-jaw renewable-face type. The sliding half is a steel casting and the fixed half is cast integral with the large gear and reinforced by a steel ring shrunk into place. The machine frame is an I-beam type semi-steel casting with a solid jaw, large back flange and generous fillets to provide maximum rigidity and strength. The absence of cores precludes undetected faulty sections in the casting. The sliding head is also a semi-steel casting and has a bronze take-up wedge. The head is counterweighted by springs and actuated through a

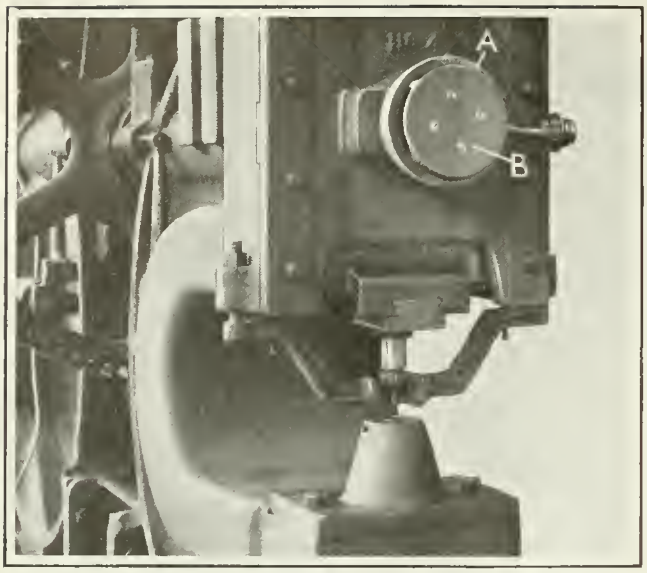


Fig. 2. Control Head in Adjusting Position on a Punching Machine

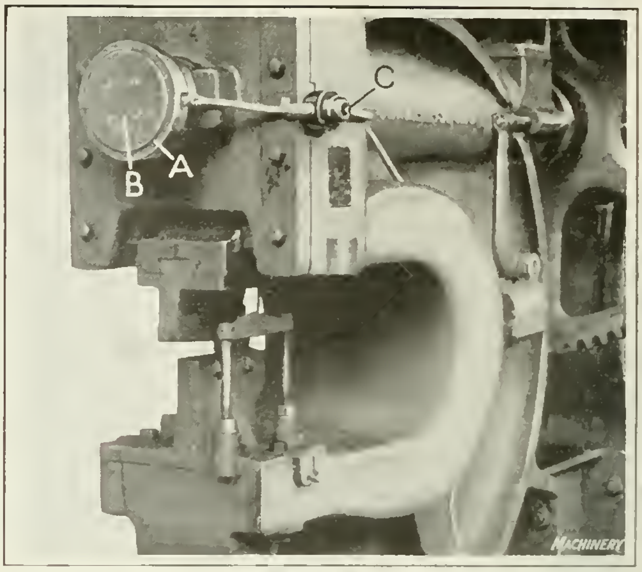


Fig. 3. Shearing Machine with Control Head in Operating Position

manganese-bronze eccentric box which minimizes lateral strains. The head cap is tongued to the frame and held by fitted screws. The eccentric shaft is a one-piece steel forging, accurately finished, which rotates in large bronze bushings. The main bearings and the sliding head are lubricated by sight-feed oil-cups, and oil-grooves provide for the efficient distribution of the oil.

The machine-molded gears are made of semi-steel, the pinion being shrouded. Fractional ratios insure the alternate stressing of the gear teeth. When a machine is motor-driven, a cut steel gear is furnished on the motor shaft. Gear guards may also be supplied. A one-piece safety capstan provides for turning the eccentric shaft by hand, and for camming the capstan bar out of the capstan, should the machine be accidentally started. The driving shaft is turned from machine steel, and runs in babbitted bearings. The tool-blocks are made of cast steel, the upper block being tongued to the sliding head and the lower block bolted to the frame. All tool-blocks are interchangeable on machines of like capacity. A patented floating punch which combines a fixed and a floating punch in one tool facilitates spacing table work. A tool-block can be removed in an instant by a quarter turn of a handle.

This line of machine is made in eight sizes, the smallest of which has a capacity for punching a 5/8-inch hole through mild steel plate 1/2 inch thick; shearing 3- by 9/16-inch flat stock, 1 1/8-inch round stock, and 2- by 2- by 3/16-inch angle-iron; and splitting plate up to 7/16 inch thick. The standard throat dimensions are 6, 12, 18, and 24 inches. The largest size machine has a capacity for punching a 2 1/2-inch hole through mild steel plate 1 inch thick; shearing 8- by 1 1/4-inch flat stock, 2 1/2-inch round stock and 6- by 6- by 11/16-inch angle-iron; and splitting plate up to 1 5/16 inches thick. The standard depths of throat for machines of this size are 15, 24, 36, and 48 inches.

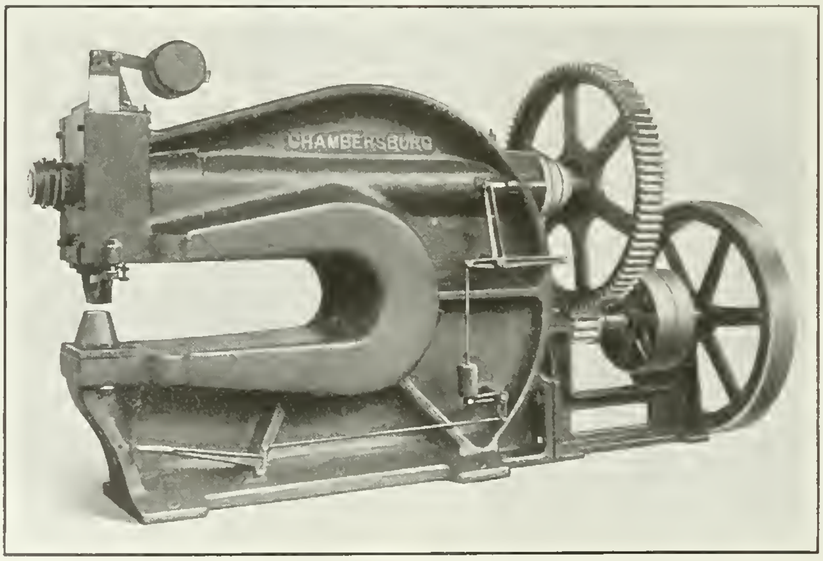


Fig. 4. Single-end Punching Machine with Mechanical Clutch Control and Belt Drive

VAN NORMAN AUTOMOBILE-VALVE GRINDING MACHINE

A small self-contained equipment for grinding automobile engine valves in service stations and garages has just been brought out by the Van Norman Machine Tool Co., 180 Wilbraham Ave., Springfield, Mass., under the trade name of "Valvo." From Fig. 1 it will be seen that belts are entirely eliminated, both the work- and grinding-wheel heads being driven by individual motors. The grinding wheel is mounted directly on the shaft of a 1/4-horsepower ball-bearing motor which runs at 3450 revolutions per minute and is rigidly attached to the base of the machine, while the work-head spindle is driven through gearing from a 1/20-horsepower motor. The work-head unit is carried on a movable slide operated by turning the lever at the left of the machine. The grinding wheel is 6 inches in diameter by 3/8 inch thick.

A valve to be ground is held by the stem in a split draw-in collet chuck which receives stems up to 9/16 inch in diameter. After the valve has been tightened in the chuck and the work-head set at the proper angle by means of graduations which run up to 60 degrees, the grinding is done by passing the valve across the face of the wheel, as shown in Fig. 2. This is accomplished by imparting a backward and forward movement to the lever. At the same time, the work is fed against the grinding wheel by revolving the handwheel on the base of the work-head. The average valve can be reground in one minute. The reamer for the valve seat can also be ground at the same setting, thus insuring proper seating of the valve. In addition to grinding valves, the machine is well adapted for grinding other parts, such as ignition contact points, tappet screws, and other short pieces. The main slide and the cross-slide are planed and scraped. The taper spindle of

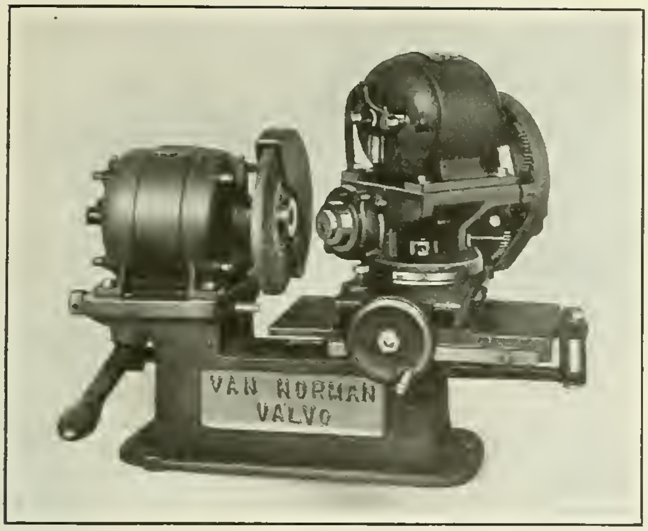


Fig. 1. Van Norman "Valvo" Grinding Machine designed for grinding Automobile Engine Valves

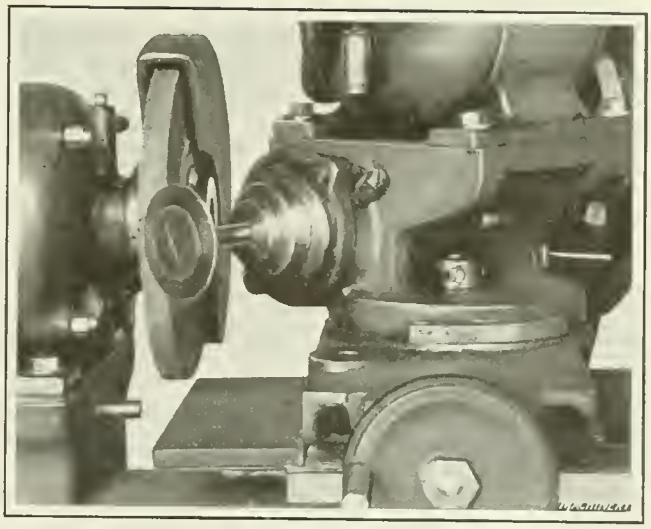


Fig. 2. Close-up View, showing the Manner of contacting the Valve with the Grinding Wheel

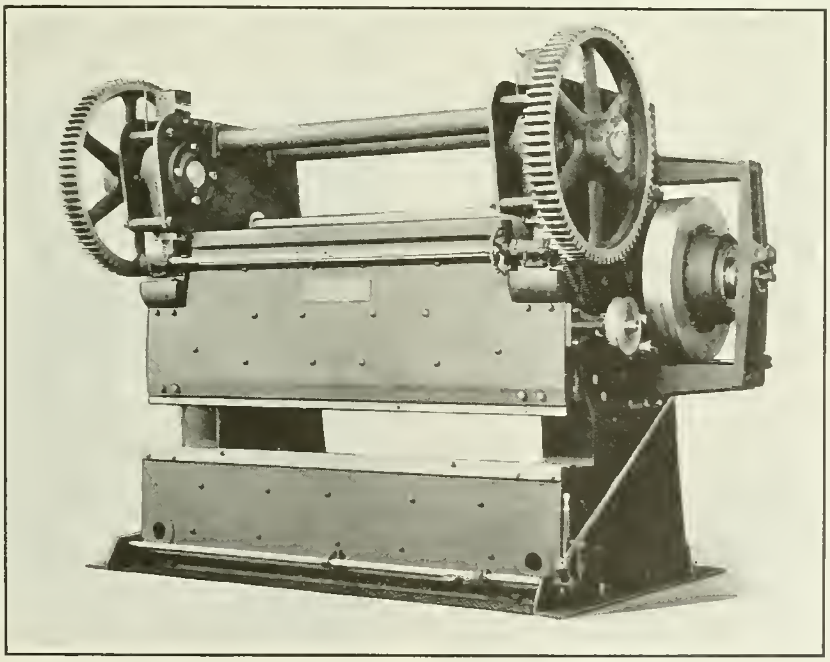
the work-head is carefully ground, and has provision for taking up wear. The small amount of power required for driving the motors makes it possible to use a lighting socket for supplying the electric current. An adjustable screw-stop may be used to control the depth of grinding. A convenient push-button is operated to lock the spindle in place when tightening the collet chuck. The intermediate gear between the work-head motor and its spindle is made of fiber to insure a smooth- and quiet-running machine. The over-all dimensions of this machine are as follows: Length, 20 inches; width, 15 inches; and height, 16 inches. The machine weighs about 110 pounds.

CINCINNATI POWER PRESS BRAKE

A power press brake for bending the edges of sheet steel and iron, which has an extensive application in the manufacture of such products as metal furniture, steel railroad cars, metal window sashes, etc., is here illustrated. This machine has recently been developed by the Cincinnati Shaper Co., Elam St. and Garrard Ave., Cincinnati, Ohio, and is made in sizes of from 6 feet 6 inches to 14 feet 6 inches between housings, for handling material from No. 10 gage to ¾ inch in thickness. The machines have capacities of from 80 to 600 tons. The frame is of all-steel construction, and as many members as possible are welded together to insure rigidity and strength. The bed and ram are constructed entirely of steel plate and bars, which are welded to each other to form what is virtually a heavy solid steel beam of box section. The housings are built from steel plates and cast-steel members, which are interlocked and welded to the plates. The cast-steel members have heavy trunnions for supporting the bed. Where bolts are used in solid members to hold the plates in place, the bolts are welded as well as the plates so that all chance of their working loose is eliminated. Parts are bolted together only when convenience of assembly requires it. The chief advantage of welding the steel plates and castings together is that maximum strength is obtained with minimum weight.

The ram extends across the entire front of the machine. It is operated by a vertical arm at each end, which is reciprocated by means of a short eccentric shaft driven through reduction gears on the outer side of the housing. Power is transmitted to the left side of the machine by a long shaft, the machine being driven at the right end through a multiple-disk friction clutch having a simple adjustment. This clutch has repeatedly picked up a full load instantly, that is, with the ram down against the work. It can be operated by a hand-lever or by depressing the foot-treadle on the splined trip-shaft extending along the front of the bed. The treadle is adjustable along the trip-shaft to suit the convenience of the operator.

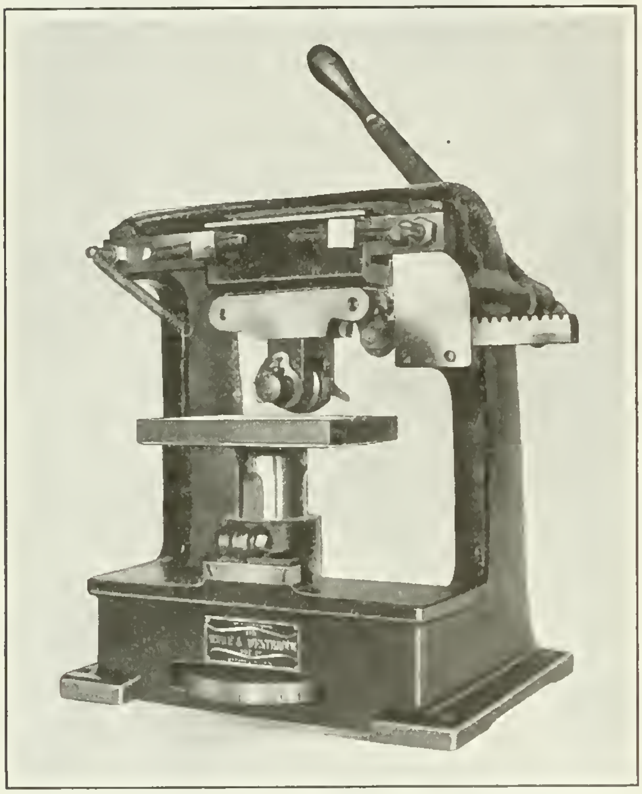
All power-driven shafts are made of high-carbon steel, and their bearings have automatic sight-feed lubrication. The eccentric shafts are forgings and the eccentrics are integral with the shafts. The ram is gibbed endwise as well as sidewise, a provision which is essential when using the machine as a gang punch. Adjustment of the ram is obtained through worm-gearing running in oil. In a motor-driven machine, the motor is mounted on a bracket attached to the right-hand housing, the driving belt being held in tension by a weighted idler pulley. Open-throat housings permit the forming of sheets of greater width than can be passed between the housings. Thus, for most classes of work, the machine may be rated with respect to the length of the die-holding surface instead of the distance between the housings. The clear space between the



Cincinnati Power Press Brake for bending the Edges of Sheet Steel housings at the rear may be readily utilized for stacking finished parts. When more than one operation is necessary on a piece, the work may be passed back and forth through the machine, thus avoiding the inconvenience of turning the work end for end. The weight of the machine ranges from 9 to 60 tons according to its size.

NOBLE & WESTBROOK MARKING MACHINE

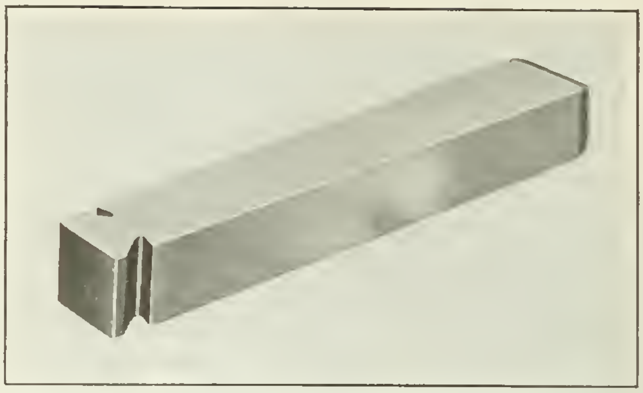
Four lines of lettering 1/16 inch high can be marked on round pieces up to 2 inches in diameter and also on flat pieces by the use of a small No. 13 bench-type marking machine, which is a recent product of the Noble & Westbrook Mfg. Co., Hartford, Conn. The marking is done by means of steel dies. On flat pieces the die rolls over the part being marked, and on round pieces, both the die and the work roll together. The design is similar to that of other marking machines manufactured by the same concern, except that the pressure is applied from the top by a cam movement operated through a rack and pinion, and not by means of the table, as in the larger models. The slide is fitted with roller bearings. The table is raised or lowered by means of a handwheel graduated in thousandths of an inch, and is locked in the desired position. Small drills, reamers, knives, chisels, and similar parts may be marked at the rate of about 700 per hour. The machine occupies a space of 10 by 12 inches, and its weight is approximately 60 pounds.



Noble & Westbrook Small-sized Marking Machine

SMITH & SERRELL SELF-FITTING KEYS

The fitting of keys in the assembly of two parts may be eliminated by using a line of "Keytite" self-fitting keys now being placed on the market by Smith & Serrell, 46 Central Ave., Newark, N. J. A key typical of the larger sizes is shown in the illustration. The body of these keys is ground several thousandths inch wider than the nominal size of the keyways, and near the front end are two cutting edges and chip recesses. The width of the key at the front end is slightly less than the nominal width of the keyways to permit this end to serve as a pilot when driving the key into place. The key is inserted in the keyways with the cutting edges on the sides, and as the key is driven into place these cutting edges shave sufficient material from the keyway of both parts being assembled to insure a tight fit. The keys are furnished in nominal widths of from 3/16 to 3½ inches. The smaller sizes have only one cutting edge.



"Keytite" Key which shaves the Sides of a Keyway to insure a Tight Fit

Keys with heads may be supplied for cases in which headless keys cannot be drifted out, or many of the larger sizes may be tapped to permit their removal by means of a bolt. Taper keys may be supplied with or without heads. On heavy-duty work in which the keys must be fitted on the top and bottom, as well as on the sides, they may be supplied with cutting edges for the four surfaces.

VICTOR COLLAPSIBLE PIPE TAPS

An improved line of receding-chaser collapsible pipe taps is being introduced to the trade by the Victor Tool Co., Inc., Madison and W. M. R. R., Waynesboro, Pa. These tools are adapted for tapping pipe threads in forged-steel flanges, fittings for ammonia and high-pressure lines, couplings, casing shoes and heads, etc. The stationary type is illustrated in Fig. 1. As in the original design described in April, 1920, MACHINERY, short chasers are used for cutting a Briggs tapered pipe thread, instead of ordinary tapered chasers. These chasers are receded radially into the holder as the tap enters the work, by means of a trip-collar set against the face of the work prior to the operation.

As the tap feeds into the hole, the collar is pushed back along the body. The collar has cam-blocks which engage a plunger at the center of the tool, and the chasers are mounted at the forward end of the plunger on tapered surfaces. Thus as the collar is pushed back it imparts a similar movement to the chaser plunger which results in

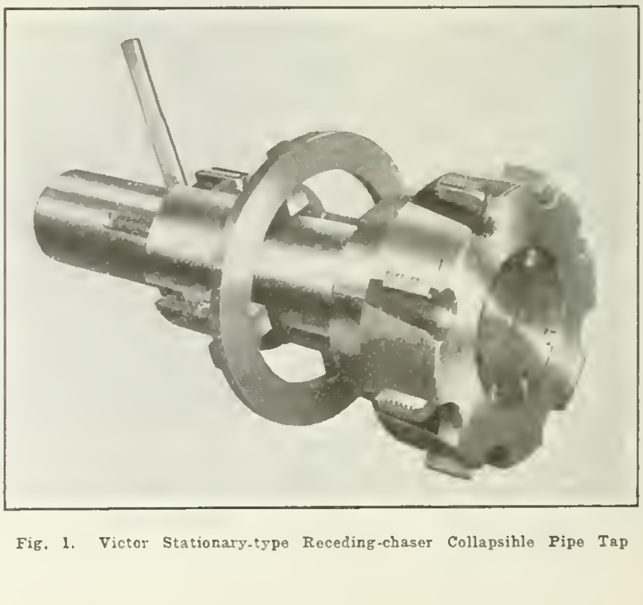


Fig. 1. Victor Stationary-type Receding-chaser Collapsible Pipe Tap

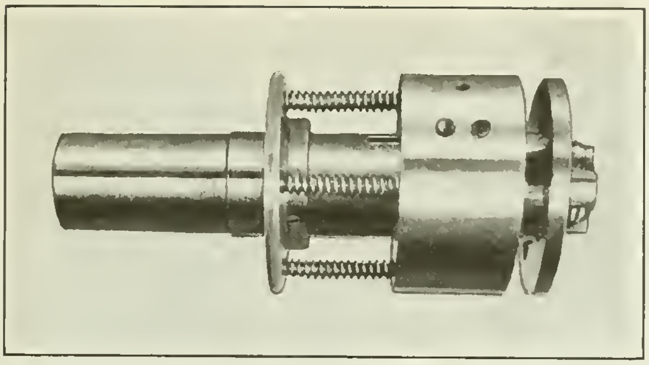


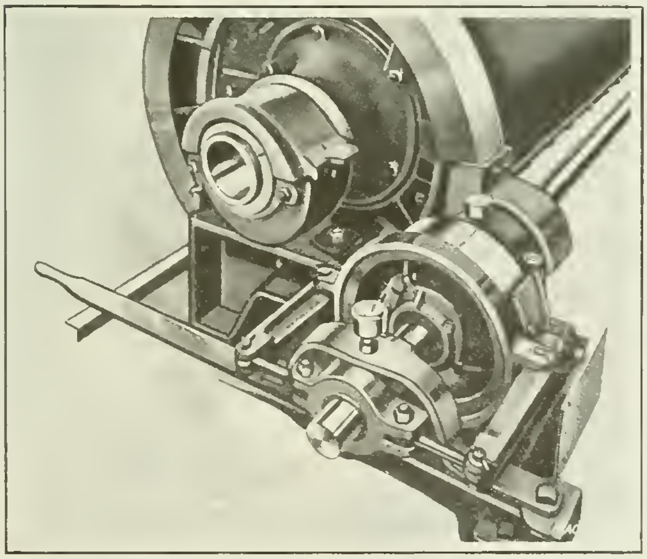
Fig. 2. Rotary Type of Pipe Tap in which the Chasers recede into the Body

the chasers receding toward the center of the tap. Formerly, there was only one cam-block, but by the addition of a second block, which works in conjunction with the first, the receding of the chasers is said to be more positively controlled and a uniform taper is insured in the thread being produced. It is possible to cut a tapered thread of any desired length. The design of the cam-blocks has also been altered to make them more efficient.

The rotary-type collapsible tap of this style, Fig. 2, has also been changed considerably. In this design, a ring or collar is employed for setting the collars and chasers in position for cutting, instead of a detachable lever. By pressing forward on this collar by hand or by having an attachment on the drilling or tapping machine come in contact with it when the machine spindle is raised, the chasers may be set without stopping the machine. There are no projections on the device, so that it conforms with all safety laws. All taps have an adjustment range of 1/16 inch either over or under size. This tap is said to require considerably less power for driving than the ordinary taper-thread tap, due to the reduced length of the chasers. These taps are made in all sizes from 1¼ to 12 inches in diameter.

COMBINATION CLUTCH AND BRAKE FOR TUMBLING BARRELS

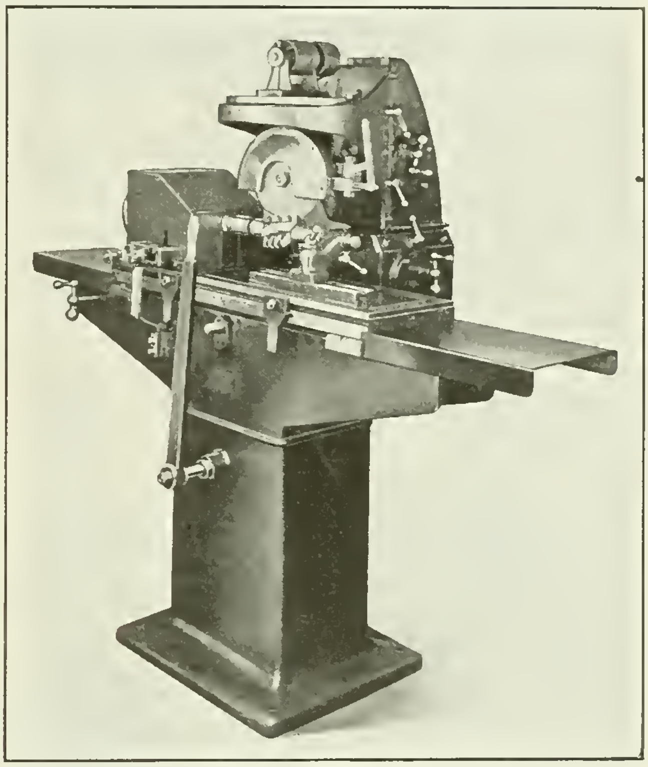
In unloading work from tumbling barrels, it is common practice to hold the barrel in the desired position by a wood prop, by inserting a bolt between gears, or by some other makeshift method. The accompanying illustration shows a combination clutch and brake by means of which the rotation of a tumbling barrel may be stopped immediately, when the operator manipulates the lever. This device also prevents the barrel, when unequally loaded from turning after having been stopped. The clutch is engaged and the barrel revolved when the controlling lever is pushed toward the barrel, and when the lever is pulled in the opposite direction the barrel is stopped. This mechanism has been placed on the market by the Whiting Corporation, Harvey, Ill.



Combination Clutch and Brake for controlling the Rotation of Tumbling Barrels

HARRIS SEMI-AUTOMATIC HOB-GRINDING MACHINE

For use in shops where the quantity of hobs and form cutters to be ground does not warrant the installation of the full-automatic hob-grinding machine built by the Harris Engineering Co., Bridgeport, Conn. (described in February MACHINERY), this concern has brought out a No. 10 semi-automatic hob-grinding machine. It will be seen from the illustration that the design of the new machine is similar in several respects to the automatic type. The hob or cutter to be sharpened is carried on an arbor provided with a taper shank that fits the work-carrying spindle, the outboard end of the arbor being supported by the center of an adjustable tailstock. The work-spindle and tailstock are mounted on a long table which is operated to and fro by means of a hand-lever on the base. The table is carried by ball-roller bearings of special design which are said to render the action so sensitive that the operator can tell from the feel of the lever if the grinding is too heavy or too fast. Stops limit the stroke of the table to suit the length of the hob.



Harris Semi-automatic Machine for grinding Hobs and Form Cutters

Hobs having helical flutes are given a rotary movement during the travel of the table by a sine bar which can be instantly adjusted to different angles. This sine bar actuates a cross-slide carrying a rack that meshes with a gear on the work-spindle. Index-plates are used to set the rows of teeth for grinding; these plates have two sets of notches, one for indexing and the other for escapement. The index-plate must have the same number of notches as there are gashes or flutes in the hob to be ground. The indexing mechanism is semi-automatic and can operate only at the end of the return stroke. At this point the operator pulls a handwheel at the left end of the machine as far toward him as it will go, and the hob is then indexed to the next flute.

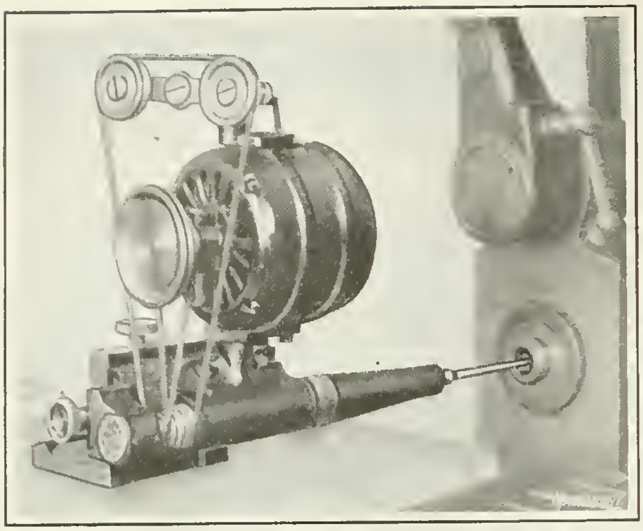


Fig. 1. Precision Thread Grinder equipped with an Extended Housing and Spindle Attachment

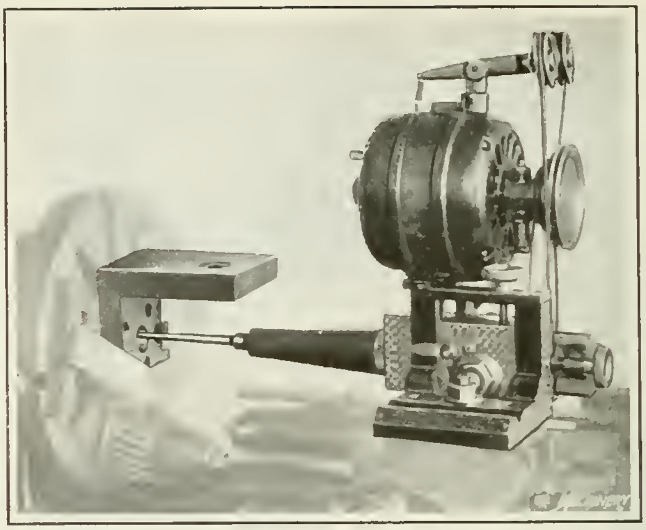


Fig. 2. Using the Extension in grinding the Hole of a Part having a Long Projection

The wheel-head is provided with all the necessary adjustments and graduations for obtaining settings and compensating for wear. A diamond truing device is built into the head, which can be used when the machine is in operation without disturbing the work. This device can be set for truing the wheel to grind the faces of the hob teeth radially or with a top rake. The hob is fed against the grinding wheel by turning a handwheel. Some of the principal specifications of this machine are as follows: Table travel, 15 inches; maximum diameter of work, 8 inches; maximum length of work, 10 inches; range of flutes in hobs, 4 to 26; size of grinding wheel, 8 inches by 1 inch; and approximate weight of machine, 1760 pounds.

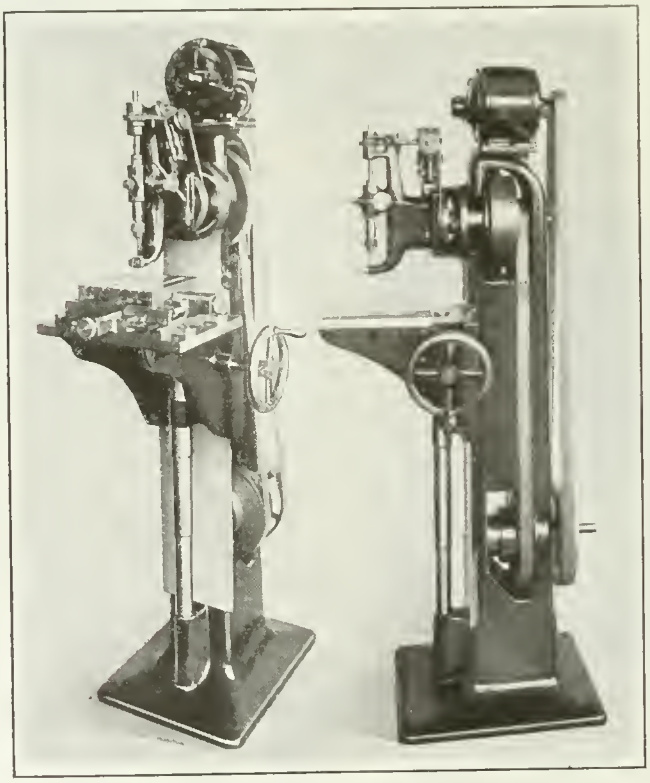
EXTENSION HOUSING AND SPINDLE FOR PRECISION THREAD GRINDERS

Multi-graduated precision thread grinders of all types manufactured by the Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., may now be equipped with an extension housing and spindle that enables internal grinding operations to be performed to a depth of 12 inches on holes 2 inches or greater in diameter and to a depth of 6 inches on holes ½ inch in diameter. The new attachment is especially applicable for grinding the tapered bore in milling machine spindles, as illustrated in Fig. 1. Concentricity of this bore promotes full service and long life of the cutters, especially in the case of unhardened spindles.

Lathe-spindle taper bores also require truing occasionally to correct errors in concentricity and alignment, and these bores may be trued by means of the attachment. Fig. 2 shows a grinder equipped with the extension housing and spindle attachment being used in a lathe for grinding a hardened part having a projection that would interfere with the operation if the grinder were not provided with the extension. The extension housing is screwed on threads at the front of the regular spindle cap of the grinder. The extension spindle is coupled to the regular spindle by means of taper joints, and is supported at the working end of the extension housing by radial and thrust ball bearings. The spindle support is of sufficient length to insure rigidity at the grinding end of the spindle.

KRAG LAYING-OUT AND DRILLING MACHINE

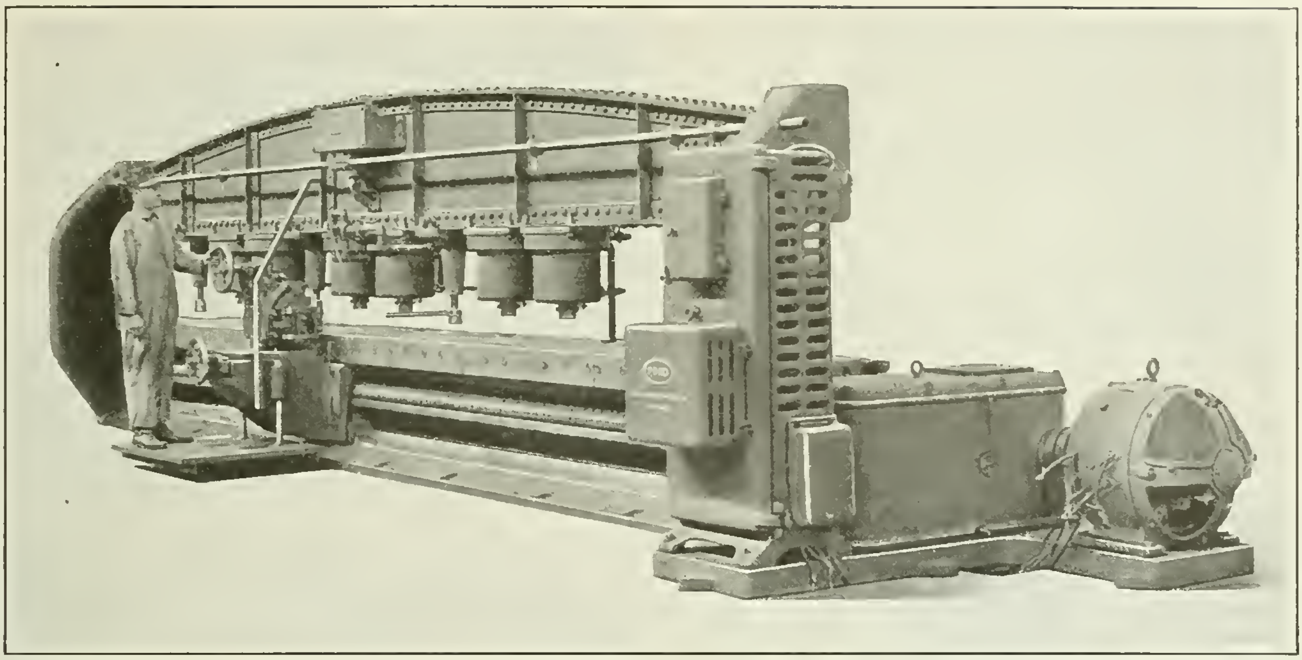
Dies, jigs, templets, master plates, and other tool-room work in which holes must be accurately laid out and drilled, can be quickly handled on the "K-N" laying-out and drilling machine here illustrated, when the machine is equipped with a Johansson compound slide, as shown at the left. This slide is used in conjunction with gage-blocks. The machine is being placed on the market by E. L. Krag & Co., 50 W. Randolph St., Chicago, Ill. It is stated that with this machine holes may be laid out and drilled in one-tenth the time required by the button method.



Krag Laying-out and Drilling Machine for Tool-room Work

The head of the machine swivels through 360 degrees, allowing locating and drilling to be done at any degree about a circle. An interchangeable drill bushing is supported in a rigid arm that is integral with the head casting. As this bushing is immediately above the work, any tendency of the drill to spring is eliminated. The machine has six changes of speed ranging from 400 to 4300 revolutions per minute, and thus furnishes the proper speed for drills up to ¼ inch in diameter.

Without the Johansson compound slide and gage-blocks, the machine becomes a precision high-speed drilling machine with a swinging head and with the drill guided immediately above the work to insure accuracy. The head is so constructed that it can also be removed from the



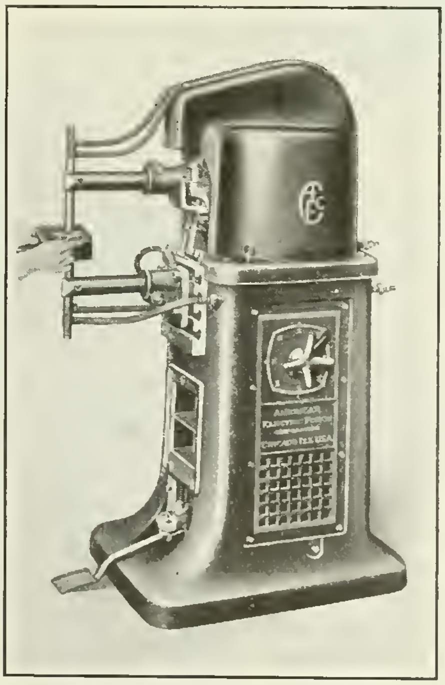
Niles-Bement-Pond Plate Planer of Improved Design

column and quickly mounted on a milling machine for laying out and drilling. As a routing and milling machine, the equipment works well with a single-lip cutter. A screw is provided for locking the spindle in a fixed position. A spring idler keeps the belt at the proper tension at all times, allowing the belt to slip if too great a pressure is exerted on the cutter and thereby saving the cutter from breaking.

NILES-BEMENT-POND PLATE PLANER

The principal improvements in a new line of plate planers now being built by the Niles-Bement-Pond Co., 111 Broadway, New York City, include a redesigned bed and tool carriage. The primary object for redesigning these members was to prevent chips from getting on the carriage screw. The tool carriage is attached to the front of the bed and guided along it by means of square ways. It is secured at the top and bottom by removable bearing supports, the bearing surfaces of which have taper gibs for taking up wear. There are two relieving tool-holder slides which may be simultaneously adjusted vertically and horizontally by turning handwheels seen at the front of the machine. Both of the tool-slides can be swiveled so as to permit the planing of bevels.

The driving screw is supported in a trough having an oil channel of sufficient depth for the oil to reach to the full depth of the thread. Roller bearings take the end thrust of the screw. The carriage is reversed automatically at any desired point by coming in contact with stops which are adjustable on a shifter-rod. The operator can start, stop, or reverse the carriage by manipulating this shifter-rod by hand. The motor is controlled by a master switch attached to the shifter-rod, and an enclosed panel with a forward, reverse, accelerating and dynamic-brake contactor. A push-button switch on the right-hand housing permits the machine to be started and stopped without manipulating the shifter-rod. The main driving gears are enclosed in a box and run in oil. The pneumatic jacks are of a two-way type in which air is admitted at the top for clamping the plate, and at the bottom for unclamping it, a feature that is considered a valuable improvement.



"A. E. F." Spot Welding Machine with Rocking Upper-electrode Holder

AMERICAN SPOT WELDING MACHINE

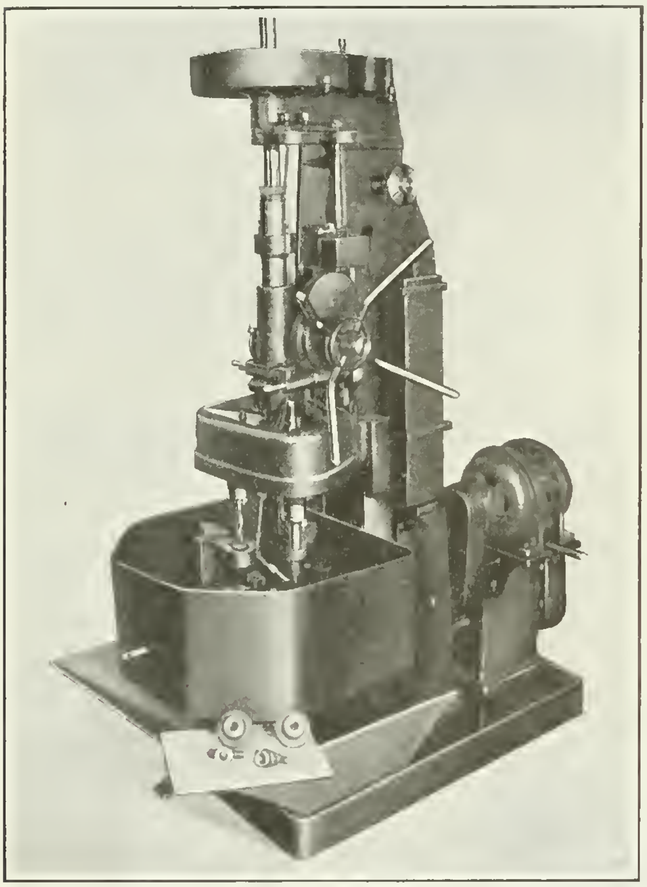
The main feature of a spot welding machine now being introduced to the trade by the American Electric Fusion Corporation, 972-982 Montana St., Chicago, Ill., is the mounting of the upper electrode at the end of a rocking arm which is lowered on the work by depressing a foot-treadle. This arm is mounted on bronze-bushed trunnions which are lubricated by the Alemite pressure-lubricator system. The arm is balanced by a counterweight to lessen the exertion of the operator. An automatic switch closes when the electrodes grip the work and opens before pressure on the foot-treadle is released. An adjustable compression spring device permits regulation of the grip on the work and the pressure at the weld. The electrodes consist of die-formed one-piece copper parts.

The electrical contact is entirely independent of the mechanical grip, and positive contact is assured at all times. The lower horn is water-cooled and of a design which allows the use of a short electrode. All moving members and high-voltage electrical parts are completely enclosed to insure safety. The square faceplate on the front of the machine has T-slots in it to permit the mounting of jigs and special fixtures. A heat regulator furnishes eight different speeds of welding to suit all thicknesses of metal within the capacity of the machine. The automatic switch and connections are accessible through a door at the rear of the column, and other interior parts through a panel on each side of the column. The length of the treadle-rod may be increased to suit the convenience of the operator.

ROCKFORD DRILLING MACHINE WITH ROTARY TABLE

A four-station rotary table and a three-spindle head are shown in the accompanying illustration applied to the 20-inch box-column drilling machine built by the Rockford Drilling Machine Co., Rockford, Ill. This arrangement adapts the machine for performing economically three successive operations on parts. The particular set-up illustrated is employed for machining the yoke and flange members of a universal joint. The successive steps are as follows: Rough-drill; rough-taper-ream and face; and finish-taper-ream. The rough-drilled hole is 3/4 inch in diameter and 2 5/8 inches long. The production per ten-hour day is 250 pieces.

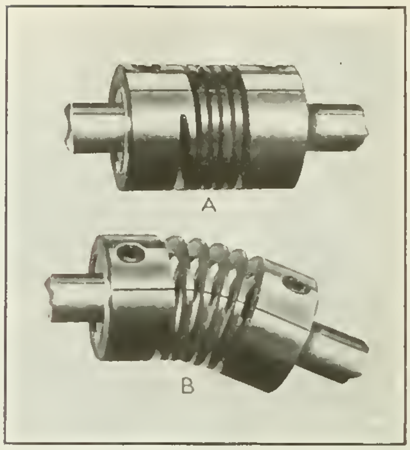
The rotary table is mounted on the regular table of the machine, and indexed by hand after a locating plunger has been withdrawn. Four chucks are mounted on the rotary table and each of these is supplied with two jaws formed to suit the work. During each downward feed of the drill head the finished work in the idle chuck at the front of the machine is replaced by an unfinished part. By means of an extended wrench the chuck screws may be tightened from outside of the chip guard. The drill head is gibbed to the table ways. It is driven and fed by the machine spindle and is counterweighted. A micrometer stop on the spindle quill provides for drilling to a predetermined depth. This machine is regularly rated as having sufficient capacity for drilling a 2-inch hole through solid steel.



Rockford Drilling Machine arranged with Rotary Table and Three-spindle Drill Head

STEEL-FLEX CUT-SPRING COUPLING

A flexible cut-spring coupling made from steel tubing having qualities of toughness and elasticity which adapt it for the transmission of power is now being manufactured by the Steel-Flex Coupling Corporation, 1712 First National Bank Bldg., Detroit, Mich. The coupling is intended for shafts up to 1 inch in diameter which are slightly out of line, or for use where it is desired that the coupling act as a shock absorber against sudden starts. It is particularly suitable for use in directly connecting light-duty motors to such equipment as small drilling machines, blowers, pumps, washing machines, refrigerating outfits, etc.



Steel-flex Cut-spring Coupling

At *B* in the accompanying illustration, the coupling is shown operating at a considerable angle. It may also be used for installations in which the shafts are parallel but have a lateral offset. The same company also manufactures a standard line of coil-spring flexible couplings for shafts from 1 to 12 inches in diameter. The driving coils of these couplings are made from rectangular chrome-vanadium steel bars, tempered to have a high elasticity. The coils are mounted within one another on machine-steel plugs and have steel headers shrunk on the ends to bind them into a flexible unit. Flanges are attached by means of safety cap-screws.

NEWTON FOUR-SPINDLE MILLING MACHINE

A four-spindle knee-type milling machine for simultaneously facing and slotting the crankpin end of automobile connecting-rods has been developed by the Newton Machine Tool Plant of the Consolidated Machine Tool Corporation of America, 23rd and Vine Sts., Philadelphia, Pa. A general view of the machine is shown in Fig. 1, and a close-up view of the work-holding fixtures and the cutters in Fig. 2. It will be seen that six rods are held in a fixture at a time, the three front fixtures being loaded and unloaded, while the parts in the fixtures next to the cutters are being operated on. When the operation has been completed, the

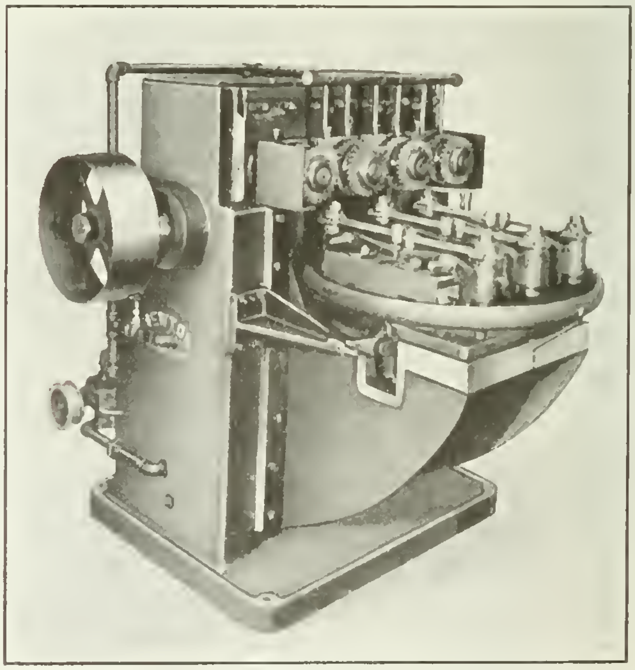


Fig. 1. Newton Four-spindle Milling Machine for facing and slotting Connecting-rod Ends

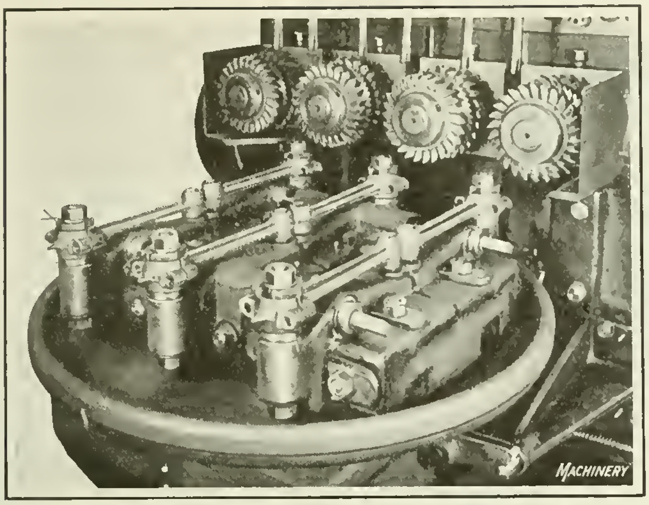


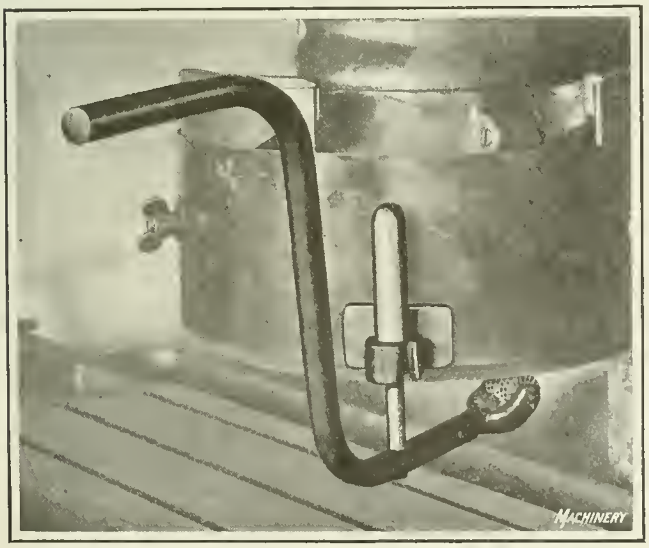
Fig. 2. Close-up View of the Work-holding Fixtures and the Facing and Slotting Cutters

table is indexed to bring the new parts into alignment with the cutters and permit completed rods to be replaced. No time is lost between cuts except the small amount required for indexing the table. Each fixture has an individual adjustment to permit a variation in the distance between rods.

The four spindles have a taper-end construction, are mounted in substantial housings, and have individual adjustments. The adjustments allow an ample variation between the spindle centers to permit the grinding of the milling cutters. The work is fed to the cutters by imparting a vertical feed to the table through change-gears, a worm, a large diameter worm-wheel and a cam. The cam gives a quick upward movement to the knee, a slow feed during the cut, and a quick downward movement. The feed is automatically stopped to allow the table to be indexed, after which the feed is reengaged by means of a hand-lever conveniently located on the right-hand side of the machine. The power is transmitted directly from the driving shaft to the spindles by worm-gearing. The machine is geared to give one cycle of feed in 0.78 minute and to index in two seconds. The production with this gearing is about 225 rods per hour, or, considering the machine efficiency to be 90 per cent, 1620 rods per eight-hour day.

PRATT & WHITNEY GRINDING-WHEEL DRESSER

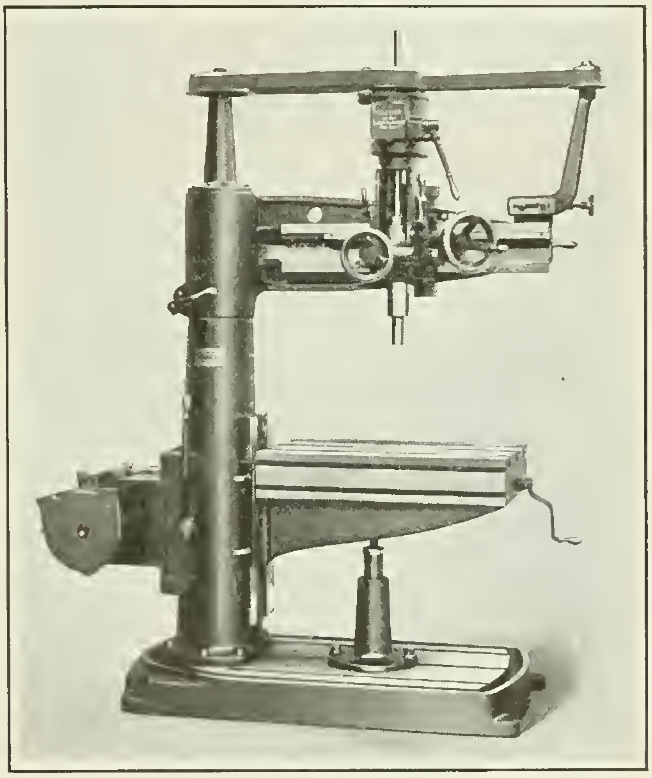
A grinding-wheel dresser of a type commonly employed in hand dressing, but which is mounted on the machine to insure the safety of the operator while dressing a wheel, is shown in the accompanying illustration. This device has been brought out by the Pratt & Whitney Co., Hartford, Conn., for application to the vertical surface grinding machines of its manufacture. It consists of a bracket that is bolted or riveted to the wheel guard to support the stem of the dresser. The dressing wheels are held in the yoked end of a bar, which is bent to fit under the wheel. The other end of the bar is bent to form a handle, by means of which the dresser can be easily moved across the face of the wheel. It is not necessary to make any change in the relation of the work and the grinding wheel when it is desired to dress the wheel, and for this reason the device is quick-acting.



Wheel Dresser for Pratt & Whitney Vertical Surface Grinders

FOSDICK HIGH-SPEED SENSITIVE RADIAL DRILLING MACHINE

The radial drilling and tapping machine shown in the accompanying illustration has recently been developed by the Fosdick Machine Tool Co., Cincinnati, Ohio. The machine is intended for drilling and tapping work that is too large for a high-speed sensitive upright drilling machine but that requires the drilling and tapping of small holes at a much greater speed than can be obtained in a heavy-duty radial drilling machine. The rapidity with which the drill can be placed in position in the radial type of machine minimizes the time "between holes," while the high speed reduces the actual drilling time. The machine is built with either a 3- or 3½-foot arm. The dimensions mentioned in the following are for the 3-foot size, the weight of which is 2650 pounds.



Fosdick High-speed Sensitive Radial Drilling Machine

The spindle of the machine, like all other revolving members, is equipped with ball bearings. It is provided with a No. 2 Morse taper. Its vertical traverse is 8 inches, and the horizontal movement along the arm 28½ inches, the latter being actuated through a rack and spiral gear by means of a handwheel at the right. The position of the handwheel enables the operator to swing the arm and move the head simultaneously with the right hand, while the left hand is free to raise and lower the spindle, and clamp the arm. The latter may be swung completely around the column. It is supported on both annular and thrust ball bearings on the column, which extends through to the top. The sensitive feed and quick return are operated by the lever at the right, or by the handwheel at the left.

The machine is provided with friction back-gears; this is a new feature for a machine of this type, and permits instantaneous shifting from high drilling speeds to slow speeds for tapping or for the drilling of larger holes, the ratio being 4½ to 1. The tapping attachment frictions, like those of the back-gears, are easily adjustable with an ordinary screwdriver. The drive is through tight and loose pulleys on the machine, giving both a high and a low speed, forward and reverse. The pulley guard and belt-shifter are adjustable to suit the belt at any angle. Another feature is the full contact of the belt, which maintains a uniform tension regardless of the position of the head.

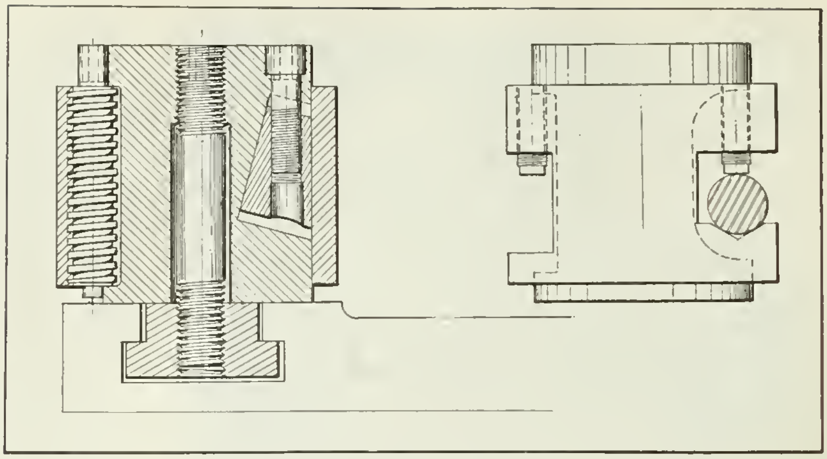


Fig. 2. Cross-sectional and End Views of Toolpost, showing Adaptability for Both Round and Square Shanks

The table is readily removed, allowing a space of 49½ inches between the spindle and the base. The base has a working surface of 28 by 36 inches, and is planed and provided with T-slots. The table can be moved vertically a distance of 16 inches, through a telescopic screw supported by ball bearings. The working surface of the table is 20 by 33 inches, and its maximum distance from the spindle 31 inches. Separate box or universal tables can be furnished for use in place of the regular elevating rectangular table. When the machines are motor-driven, they require a one-horsepower motor, of either the constant or variable-speed type, as desired.

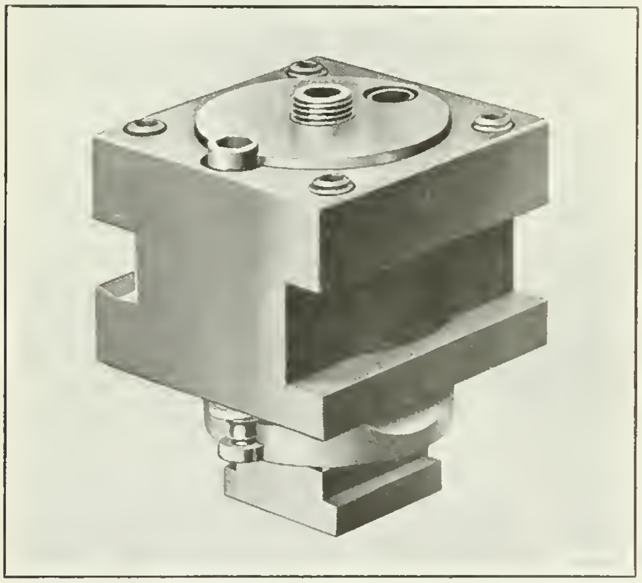


Fig. 1. Skelton Toolpost for facilitating the Raising and Lowering of Lathe Tools

SKELTON ELEVATING TOOLPOST

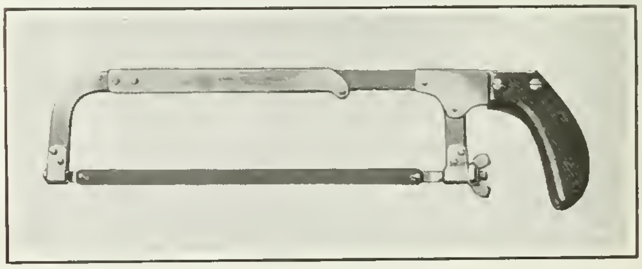
Elevating or lowering a boring-bar or other tool in a lathe without disturbing its setting otherwise can be accomplished by employing the elevating toolpost here illustrated, which is a recent product of Charles E. Skelton, 4025 S. Salina St., Syracuse, N. Y. This toolpost has a cylindrical part which is clamped to the cross-slide of the lathe by means of a stud having right-hand threads at both ends. The threads of the upper end, which engage the threads of a tapped hole in the cylindrical part, as shown in the sectional view of the toolpost, Fig. 2, are of a pitch slightly smaller than the threads of the lower end of the stud, which enters the tapped hole of the clamping plate. As both threads are right-hand, a sufficient clamping effect is obtained without using fine-pitch threads, and the required pressure can be applied with a light wrench.

A block having a recess on two sides for carrying tools, slides vertically on the fixed cylindrical part. The recess on one side is somewhat deeper than that on the opposite side, and has a V-groove for holding round-shank tools. The second recess is intended for receiving rectangular and square shanks. Raising or lowering of the tool-carrier is accomplished through an Acme-thread screw which has top and bottom bearings in the fixed cylindrical part, while its threads engage the threads of a hole at the front of the tool-carrier. When a tool has been set to the desired level, the carrier is clamped in position by means of a wedge at the back of the carrier which can be raised or lowered by turning a screw.

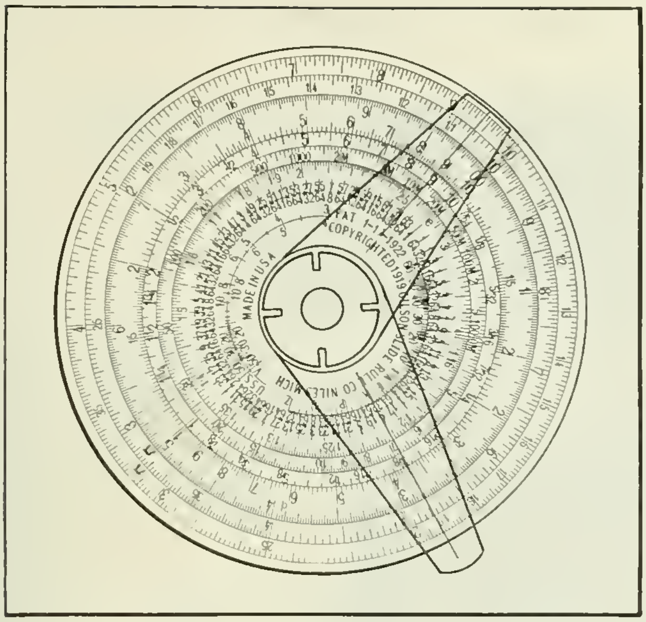
The toolpost is supplied with hollow-head screws so that nothing will project above the top to interfere with the operator's view during a boring operation. However, square-head set-screws may also be provided. All parts are made either from nickel steel and heat-treated or from carbon steel and pack-hardened. The tool-carrier will accommodate boring-bars with a 1-inch diameter shank or under, and lathe tools with shanks up to 1¼ by ⅝ inch.

CONSOLIDATED HACKSAW FRAME

An "Easy-Grip" hacksaw frame which accommodates blades from 8 to 12 inches in length has been recently placed on the market by the Consolidated Tool Works, Inc., 296 Broadway, New York City. The hard-wood handle is designed to obviate cramping of the hand and to afford an easy stroke. The blade is tightened by means of a wing-nut located at the handle end of the frame. The blades can be faced in four directions by simply changing the position of the square-section stretcher piece to which each end of the blade is attached. The notches in the under side of the adjustable part of the frame are spaced ½ inch apart, so that the frame can accommodate blades which are not of standard length.



No. 40 Consolidated "Easy-grip" Hacksaw Frame



"Midget" Circular Slide-rule which has Additional Scales to those on Ordinary Slide-rules

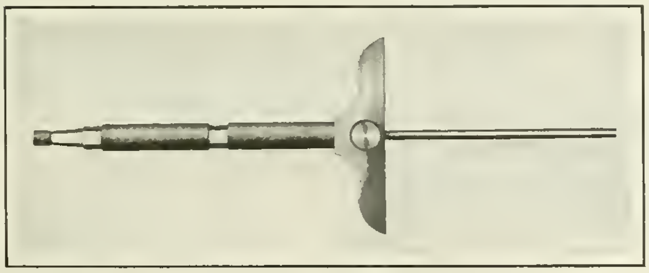
GILSON CIRCULAR CALCULATOR

A circular celluloid calculator or slide-rule which has all the scales of the ordinary slide-rule, and in addition other scales useful in many drafting-room and shop calculations, is being manufactured by the Gilson Slide Rule Co., Niles, Mich. The illustration shows that there are two transparent celluloid indicators on the face of the instrument which have hair lines for close reading. The longer indicator always gives the answer to the problem being solved. One of the interesting features is a binary scale which is divided into eighths, sixteenths, and thirty-seconds of an inch, etc. This scale makes it possible to multiply and divide fractions and mixed numbers without changing the fractions to decimals, and to read the answer as a decimal or a fraction.

Another scale permits the addition and subtraction of decimals or fractions. Also, fractions and decimals may be added or subtracted from each other and the result read as a decimal or as a fraction. Other scales give the diameter of drills from No. 1 to 60 in decimals and fractions, and the diameter of drill to use for any sized tap having from three to fifty threads per inch. The latter scale also gives the root diameter of bolts with U. S. standard or V-threads. The "Log-log" scale is a spiral, and with it any root or power can be determined, usually with but one set of the indicators. An inverted C-scale permits handling three factors at one setting, while with the A-scale square roots and corresponding powers can be obtained without the use of the "Log-log" scale. On the reverse side are graduations which give the sine, cosine, tangent, and cotangent of all angles. Another scale gives six-place decimal equivalents of fractions. This calculator is 4 inches in diameter.

STARRETT SPRING DEPTH GAGE

A new device known as a No. 48 spring depth gage, which is particularly adapted for taking quick measurements, has been brought out by the L. S. Starrett Co., Athol, Mass. A spring in the barrel automatically forces the rod downward until it is locked in position by the clamping screw shown. The gage has an especially long base—2½ inches. The base is 0.4 inch thick, and the rod is ⅛ inch in diameter. Both the base and the contact point of the rod are hardened and ground. The contact end of the rod is ground square instead of convex, to make it easier to measure from the flat surface to a very narrow shoulder. The gage is especially useful for measuring the depth of drilled holes. Its capacity is 3 inches.

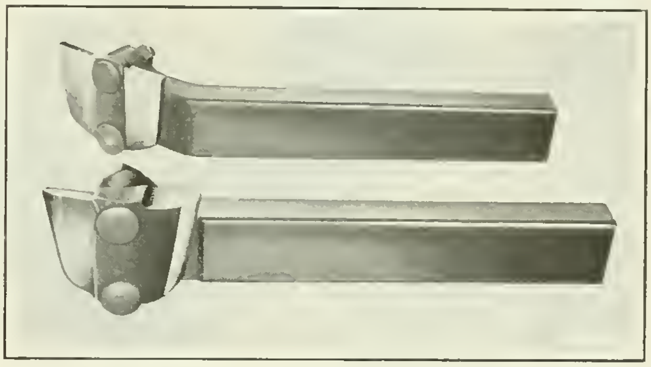


Starrett No. 48 Spring Depth Gage

MORRIS TOOL-HOLDERS AND INTERCHANGEABLE CUTTERS

A line of patented tool-holders and interchangeable cutters for taking unusually heavy cuts in lathes, planers, shapers, boring mills, and slotters is being introduced on the market by the Morris Tool Co., 30 Church St., New York City. As shown in the accompanying illustration, each tool consists of a chrome-nickel steel holder to which a heat-treated high-speed steel cutter or blade having two cutting edges is attached by means of heat-treated tool-steel bolts. The holder is made with straight and offset shanks and, as either of the two narrow sides may be used as its base, one offset shank provides for both right- and left-hand positions of the cutter.

The cutter may be clamped on either side of the holder and reversed from front to back on both sides to permit the two cutting edges to be used. A unique feature of the device is the provision for raising the plane of a cutting edge relative to the axis of the holder as the cutting edges are ground away. The bolt holes are offset and so, by removing the cutter, reversing the holder relative to it, and reclamping the cutter, the cutting edges are raised. This provision permits the cutter blades to be used until ground to within ½ inch of the base line.

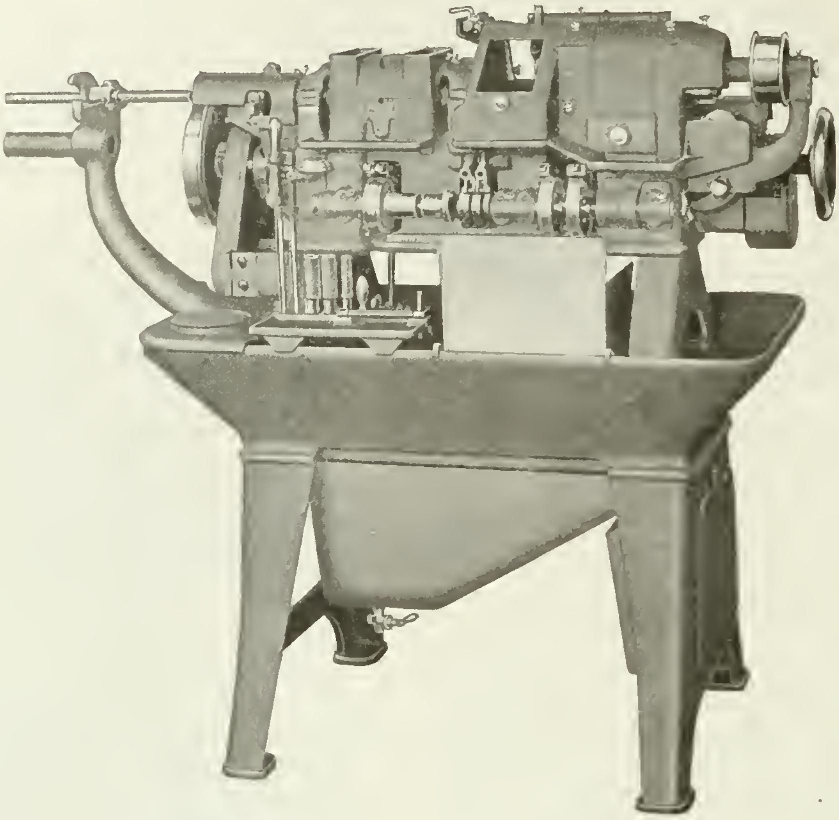


Morris Straight and Offset Tool-holders with High-speed Steel Cutter Blades

It is claimed that these tools are as strong and rigid as forged tools. In boring nickel-steel flasks, a cut 7/16 inch deep with a ⅛-inch feed was taken at the rate of 35 feet per minute. The bore was 20 inches in diameter and 76 inches long. Three of these flasks were machined without grinding of the cutter edge being necessary. The tools are made in twelve sizes, the smallest of which is intended for use on bench lathes.

GLUE POT WITH AUTOMATIC HEAT CONTROL

Glue is one of the important factors in the successful operation of polishing rooms and pattern shops. The experimental stations of the United States Government have established that glue possesses its greatest holding qualities at temperatures of from 140 to 150 degrees F. When heated to 175 degrees F. or more, it loses its tensile strength, and if cooled below 105 degrees, there is a decided loss in its holding qualities. Hence, thermostatic heat control has been recommended for glue pots. With the aim in view of



BROWN & SHARPE
No. 19 AUTOMATIC SCREW MACHINE

A High-Speed Machine for Brass and Similar Work

This machine is designed primarily for work on brass. It accurately and automatically turns pieces from the bar at an extremely rapid rate.

The work spindle runs in one direction only, at either of two instantly available speeds. The turret consists of a drum revolving horizontally on an axis parallel to that of the work with sliding spindles for advancing and withdrawing the tools.

On account of its high speed the spindle is constantly lubricated and cooled by a large flow of oil which is forced to the bearings by a pump. To eliminate the effects of belt pull from the spindle the two driving pulleys are not mounted directly on the spindle, but are supported on roller bearings carried in extensions of the spindle housings.

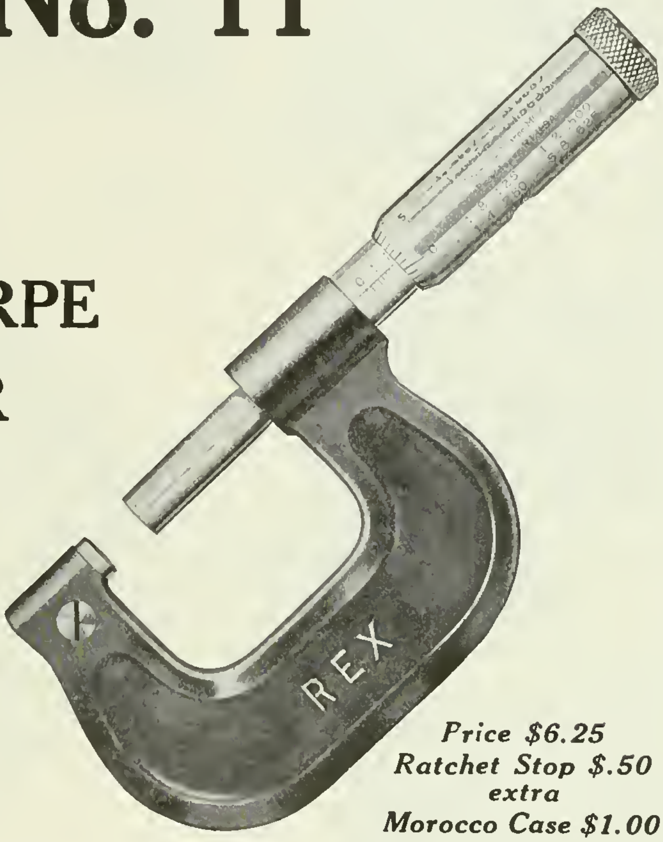
Such construction insures the accuracy essential for satisfactory automatic production at high speed. Manufacturers of brass radio parts and similar work should investigate the production possibilities of this speedy, accurate machine. Send for Specification Sheet describing this machine in detail.

BROWN & SHARPE MACHINISTS' TOOLS

REX—No. 11

A ONE INCH BROWN & SHARPE MICROMETER

At a low price



Price $6.25
Ratchet Stop $.50 extra
Morocco Case $1.00

This accurate, inexpensive measuring tool is admirably suited to the needs of screw machine operators. Its frame of I-section, combining strength with lightness, has a rectangular shape which gives larger measuring capacity than a frame of circular shape.

The screw machine operator will find constant use for this tool both in setting up work and in testing for accuracy during production. In the tool crib this micrometer will settle arguments about the size of bits, reamers, counterbores, etc. Encourage your men to use Rex Micrometers. More uniform accuracy of production will be the result.

There is a complete Rex line of micrometers in 24 sizes, covering a range from 0 to 24 in. These high grade measuring tools make available at a low price the Brown & Sharpe accuracy you have always known. Rex Micrometers will meet every measuring requirement of the busy shop. Write for our circular describing the complete Rex line.

Rex Micrometers are Brown & Sharpe Tools

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

meeting the needs of the industry for a glue pot, the heat of which can be fully controlled—that is, that will be fully automatic and require no personal attention—J. D. Wallace & Co., 1421 W. Jackson Blvd., Chicago, Ill., have brought out an electrically heated glue pot, which operates from any electric lighting circuit and is put in operation by merely turning the switch. As it is provided with an automatic heat control, it cannot become overheated, requires no attention from the workmen, and keeps the glue at the right temperature for maximum strength and viscosity. Thus spoiled work due to overheated or underheated glue is prevented.

NEW MACHINERY AND TOOLS NOTES

Pillar Punch Press: George W. Dover, Inc., 1012 Eddy St., Providence, R. I. A small pillar punch press developed primarily for work on radiator cells, although it is also adapted for any sheet-metal work within its capacity. The press is equipped with a roll feed. The ram has a stroke of 1¼ inches and a vertical adjustment of 2 inches. The maximum distance from the ram to the bed is 5 inches.

De Bats Metal No. 4: De Bats Sales, Inc., 60 South St., Boston, Mass. A non-ferrous alloy of the tungsten-chromium-cobalt class, for which remarkable claims are made in the way of speed and endurance in cutting cast iron and alloy steels. It is produced by melting in electric furnaces and casting in steel molds to the form of tool bits, inserted teeth for milling cutters, twist drills, reamers, etc. Standard sizes of tool bits are made for use with Armstrong holders. For more severe duty, blocks of the metal are welded to carbon-steel shanks.

Metal-parts Washing Machine: Crescent Washing Machine Co., New Rochelle, N. Y. A machine for washing metal parts produced in quantities of 50,000 to 100,000 per day, which is arranged for both washing and rinsing the parts as well as for drying them, when the latter is required. The machine is suitable for use in the manufacture of automobile parts, cleaning objects up to 24 inches in height, 40 inches in width, and 16 feet in length. Small objects, such as stampings and screw machine products, are placed in racks made of wire mesh to feed them through the machine. The work is first introduced into a chamber having four sets of revolving washing units which spray water on the work, and then through the rinsing chamber which has two units.

Multi-angle Sine Plate: Carling Tool & Machine Co., 302 Asylum St., Hartford, Conn. A sine plate which provides an easy means of setting work to a compound angle. Angles up to 46 degrees can be set by the use of size blocks. The pivot shafts of the device are located at exactly 90 degrees with each other and permit inclination of the table in forward and sidewise directions. The edges, table top, and base seat are accurately aligned with the pivot shafts to permit quick set-up on the table of a grinding machine. The size blocks used in setting the device to an angle are placed on the proper gaging point, after which the corresponding pivot shaft is locked. The binding action is against the size blocks and supporting walls, so that the setting is not disturbed in clamping.

* * *

DETERMINING THE DIAMETER AT THE END OF A TAPERED ROD

In September MACHINERY, page 57, a comment appeared on the article "Determining the Diameter at the End of a Tapered Rod," which was published in July MACHINERY, page 910. The formula for determining M as given in July is correct, while that published in September is incorrect. In the latter solution, the equation for N should be

$$N = T \tan a = [r - (r \tan a) \cos a] \tan a.$$

* * *

When the *St. Louis*, one of the American Line steamers, sails from New York next January, it will carry exhibits of 300 American manufactures to the West Indies, South America, Africa, Australia, Japan, China, India, Turkey, Greece, Italy, France, Spain, Portugal, Belgium, Holland, Germany, Sweden, Norway, and the United Kingdom. The purpose is to familiarize foreign markets with American-made products.

PERSONALS

H. J. Swanson has been appointed general sales manager of the Peerless Machine Co., 1611 Racine St., Racine, Wis., manufacturer of high-speed metal saws.

W. C. Allen, who has been in charge of the Chicago branch of the Black & Decker Mfg. Co., Baltimore, Md., for the past year, has been appointed sales supervisor.

George Scherr, dealer in machine tools, 126 A Liberty St., New York City, is at present in Europe on an extended business trip. He will visit Italy, Austria and Germany. His address while in Europe will be care of Schuchardt & Schutte, 29 Spandauer St., Berlin, Germany.

A. W. Robbins, for several years connected with the Standard Roller Bearing Co., and the Bearings Service Co., is now with the Bearings Co. of America, Lancaster, Pa. Mr. Robbins will have headquarters at the Detroit office of the company located at 1012 Ford Bldg., Detroit, Mich.

R. S. Mitten has been appointed branch manager for the Chicago territory of the Black & Decker Mfg. Co., Baltimore, Md. Mr. Mitten was formerly sales manager of the Electric Appliance Co., of Chicago. The territory which is to be in Mr. Mitten's charge consists of the states of Illinois, Iowa, Wisconsin, Minnesota, North Dakota, the eastern half of Missouri, including St. Louis, a small corner of Indiana, taking in South Bend, and the western end of the state of Michigan.

Robert C. Yates, for many years connected with the Union Drop Forge Co., Chicago, Ill., has left that company to become general manager of the Interstate Drop Forge Co. of Milwaukee, Wis., which was organized in 1919 for the manufacture of small commercial forgings, and which is closely allied with the Chain Belt Co., the Sivyer Steel Casting Co., and the Federal Malleable Co., all of Milwaukee. Mr. Yates, after graduating from Union College, Schenectady, N. Y., was connected with the American Locomotive Co. and later with the Bethlehem Steel Co. He was manager of the Chicago district office of the Bethlehem Steel Co. prior to his connection with the Union Drop Forge Co.

* * *

STEEL TREATING AND DROP-FORGING CONVENTIONS

The Drop Forge Supply Association has made arrangements for holding a meeting of its members in Detroit at the same time as the American Society for Steel Treating and the American Drop Forging Institute will hold their conventions, October 2 to 7. The meeting of the Drop Forge Supply Association will be held October 3, at 12:30, in the General Motors Building.

The Committee on Steel of the American Society for Testing Materials will also meet in Detroit in connection with the International Steel Exposition and the conventions of the two societies mentioned. This committee will meet on October 5 and 6 at Hotel Statler, meetings being held during the first day at 10:00 A. M. and 2:00 P. M., and on the second day at 10:00 A. M.

One of the most interesting events in connection with the exposition and the convention of the American Society for Steel Treating will be the unveiling of a bronze tablet dedicated to the memory of those pioneers in the steel industry who in 1864, at Wyandotte, Mich., erected the first Bessemer steel converter used commercially for the manufacture of Bessemer steel in America. This tablet is to be erected by the Detroit chapter of the American Society for Steel Treating. The site of the Wyandotte Iron Works where the first tilting Bessemer steel converter was erected is the present location of the Wyandotte public library, and the tablet will be placed in the front of this building. The unveiling exercises will be held on Thursday afternoon, October 5.

* * *

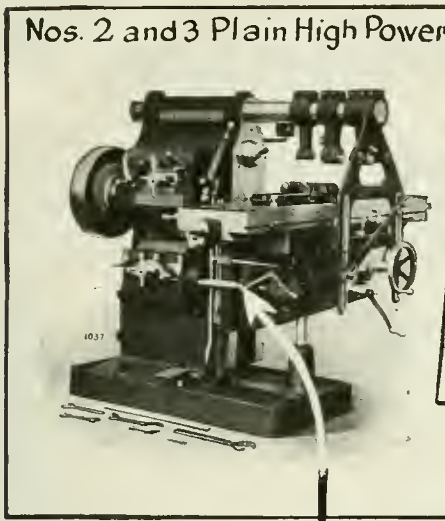
FITCHBURG INDUSTRIAL EXPOSITION

The diversified industries of Fitchburg, Mass., were exhibited at a manufacturers' and merchants' exposition held in the State Armory on September 18 to 22. Among the exhibitors in the metal-working field were the following: Fitchburg Machine Co., Putnam Machine Co., Simonds Mfg. Co., Universal Grinding Machine Co., and Fitchburg Grinding Machine Co.

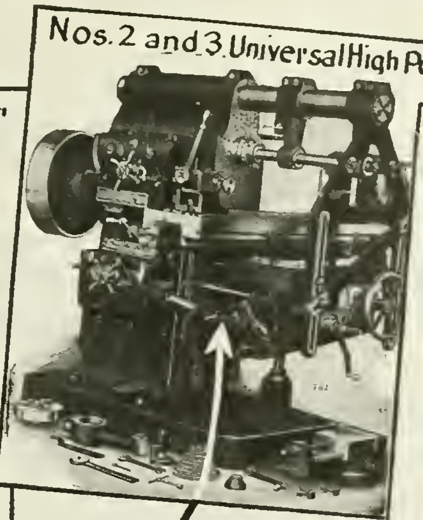
* * *

The index to the twenty-eighth volume of MACHINERY (September, 1921 to August 1922, inclusive) is ready for distribution. Copies will be sent upon request.

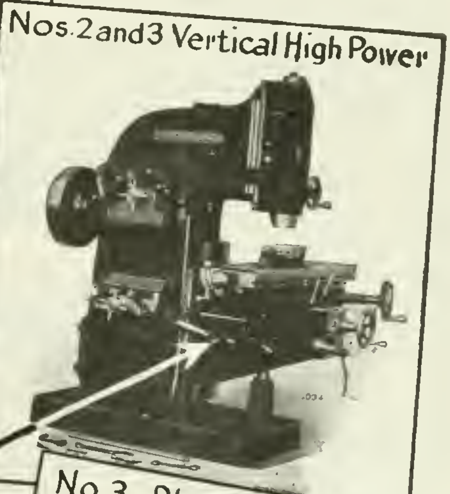
Nos. 2 and 3 Plain High Power



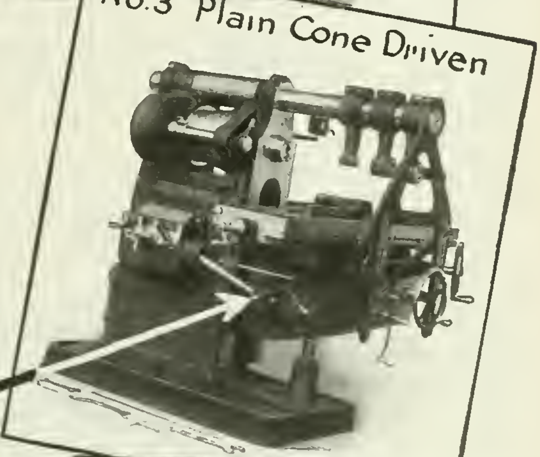
Nos. 2 and 3 Universal High Power



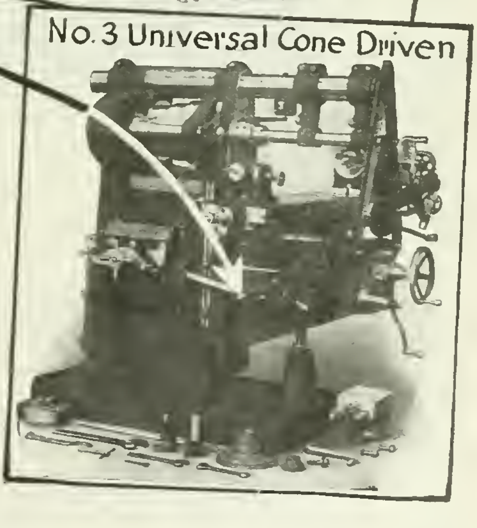
Nos. 2 and 3 Vertical High Power



No. 3 Plain Cone Driven



No. 3 Universal Cone Driven



They all have the Cincinnati double control feed lever

ALL Cincinnati Millers of the Nos. 2 and 3 High Power type as well as the Cone Driven machines in this design are equipped with this additional feed operating lever at the side of the knee.

Whether the operator stands in the usual position in front of the machine, or behind the table as the nature of the work sometimes requires, he still has instant control over feeds.

This is only one of their many features providing unusual convenience of control.

Cincinnati reputation is founded largely upon the performance of these machines. Their great power, with convenience of control, has made them famous. We are ready with the full details.

The Cincinnati Milling Machine Co., Cincinnati, O.

TRADE NOTES

Morse Chain Co., Ithaca, N. Y., manufacturer of chain drives, has removed its Philadelphia office into larger quarters. The present address is Room 612, Franklin Trust Bldg., 18-22 S. 15th St.

Illinois Tool Works, 154 E. Erie St., Chicago, Ill., manufacturers and designers of cutters, hobs, and reamers, have appointed the Commercial Steel & Supply Co., Plymouth Bldg., Cleveland, Ohio, as their representative in the Cleveland district.

Chas. Eisler, mechanical engineer, Newark, N. J., has moved his factory and offices from 15 Kirk Alley to 756 S. 13th St., where he will occupy a well equipped factory of 6000 square feet floor space in a modern brick building recently erected at a cost of $30,000.

Landis Tool Co., Waynesboro, Pa., manufacturer of cylindrical grinding machines, announces that, owing to increased cost of production it has been found necessary to advance the prices 10 per cent on all machines and machine parts. These prices became effective August 15.

White Co. and White Motor Co., Cleveland, Ohio, have removed their general offices from 6611 Euclid Ave. to the administration building, at the factory, St. Clair Ave. and E. 79th St., Cleveland. The Cleveland branch of the White Co. retains its present location at 407 Rockwell Ave.

Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago, Ill., has opened a new district sales office at 305 Merchants Bank Bldg., Indianapolis, Ind., for handling furnace sales and Stewart engineering service in southern Indiana, southern Ohio, and western West Virginia. F. W. Odemar is in charge of the office.

Atlantic Elevator Co. and the Albro-Clem Elevator Co. have consolidated. The new company will continue its business under the name of the Atlantic Elevator Co., Erie Ave. and D St., Philadelphia, succeeding to all liabilities and assets and all contracts entered into by the former companies.

Gould & Eberhardt, Newark, N. J., manufacturers of shapers and gear- and rack-cutting machinery, announce that the price of the shapers manufactured by the company has been increased on an average of from 15 to 20 per cent on account of the changed industrial conditions. The new price went into effect September 1.

Buol Machine Works, 168 Arch St., New Britain, Conn., have been organized for general and special machine building, and for doing all classes of special machine work. The proprietor, Abraham Buol, was connected with the New Britain Machine Co., for about twenty-seven years, rising to the position of superintendent and vice-president.

Hoffman Drawing Stand Co., formerly located at 187 N. Water St., Rochester, N. Y. has removed its plant and office to 281 Meigs St., Rochester, N. Y., a building of modern construction which the company has purchased. New manufacturing equipment is being added, which will enable the company to perform all its machine work in its own plant.

W. A. Jones Foundry & Machine Co., manufacturer of speed-reducers and power-transmitting machinery, with general offices and factories at 4409 W. Roosevelt Road, Chicago, Ill., has opened a branch sales and engineering office at 2482 University Ave., St. Paul, Minn. C. F. Ford, who is in charge of the new branch, is an experienced transmission engineer.

Mehl Machine Tool & Die Co., 547 E. First Ave., Roselle, N. J., designer and builder of jigs, fixtures, dies, gages, and special machines, has just opened an engineering branch in Cleveland, Ohio, in order to keep in closer touch with the company's increasing number of customers in the middle-western states, and give better service in tool engineering to the middle-western manufacturing area.

B. C. Ames Co., Waltham, Mass., has acquired a substantial interest in the Triplex Machine Tool Corporation of New York City, and the Triplex combination lathe, milling machine, and drilling machine is now being manufactured in the B. C. Ames Co.'s plant at Waltham. The general office and showroom of the Triplex Machine Tool Corporation will continue to be located at 18 E. 41st St., New York City.

Diamond Chain & Mfg. Co., Indianapolis, Ind., announces the opening of an office at 340 Leader-News Bldg., Cleveland, Ohio, which will be in charge of H. I. Markey, who has been with the company for five years as mechanical engineer in the engineering and sales departments. Through the Cleveland office the company will be able to be of greater service to manufacturers, engineers, and chain users in the territory including Cleveland, Rochester, and Pittsburg.

Mackintosh-Hemphill Co., Pittsburg, Pa., has acquired the property, assets and good will of the following corporations: A. Garrison Foundry Co., S. 9th and Bingham Sts., Pittsburg, Pa.; Pittsburg Iron & Steel Foundries Co., Midland, Pa.; and the Woodard Machine Co., Wooster, Ohio. These will hereafter be known, respectively, as the Garrison Plant, Midland Plant and Woodard Plant, of the Mackintosh-Hemphill Co.

Reeves Pulley Co., Columbus, Ind., has made a change in the agency for the Reeves variable-speed transmission for the New England territory. This transmission is now sold exclusively by Manning, Maxwell & Moore, Inc., 99 Chauncy St., Boston, Mass., where a complete variable speed department has been installed, in charge of competent engineers, and where a large stock of complete transmissions and parts is carried.

C. F. Davis Machine Co., Inc., formerly located at 133 Andrews St., Rochester, N. Y., moved October 1 to a new factory at 150-160 N. Water St., Rochester. The new Davis factory occupies the second floor of a modern fireproof brick and steel structure. In the new and enlarged plant a considerable amount of new equipment will be installed, making it possible to increase the output of keyseaters and keyseating cutters and to give quicker service to the company's customers.

Meldrum-Gabrielson Corporation, Syracuse, N. Y., manufacturer of Syracuse adjustable limit snap gages, has appointed W. R. Wyatt, 50 Church St., New York City, exclusive representative in the Metropolitan district and vicinity. Wm. Battersby, 3325 N. 21st St., Philadelphia, Pa., has been appointed exclusive representative of the company for southeastern Pennsylvania and Delaware. The Kemp Machinery Co., 215 N. Calvert St., Baltimore, Md., will represent the company exclusively in Maryland, Virginia, and the District of Columbia.

E. L. Essley Machinery Co., 551-557 Washington Blvd., Chicago, Ill., has added the following men to its sales force: H. A. Bruce, who will represent the company in the Michigan territory; C. B. Burns and T. P. Nielsen, who will represent the company in Chicago; and Ralph Wirth, who will be identified with the company's sheet-metal machinery department. Mr. Bruce was formerly connected with the Packard Motor Car Co., Mr. Burns with the Fairbanks Co., and Mr. Wirth with the Toledo Machine & Tool Co., and the Niagara Machine Tool Works.

Oilgear Co., Milwaukee, Wis., has opened a New York office at 39 Cortlandt St., in order to be in direct touch with the entire eastern territory. Russell, Holbrook & Henderson, 30 Church St., New York City, have been appointed sales representatives of this company for the district in and near New York City. The Cadillac Machinery Co., 452 E. Lafayette St., Detroit, will handle Oilgear products in the state of Michigan, and R. E. Ellis Engineering Co., 621 Washington Blvd., Chicago, will represent the Oilgear Co. in Chicago and the surrounding district.

Hunter Saw & Machine Co., 57th and Butler Sts., Pittsburg, Pa., manufacturer of metal-cutting circular saw blades, saw-sharpening machines and hardened steel specialties, has opened an office in the Manhattan Bldg., Chicago, Ill., of which Paul W. Wendt is in charge. A complete stock of metal-cutting saw blades, pneumatic hammer rivet sets, and chisel blanks will be maintained there. The company has also opened an office at 56 Pine St., New York City, in charge of Frank E. Harrison, and a complete stock of the company's products will also be carried by this office.

Alfred Box & Co., Philadelphia, Pa., manufacturers of electric cranes and hoists, have disposed of their old factory on Front St., and will soon move into a newly erected plant at Ontario St. and Trenton Ave., Philadelphia. The new plant will have a main bay in the middle, 50 by 240 feet, and two side bays, 30 by 240 feet. The main bay is 50 feet high. A separate building, 30 by 90 feet, will be used for pattern shop and storage. The building will contain five electric cranes, and all the machine tools will be motor-driven. The capacity of the new plant will be three times that of the old.

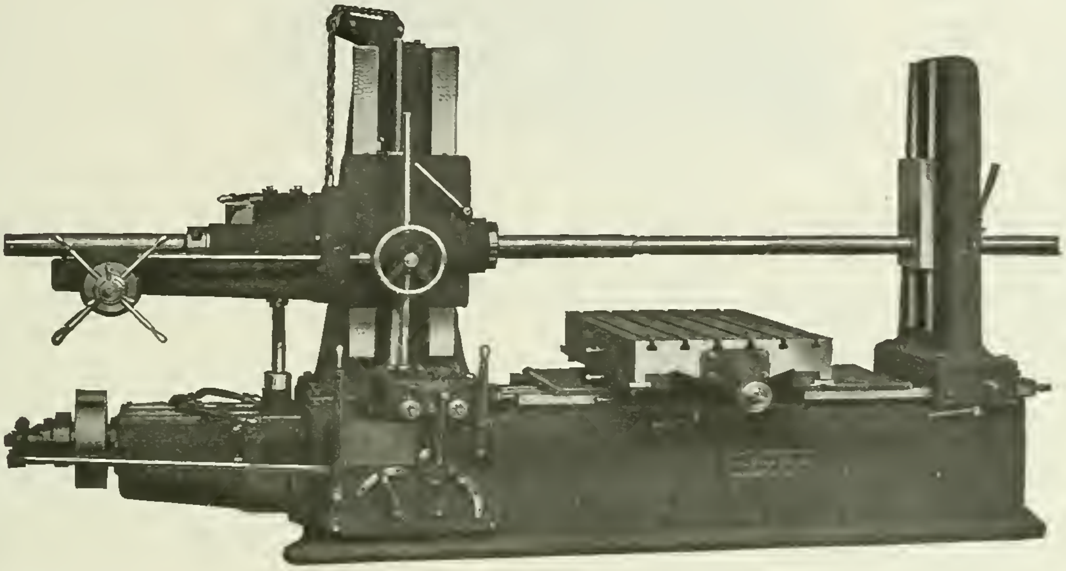
Davis Boring Tool Co., Inc., St. Louis, Mo., manufacturer of expansion boring tools and expansion reamers, has purchased a factory site on Forest Park Blvd., at the corner of Spring Ave., St. Louis. Preliminary work is now under way for the erection of a modern three-story factory building. During the last eighteen years the company has outgrown four different buildings, the rapidly increasing demand for the company's product having necessitated several increases in floor space from time to time. The present factory is now inadequate for the requirements. The new site provides for additional expansion in the future.

CONSERVATIVES like the

"PRECISION"

Boring, Drilling and Milling Machine

Because It Is *Reliable*



PROGRESSIVES

like it because it is *Efficient*

WE like it because we believe that in it we are furnishing the world with something to its advantage.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

COMING EVENTS

October 2-7—Annual convention and exposition of the American Society for Steel Treating in Detroit, Mich., General Motors Bldg. Secretary, W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

October 18-20—Ninth national convention of the Society of Industrial Engineers at Hotel McAlpin, New York City. Office of the secretary, 327 S. LaSalle St., Chicago, Ill.

October 25-27—Third annual meeting of the American Trade Association Executives at the Inn, Buckhill Falls, Pa.

October 26-27—Automotive production meeting of the Society of Automotive Engineers to be held in Detroit. Further information may be obtained from the Society of Automotive Engineers, 29 W. 39th St., New York City.

December 4-7—Annual convention of the American Society of Mechanical Engineers, in the Engineering Societies Bldg., 29 W. 39th St., New York City. Calvin W. Rice, secretary.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St. and Lexington Ave., New York City.

March 18-24, 1923—Second general meeting of the International Chamber of Commerce in Rome, Italy. Lacey C. Zapf, secretary American Section, Mills Bldg., Washington, D. C.

NEW BOOKS AND PAMPHLETS

Proceedings of the National Association of Office Managers, Third National Conference, Washington, D. C., May 18 to 20, 1922. 73 pages, 8½ by 11 inches. Published by G. S. Childs, secretary of the association, Alexander Hamilton Institute, 13 Astor Place, New York City. Price, $1.50.

Knots, Splices, and Rope Work. By A. Hyatt Verrill. 104 pages 4¼ by 6½ inches; 154 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.

This is the third revised edition of a book that gives complete and simple directions for making the most useful knots commonly employed. It includes chapters on splicing, pointing, seizing, serving, etc., and is intended for the use of all who employ or handle ropes for any purpose.

Jigs, Tools, and Fixtures. By Philip Gates. 195 pages, 4½ by 7½ inches; 165 illustrations. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $2.50.

This book, which is prepared by an English author, deals with equipment for various types of machine tools. Chapters on the first principles of mechanical drawing and sketching are included, which are followed by chapters on drill jigs, milling fixtures, chucks, cutters, threading tools, gages, press tools, and tool designing procedure.

Maxton's Manual of Engineering Drawing. By John Maxton and G. C. Malden. 251 pages, 4½ by 7½ inches; 313 illustrations. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $3.

This is a new edition of Maxton's Manual, a work of English origin, the new edition having been revised and some new material added by Lieutenant-Commander G. C. Malden of the British Navy. The book covers the subject of mechanical drawing in a conventional way. The new matter that has been added deals specifically with the laying out of propellers.

Modern Work-shop Practice. By Ernest Pull. 671 pages, 5¼ by 8¼ inches; 542 illustrations. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $5.

This book, compiled and prepared by an English author as a text-book, covers briefly a great number of subjects relating to machine shop practice. The present edition, which is the sixth, has been rewritten and considerably enlarged. The chapter on measuring tools and measuring machines, for example, includes descriptions of some of the very accurate measuring machines recently introduced by British manufacturers. Gaging and gaging systems have been referred to in greater detail than in the past, and a number of the other chapters have been enlarged.

Machinists' and Draftsmen's Handbook. By Peder Lobben. 487 pages, 4½ by 7½ inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $3.

This is the third edition of Lobben's Handbook. The first edition appeared in 1899, and was republished in 1910 in a second edition, which was considerably enlarged. In the present edition a few of the tables in the steam section have been revised and the electrical formulas have been made to conform to the new standardization rules. The book deals with arithmetic, algebra, logarithms, weights and measures, geometry, strength of materials, mechanics, mechanical power transmission, screws, pipes, hydraulics, steam, and electric terms, and contains a few shop notes and directions for blueprinting.

Engines and Boilers. By Thomas T. Eyre. 234 pages, 5½ by 8½ inches. Published by the MacMillan Co., 64 Fifth Ave., New York City. Price, $3.50.

This is a text-book on engines and boilers which is intended for use in engineering schools that offer an elementary course in heat engines. No attempt has been made in this book to cover the more advanced work in thermodynamics or to give an exhaustive treatment of the subject of heat power. The author is dean of the College of Engineering of the State University of New Mexico, and was formerly assistant professor of mechanical engineering at Purdue University, and his work is the result of experience gained in teaching classes in engines and boilers and in allied subjects at Purdue University. The material is divided into eleven chapters dealing with the following subjects: Pressure, Temperature, and Heat Units; Fuel; Steam; Boilers; Boiler Accessories and Auxiliaries; the Steam Engine; Common Types of Steam Engines; Valves; Governors; Steam Turbines; and Gas Engines.

NEW CATALOGUES AND CIRCULARS

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Catalogue 6-M, entitled "Westinghouse Line Material for Mines."

Electric Controller & Mfg. Co., Cleveland, Ohio. Circular entitled "A New Motor," illustrating the features of the Type NC squirrel-cage induction motor made by this concern.

Hobart Bros. Co., Troy, Ohio. Folder entitled "HB Constant Potential Battery Charger," describing the new and improved battery charging equipment built by the company.

Sprague Electric Works of General Electric Co., 627 W. 34th St., New York City. Bulletin 68912, illustrating and describing Sprague electric Type WX worm drive hoists.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets Nos. 147FE and 148FE, illustrating the application of ball bearings in motor-generator sets and induction motors.

Roller-Smith Co., 233 Broadway, New York City. Bulletin 250, illustrating and describing the company's portable direct-current galvanometers known as Types LGD and KGD.

Pawling & Harnischfeger Co., Milwaukee, Wis. Bulletin 3-T, illustrating and describing the No. 3-T table type horizontal boring, drilling, and milling machine, built by this company.

General Electric Co., Schenectady, N. Y. Bulletin 47606, entitled "Relays," dealing with the operation and general application of relays. Bulletin 44015, entitled "Safety Car Equipment."

Bausch & Lomb Optical Co., Rochester, N. Y. Booklet entitled "What Lens Shall I Buy?" This publication includes both a complete catalogue of lenses and a compendium of lens applications.

Bristol Co., Waterbury, Conn. Catalogue 1401, of Bristol pyrometers. This catalogue consists of 68 pages, is profusely illustrated, and contains much valuable information on the subject of pyrometers.

Schutte & Koerting Co., Philadelphia, Pa. Bulletin SG, illustrating and describing Schutte regrinding swing gate valve, designed for steam pressures up to 300 pounds per square inch and temperatures up to 750 degrees F.

Cleveland Engineering Institute, 8120 Euclid Ave., Cleveland, Ohio. Booklet entitled "The School of Greater Opportunities," describing the courses given in this institute, which specializes in teaching heating and ventilating engineering.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa. Folder illustrating and describing the company's multi-graduated precision grinder, precision thread lead variator, and permanent alignment wheel-truing head. A partial list of the users of the company's products is also given.

Ingersoll Milling Machine Co., Rockford, Ill. Folder illustrating and describing the milling of impeller bodies for blowers, as it is being done in one of the largest blower shops in the country on Ingersoll milling machines to an accuracy of plus or minus 0.003 inch over the entire form of the impeller body.

Whiting Corporation, Harvey, Ill. Catalogues 161 to 164, illustrating and describing, respectively, ladles, tumbling mills, core oven equipment, and trucks and turntables. Each of these catalogues is profusely illustrated, showing not only detail pictures of the equipment but also illustrations of installations.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Folder illustrating and describing the Shepard electric "Liftabout," a small electric hoist designed for the smaller load-moving and lifting jobs, such as three, four or five men are ordinarily able to do. This hoist is made in capacities up to 2000 pounds.

Wiesman Mfg. Co., 14 N. Canal St., Dayton, Ohio. Circular of Wiesman safety guard for punch presses, illustrating and describing the improved type of Wiesman safety guard. The circular also gives instructions for ordering these safety guards, specifying what data should be given in order that the right type of guard may be supplied.

Winfield H. Smith, 10-16 Lock St., Buffalo, N. Y., Catalogue 20, descriptive of a full line of power transmission machinery, including grooved iron pulleys, crown faced pulleys, hangers, pillow blocks, reducing gears, etc. Data are also given for arbor presses, and revolving display tables. Dimensions and price lists are given.

Willson Goggles, Inc., Reading, Pa. Folder illustrating and describing Willson respirators for dusty work. Price list of safety goggles and respirators for dusty work. Folder illustrating and describing helmets and hand-shields for electric welding. Catalogue illustrating and describing the different types of safety goggles manufactured by the company.

Midwest Steel & Supply Co., Inc., 28 W. 44th St., New York City. Folder illustrating and describing the Midwest transmission steel sections for anchoring shaft hangers, cables, and piping, and for fastening sprinklers and lighting and similar equipment. These transmission steel sections are made in what is known as "box" rail, "L" rail and steel stringer sections.

Reeves Pulley Co., Columbus, Ind. Booklet entitled "Engineer's Manual," listing the complete line of variable-speed transmissions built by the company, pointing out their various uses, and giving mechanical data pertaining to them. The company has also brought out a catalogue entitled "Reeves Wood Split Pulleys," describing and illustrating this type of pulley and showing illustrations of its application.

Electric Furnace Co., Salem, Ohio. Circular illustrating and describing Baily electric furnaces for melting non-ferrous metals, calling attention to what alloys they are melting, what products they are producing and what the users think of them. Also circular of some of the many types of electric enameling, annealing, and heat-treating furnaces that have been installed by the company during recent years.

B. F. Sturtevant Co., Hyde Park, Boston, Mass. Engineering bulletin dealing with pneumatic collecting and conveying. This bulletin of 72 pages contains 33 pages of pictures and diagrams, and 17 pages of tables, indicating how to find the size of fans, the suction, volume, revolutions per minute, and horsepower for any system, cubic feet of air handled per minute, and size of pipes and ducts used, together with a great deal of other useful data.

Mehl Machine Tool & Die Co., 547 E. First Ave., Roselle, N. J. Catalogue entitled "Tool Service," illustrating by interior views of the company's shops the facilities that the company has for doing special tool work. It deals specifically with the work being done in the design and making of jigs, fixtures, dies, gages, and special machines, and illustrates some of the equipment that has been built by the company. Illustrations and descriptions of the designing department, pattern shop, and inspection department of the company complete the catalogue.

Jacobs Mfg. Co., Hartford, Conn. Booklet entitled "The Backbone of Automotive Service." The object of the booklet is to promote a more general appreciation of the importance of adequate shop equipment in automotive service stations and repair shops. It makes a strong point of the fact that adequate machine tool equipment is a necessity for profitable work in this field, and then refers specifically to some of the essential machine tools in the service plant—the lathe, drilling machine, portable electric drill, cylindrical grinding machine, cylinder grinder, and arbor press.

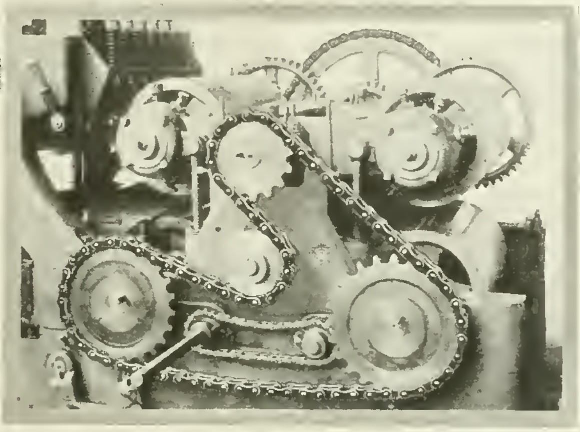
Lovejoy Tool Co., Inc., Springfield, Vt. Catalogue of positively locked inserted tooth milling cutters, illustrating and describing the various classes of milling cutters manufactured by the company, including face milling cutters from 6½ to 18 inches in diameter; side milling cutters, from 6 to 14 inches in diameter; plain milling cutters, from 6 to 16 inches in diameter; and plain arbor mills from 4½ to 12 inches in diameter. In addition, the catalogue illustrates and describes staggered-tooth grooving mills, deep slotting cutters, stellite blades, taper shank arbors and multiple cutter boring heads.

Chambersburg Engineering Co., Chambersburg, Pa. Bulletin 67, illustrating and describing the company's steam drop-hammers, one of the special features of which is that they have parallel adjustable type guides with large vees, providing a large wearing surface. The guides can be removed without removing the ram. As the lower portions of the guides are subjected to the greatest wear, upper and lower horizontal adjusting shoes are provided, which are regulated from the side of the hammer for adjusting the guides very accurately, as is required in matched die work. These shoes can be removed without disturbing the guides.

A. W. Cadman Mfg. Co., Pittsburg, Pa. Engineering bulletins M-1 and M-2, containing technical data on bearing metals obtained from actual tests. The information contained in Bulletin M-1 includes requirements of a bearing metal and properties of Cadman metals—hardness and compressive strength, relative wear, coefficient of friction, ability to hold an oil film under adverse conditions, plasticity, heat conductivity, uniformity, and tensile strength and bonding properties. Bulletin M-2 treats of types of bearing metals, requirements of a bearing metal, alloys and the theory of bearing metals, friction in bearings, and permissible bearing pressures.

NOVEMBER MACHINERY 1922

Efficiency of Chain Drives



An Original Analysis of Chain and Sprocket Action

By G. M. BARTLETT
Chief Engineer,
Diamond Chain & Mfg. Co.,
Indianapolis, Ind.

Low Numbers of Teeth and Incorrect Center Distances as Causes of Appreciable Variations in Angular Velocity and a Reduction in Efficiency

THE action of a chain as it travels over a sprocket having ten teeth may be compared with the action of a non-slipping belt traveling over a ten-sided prism. The action of the belt would not be as smooth as if the prism had twenty sides, nor would the action over a twenty-sided prism be as smooth as over a forty-sided one. This is the reason that the use of sprockets having less than twelve or fourteen teeth is not usually recommended by chain drive engineers. Nevertheless, it can be shown that a pair of sprockets with a low number of teeth and the proper center distance can be more efficient than a pair with a larger number of teeth and the wrong center distance. It would not be correct, therefore, to say that under no circumstances should a sprocket be used with less than twelve teeth.

Cause of Fluctuations in Angular Velocity

The conditions that cause fluctuations in angular velocity can best be illustrated by diagrams in which the sprockets are shown as polygons. The number of sides in each polygon represents the number of teeth in the sprocket, and the length of each side is equal to the pitch. The action that takes place in all sprockets is most clearly shown by assuming a very low number of teeth, as, for instance, three, four or six.

Fig. 1 shows a four-toothed sprocket driving another four-toothed sprocket. Since the number of teeth is the same in the two wheels, the driven sprocket will make exactly one revolution for every complete revolution of the driver; also the driven sprocket will make exactly one-quarter of a revolution for every one-quarter revolution of the driver. But for anything less than a quarter of a revolution this is not true. Let us suppose that the driver is turning with a uniform angular velocity. In the position shown, NK is only about seven-tenths as long as MA. Hence the angular velocity of the driven wheel at this instant will be only seven-tenths the angular velocity of the driver. After the driver has turned through about one-eighth revolution, the roller C will be on top, and the link IA will be nearly horizontal. The relation will then be reversed, and the driven wheel will have increased its angular velocity so that it will be about 1.4 times the velocity of the driver. In another one-eighth turn the driven wheel will again be running slow, and so on. The total variation in the speed of the driven wheel is in this case 0.7 to 1.4 or 1 to 2. As the number of teeth is increased this variation becomes less pronounced.

In Fig. 2 is shown the same pair of sprockets with the center distance increased by about one-half the pitch and with one link added to the total length of the chain. In this case MA and ND always make the same angle with the driving strand AD of the chain, and being of the same length, the angular velocity of the driven sprocket is at all times exactly equal to that of the driver; hence, instead of a 100 per cent fluctuation in speed there is no fluctuation. Moreover, the conditions in Fig. 2 allow the use of a chain whose length is a multiple of twice the pitch, while in Fig. 1 an offset link is required, the chain length being an odd multiple of the pitch. Furthermore, the non-driving strand of the chain in Fig. 2 is always of the same length, while in Fig. 1 it is alternately tight and slack during every one-eighth part of a turn of the sprockets. If the number of teeth in the two equal sprockets is odd, the same conditions would hold; hence, the following general rule:

When two sprockets have the same number of teeth, the condition for no fluctuation in the angular velocity of the driven wheel and no whipping of the slack strand of the chain is that the center distance must be an exact multiple of the pitch.

This article on chain drive efficiency illustrates the practical value in engineering work of analyzing carefully every element that may prove of importance. While the power losses in well-constructed chain drives are very slight, it is an interesting fact, as shown by this analysis and by actual tests, that the efficiency may be considerably increased under certain conditions by merely changing the center distance whatever slight amount is required to avoid fluctuations in the angular velocity of the driving and driven sprockets. The effect of such fluctuations on the efficiency of different classes of sprocket combinations is dealt with in this important contribution to the literature on the correct design of chain drives.

When the velocity ratio is not 1 to 1, it is impossible to obtain a theoretically uniform angular velocity ratio, although if the number of teeth is large enough and the chain sufficiently long, the elasticity of the chain may be sufficient to absorb the slight variations in velocity that theoretical conditions would produce.

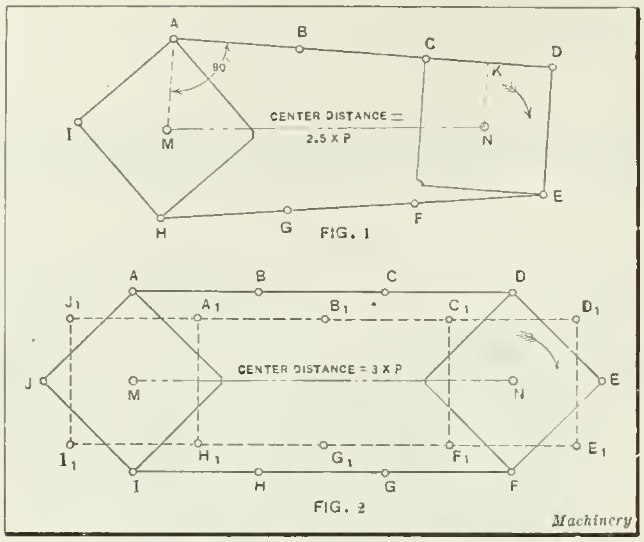


FIG. 1

FIG. 2

Figs. 1 and 2. Sprockets shown as Polygons to illustrate Fluctuations in Angular Velocity

Determining Maximum and Minimum Speed Variations

Fig. 3 illustrates a general case where the velocity ratio is not 1 to 1 and where the center distance is such as to produce the maximum variation in the angular velocity of the driven sprocket. If lines *SB* and *OC* are drawn through the center of the two sprockets perpendicular to the center line *BC* of the chain, the distance from *B* to *C* is the *span of the chain*. In Figs. 3 and 4 this span is not an exact multiple of the pitch, but is so chosen that when the distance from *O* to the chain is a minimum, the distance from *S* to the chain is a maximum, and vice versa. Fig. 4 is the same as Fig. 3, except that the chain rollers have been advanced through a distance of one-half the pitch. For the position shown in Fig. 3, the speed of the driven wheel is a minimum, the velocity ratio being $\frac{OC}{SB}$. For the position shown in Fig. 4, the speed of the driven wheel is a maximum, the velocity ratio being $\frac{OA}{SE}$.

The variation in the speed of the driven wheel for these two positions equals $(OA \div SE) - (OC \div SB)$.

The ratio of this variation to the minimum speed equals

$$\frac{(OA \div SE) - (OC \div SB)}{OC \div SB}$$

The percentage of variation equals

$$100 \times \left(\frac{OA \div SE}{OC \div SB} - 1\right) =$$

$$\frac{100}{(OC \div SB)\,(SE \div OA)} - 100 =$$

$$\frac{100}{(OC \div OA)\,(SE \div SB)} - 100 =$$

$$\frac{100}{\cos\frac{180^\circ}{n} \times \cos\frac{180^\circ}{N}} - 100 \qquad (1)$$

In Fig. 5 the center distance is such as to make the chain span an exact multiple of the pitch. In this case the speed of the driven wheel varies between $\frac{OA}{SB}$ as a maximum and $\frac{OC}{SE}$ as a minimum. (Dimensions *OC* and *SE* correspond to those in Figs. 3 and 4.)

The variation in the speed of the driven wheel $= \frac{OA}{SB} - \frac{OC}{SE}$.

The ratio of this variation to the minimum speed equals

$$\frac{(OA \div SB) - (OC \div SE)}{OC \div SE}$$

The percentage of variation $= 100 \times \left(\frac{OA \div SB}{OC \div SE} - 1\right)$

$$= 100 \times \left(\frac{SE \div SB}{OC \div OA} - 1\right) = 100 \times \left(\frac{\cos(180^\circ \div N)}{\cos(180^\circ \div n)} - 1\right) \quad (2)$$

Relation between Velocity Changes and Efficiency of Chain Drives

The accompanying table shows the percentages of variations in angular velocity for various combinations of teeth. The upper figures (calculated from Formula 2) represent

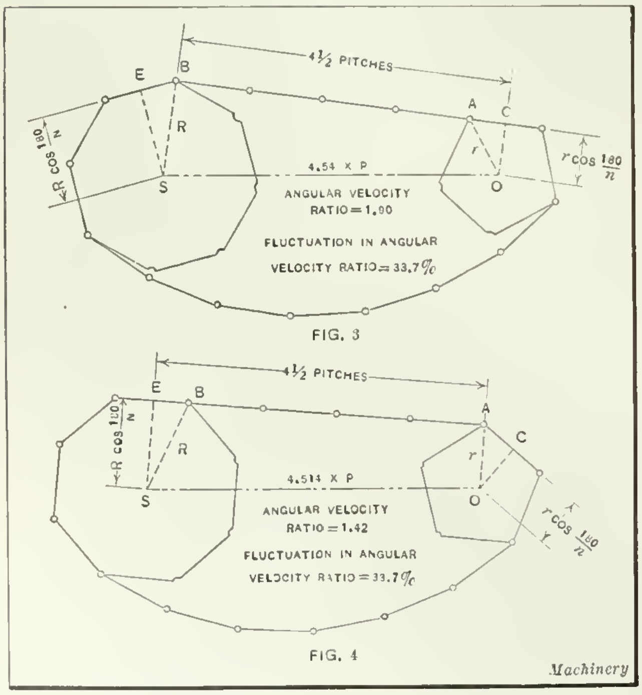

4½ PITCHES
E
B
A
C
R
R cos 180/n
r
r cos 180/n
S
4.54 X P
O
ANGULAR VELOCITY RATIO = 1.90
FLUCTUATION IN ANGULAR VELOCITY RATIO = 33.7%
4½ PITCHES
E
B
A
C
R cos 180/n
R
r
S
4.514 X P
O
ANGULAR VELOCITY RATIO = 1.42
FLUCTUATION IN ANGULAR VELOCITY RATIO = 33.7%
r cos 180/n
Machinery

FIG. 3

FIG. 4

Figs. 3 and 4. Diagrams illustrating Two Cases in which the Center Distance is Such as to produce a Maximum Variation in Angular Velocity

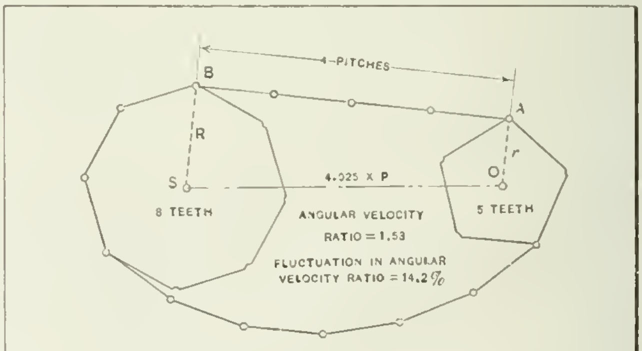

4 PITCHES
B
A
R
r
S
4.025 X P
O
8 TEETH
5 TEETH
ANGULAR VELOCITY RATIO = 1.53
FLUCTUATION IN ANGULAR VELOCITY RATIO = 14.2%

FIG. 5

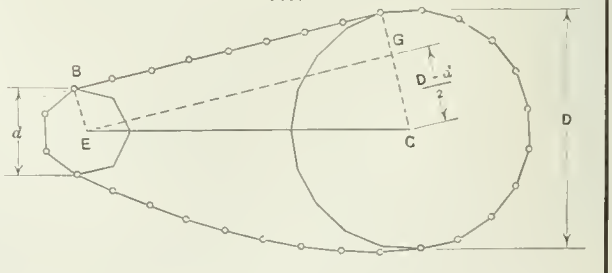


FIG. 6

Fig. 5. Center Distance which makes Span AB of Chain an Exact Multiple of the Pitch. Fig. 6. Factors Required when calculating Center Distance for Highest Efficiency

TABLE GIVING PERCENTAGES OF VARIATION IN SPROCKET SPEED FOR VARIOUS COMBINATIONS OF TEETH

		No. of Teeth on Smaller Wheel														
		6	8	9	10	12	14	15	16	18	20	24	30	36	48	60
No. of Teeth on Larger Wheel	6	00.0 33.3														
	7	4.0 28.2														
	8	6.7 25.0	00.0 17.0													
	9	8.5 22.9	1.7 15.0	00.0 13.0						Combinations allowable only when center distances are properly adjusted for reducing velocity fluctuations.						
	10	9.8 21.4	2.9 14.0	1.2 12.0	00.0 11.0											
	12	11.5 19.5	4.6 12.0	2.8 10.0	1.6 8.9	0.0 7.2										
	14	12.6 18.4	5.5 11.0	3.7 9.2	2.5 7.8	0.9 6.2	0.0 5.2									
	15	13.0 18.1	5.9 11.0	4.1 8.8	2.8 7.5	1.3 5.8	0.3 4.9	0.0 4.5								
	16	13.3 17.7	6.2 10.0	4.4 8.5	3.1 7.2	1.5 5.6	0.6 4.6	0.3 4.2	0.0 4.0							
	18	13.7 17.2	6.6 9.9	4.8 8.1	3.6 6.8	2.0 5.1	1.0 4.2	0.7 3.8	0.4 3.5	0.0 3.1						
	20	14.1 16.9	6.9 9.6	5.2 7.7	3.8 6.5	2.2 4.8	1.3 3.8	1.0 3.5	0.7 3.2	0.3 2.8	0.0 2.5					
	21	14.3 16.6	7.0 9.4	5.3 7.5	4.0 6.2	2.4 4.6	1.4 3.6	1.1 3.3	0.8 3.0	0.4 2.6	0.1 2.4			Speed variation reduced from 1 to 2½ per cent by proper center adjustment.		
	24	14.5 16.5	7.3 9.2	5.5 7.3	4.3 6.0	2.7 4.4	1.7 3.5	1.4 3.1	1.1 2.8	0.7 2.4	0.4 2.2	0.0 1.7				
	28	14.7 16.2	7.6 9.0	5.7 7.1	4.5 5.8	2.9 4.2	1.9 3.3	1.6 2.9	1.3 2.6	0.9 2.2	0.6 2.0	0.2 1.5				
	30	14.8 16.1	7.6 8.8	5.8 7.0	4.6 5.7	3.0 4.1	2.0 3.1	1.7 2.8	1.4 2.5	1.0 2.1	0.7 1.8	0.3 1.4	0.00 1.10			
	32	14.9 16.0	7.7 8.7	5.9 6.9	4.7 5.6	3.1 4.0	2.1 3.0	1.8 2.7	1.5 2.5	1.1 2.0	0.8 1.7	0.4 1.3	0.10 1.00			
	36	15.0 15.9	7.8 8.6	6.0 6.8	4.7 5.5	3.1 3.9	2.2 3.0	1.8 2.6	1.6 2.4	1.2 1.9	0.9 1.6	0.5 1.3	0.20 1.00	0.00 0.77		
	40	15.1 15.8	7.9 8.6	6.1 6.8	4.8 5.5	3.2 3.8	2.3 2.9	1.9 2.6	1.7 2.3	1.2 1.9	0.9 1.6	0.5 1.2	0.25 0.87	0.10 0.69		
	42	15.2 15.8	7.9 8.5	6.1 6.8	4.9 5.4	3.3 3.8	2.3 2.8	2.0 2.5	1.7 2.2	1.3 1.8	1.0 1.5	0.6 1.2	0.30 0.81	0.15 0.63		
	48	15.2 15.7	8.0 8.4	6.2 6.7	5.0 5.3	3.4 3.7	2.4 2.7	2.1 2.4	1.8 2.2	1.4 1.7	1.0 1.4	0.7 1.1	0.35 0.75	0.20 0.57	0.00 0.43	
	60	15.3 15.6	8.1 8.4	6.3 6.6	5.0 5.3	3.4 3.7	2.4 2.7	2.1 2.4	1.8 2.1	1.4 1.7	1.1 1.4	0.7 1.0	0.40 0.69	0.25 0.52	0.08 0.35	0.00 0.27
		Combinations which are bad under any condition.					These combinations are good, and little is gained by adjustment of centers for reducing velocity fluctuations.									

the percentages of variation in the angular velocity of the driven wheel when the span of the chain is an exact multiple of the pitch, and the lower figures (calculated from Formula 1) represent the percentages of variation when the span is an odd multiple of one-half the pitch. Tests of a drive in which 14 and 14 teeth were used, showed that the efficiency was increased 5.6 per cent by changing from 30¾-inch centers to 30-inch centers, the pitch being 1½ inches. The same test made with equal sprockets of 64 teeth showed an increase in efficiency of 0.5 per cent. These figures are so close to those given in the table as to be significant, and assuming a probable error of at least 0.3 per cent in the results of these efficiency tests, we might conclude that the approximate gain in efficiency due to a proper adjustment of centers is as follows:

Percentage of gain in efficiency equals

$$\frac{100 \times \sin\ (180° \div N) \times \tan\ (180° \div N)}{\cos\ (180° \div n)}$$

This is the difference between Formulas (1) and (2).

Four General Classes of Tooth Combinations

Assuming that a speed variation of more than 3 per cent is undesirable and that a 1 per cent reduction in speed variation is worth considering, an examination of the table referred to will enable us to divide all tooth combinations into four classes, as indicated by the division lines.

Class 1—The following combinations are bad under any condition:

6 teeth combined with 7 or more teeth
8 teeth combined with 12 or more teeth
9 teeth combined with 14 or more teeth
10 teeth combined with 16 or more teeth
12 teeth combined with 30 or more teeth

Class 2—The following combinations of teeth are allowable only when the center distance is properly adjusted:

6 teeth combined with 6 teeth
8 teeth combined with 8 to 10 teeth
9 teeth combined with 9 to 12 teeth
10 teeth combined with 10 to 15 teeth

12 teeth combined with 12 to 28 teeth
14 teeth combined with 14 to 30 teeth
15 teeth combined with 15 to 24 teeth
16 teeth combined with 16 to 21 teeth
18 teeth combined with 18 teeth

Class 3—The following combinations are allowable without special adjustment of centers, but if centers are properly adjusted there will be a reduction of from 1 to 2.5 per cent in speed variation:

15 teeth combined with 28 to 30 teeth
16 teeth combined with 24 to 30 teeth
18 teeth combined with 20 to 30 teeth
20 teeth combined with 20 to 30 teeth
24 teeth combined with 24 to 30 teeth
30 teeth combined with 30 teeth

Class 4—The following combinations are good, and very little is gained by an adjustment of centers for reducing fluctuations in angular velocity: 14 or more teeth combined with 31 or more teeth.

Thus it appears from the foregoing that a pair of sprockets with 9 and 12 teeth having the center distance properly adjusted produces less speed variation than a pair of sprockets that have 15 and 20 teeth and improper center distance.

Calculating Center Distance for Highest Efficiency

If line *EG* (see diagram Fig. 6) is drawn parallel to the tight side *BA* of the chain, and *CA* and *EB* are each perpendicular to *BA*, then *ECG* will be a right triangle, and

$$EC = \sqrt{GE^2 + CG^2} = \sqrt{AB^2 + \frac{(D-d)^2}{4}}$$

$$= \tfrac{1}{2}\sqrt{4 \times AB^2 + (D-d)^2} \qquad (3)$$

where *D* and *d* are the pitch diameters of the two sprockets and the span *AB* is an exact multiple of the pitch.

Example—Suppose it is proposed to install a chain drive with sprockets having 24 and 14 teeth, 2-inch pitch, and a center distance of about 14½ inches which is capable of being changed slightly. What is the nearest center distance to 14½ inches that will make the span of the chain an exact multiple of the pitch?

Solution—In Fig. 6 *AB* is evidently a little less than the center distance, and since it must be a multiple of the pitch which is 2 inches, its value must be taken as 14. Then,

$4 \times AB^2 = 4 \times 196 = 784$; $D = 15.323$; and $d = 8.988$

$$\text{The sprocket pitch diameter} = \frac{\text{Pitch of chain}}{\sin\,(180^\circ \div \text{No. of teeth})}$$

Therefore in this example,

$$EC = \tfrac{1}{2}\sqrt{784 + 40.132} = 14.354 \text{ inches}$$

Hence, if the center distance is exactly 14.354 inches, the span of the chain will be exactly 14 inches or 7 pitches, and the variation in angular velocity will be a minimum.

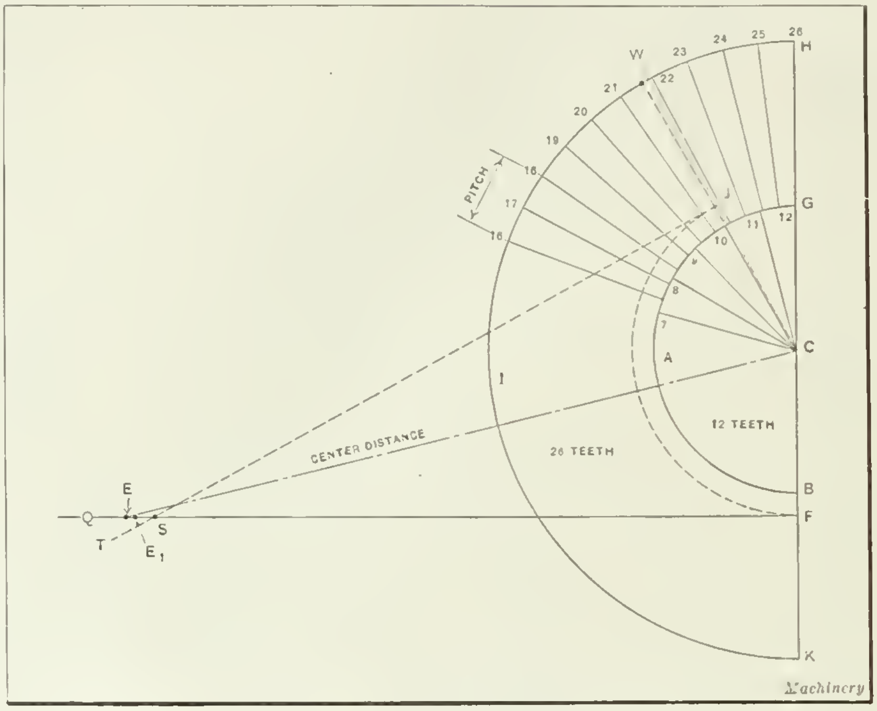


Fig. 7. Graphical Method of determining Center Distance for Maximum Uniformity of Sprocket Speed and Minimum Slack

Center Distance Based on Maximum Uniformity of Sprocket Speed and Minimum Slack in Chain

Now the effect of this careful adjustment of centers is generally to introduce an extra amount of slack in the non-driving strand of the chain. We will therefore investigate the conditions under which it is possible to obtain the minimum variation in angular velocity and at the same time eliminate the slack in the non-driving strand of the chain.

Let n = number of teeth in smaller sprocket;
N = number of teeth in larger sprocket;
P = pitch;
d = pitch diameter of a sprocket with n teeth of 1-inch pitch;
D = pitch diam. of sprocket with N teeth of 1-in. pitch;
M = angle included between the line of centers and either strand of the chain;
K = an integer, the value of which depends upon conditions as explained later.

In addition, x and y are to equal, respectively the numerator and denominator of the fraction $\frac{n}{N}$ when reduced to its lowest terms.

Thus, if $n = 14$ and $N = 35$, $\frac{n}{N} = \frac{14}{35} = \frac{2}{5}$, then $x = 2$, and $y = 5$.

Case 1—If $N - n$ is *even*, and $y - x$ is *odd*, then the angle M can be any multiple of $\frac{180x}{n}$ degrees, except that $\sin M$ must not exceed $\frac{D_1 - d_1}{D_1 + d_1}$, where D_1 and d_1 are outside diameters of the two sprockets. When this value of $\sin M$ is reached the sprockets will touch each other.

Case 2—If the conditions do not fall within Case 1, the angle M will be an *odd* multiple of $\frac{90x}{n}$ degrees; but $\sin M$ must not exceed $\frac{D_1 - d_1}{D_1 + d_1}$.

Example of Case 1: $n = 16$; $N = 24$; $x = 2$; $y = 3$.

Example of Case 2: $n = 18$; $N = 30$; $x = 3$; $y = 5$.

The span of the chain in pitches will be the integer nearest to the value obtained by the following formula:

$$\text{Span in chain pitches} = \frac{1}{2P}(D - d)\cot M \qquad (4)$$

where M is $\frac{180x}{n}$ degrees multiplied by 1, 2, or 3 for Case 1, and $\frac{90x}{n}$ degrees multiplied by 1, 3, or 5 for Case 2.

The center distance in pitches equals

$$\sqrt{(\text{Span, in pitches})^2 + \frac{1}{4P^2}(D - d)^2} \qquad (5)$$

The chain length in pitches equals

$$2 \times \text{Span, in pitches} + \frac{N+n}{2} + \frac{K\,(y-x)}{2} \qquad (6)$$

where K is either 1, 2, or 3 for Case 1 and either 1, 3, or 5 for Case 2.

Example—Let it be required to find all of the center distances for a chain drive in which the velocity variations will be a minimum with no slack in the non-driving strand of the chain, where the sprockets have 13 and 26 teeth, and the pitch is 2 inches. Then $\frac{n}{N} = \frac{13}{26} = \frac{1}{2}$; $x = 1$; and $y = 2$.

Since $N - n$ is odd, the problem comes under Case 2. The pitch radii of the sprockets are 8.2965 and 4.1785 inches, respectively; therefore

$$\begin{aligned}\text{Span} &= \frac{1}{2 \times 2} \times (16.593 - 8.357) \times \cot \frac{90 \times 1}{13}\\ &= 2.059 \cot 6 \text{ deg. } 55 \text{ min. } 23 \text{ sec.}\\ &= 2.059 \times 8.2357 = 16.95\\ &= 17 \text{ pitches}\end{aligned}$$

$$\begin{aligned}\text{Center distance} &= \sqrt{17^2 + \frac{1}{4 \times 4} \times 8.236^2} = 17.124 \text{ pitches}\\ &= 17.124 \times 2 \text{ or } 34.248 \text{ inches}\end{aligned}$$

$$\text{Chain length} = 2 \times 17 + \frac{26+13}{2} + \frac{1(2-1)}{2} =$$

$$34 + 19.5 + 0.5 = 54 \text{ pitches} = 108 \text{ inches}$$

If a second solution is possible, the angle M will be 3 × 6 degrees 55 minutes 23 seconds; or 20 degrees 46 minutes 9 seconds, and its sine will be less than $\frac{D_1 - d_1}{D_1 + d_1}$. Sin 20 degrees 46 minutes 9 seconds = 0.3546 and $\frac{D_1 - d_1}{D_1 + d_1} = 0.3095$. Hence a second solution is not possible.

Graphical Method of Determining Center Distances

With any point C as a center (Fig. 7) draw the two half pitch circles GAB and HIK. Divide the smaller semicircle into n equal parts and the larger semicircle into N equal parts. Number these points of division consecutively in reverse order beginning with H and G. From these points of division draw radial lines as shown, toward the center C, filling about one-third of the semicircles. Note where two even numbered or two odd numbered radii coincide, or nearly coincide. (Pay no attention to coincident lines which are not both odd or both even numbered.) On such a coincident pair of radii lay off a distance WJ equal to the radius of the smaller circle and draw JT perpendicular to WC. Lay off KF equal to WJ and draw FQ perpendicular to HK. Measure FS and take a point E on FQ as near S as possible, but such that FE will be an exact multiple of the pitch. This point E will be the center of the smaller sprocket, and EC will be the center distance, *provided* the radii, such as C-10 and C-22 actually coincide.

If these radii do not exactly coincide, move the point E toward F a distance equal to one-quarter of the sum of the distances between the radii, as measured at the inner and outer circles (that is, their distance at 10 and 22 in this case). Then E_1C will be the correct center distance. There will be as many solutions as there are pairs of like numbered radii that coincide, or nearly coincide—limited, however, by the interference between sprockets with center distances less than the sum of the two radii.

The elimination of all slack in a chain is not of vital importance except in certain cases. Often a reasonable amount of slack produces quieter action and lessens the tendency of the chain to "whip." Wherever the larger sprocket has 30 teeth or less it will pay to give attention to the center distance which makes the span of the chain an exact multiple of the pitch and reduces the fluctuations in angular velocity ratio.

* * *

STRENGTH OF WOODEN CRATES FOR SHIPPING

The United States Forest Service, in its forest products laboratory at Madison, Wis., has made some experiments to determine exactly what construction for crates used for shipping machinery and other products is the strongest type and will require the least amount of lumber. The views in the accompanying illustration show three different types of crates. Fig. 1 shows a crate which appears to be very strong, because of the amount of wood used, but tests have shown that crates so braced are weak in the diagonal direction of the faces, and are likely to give trouble during transportation.

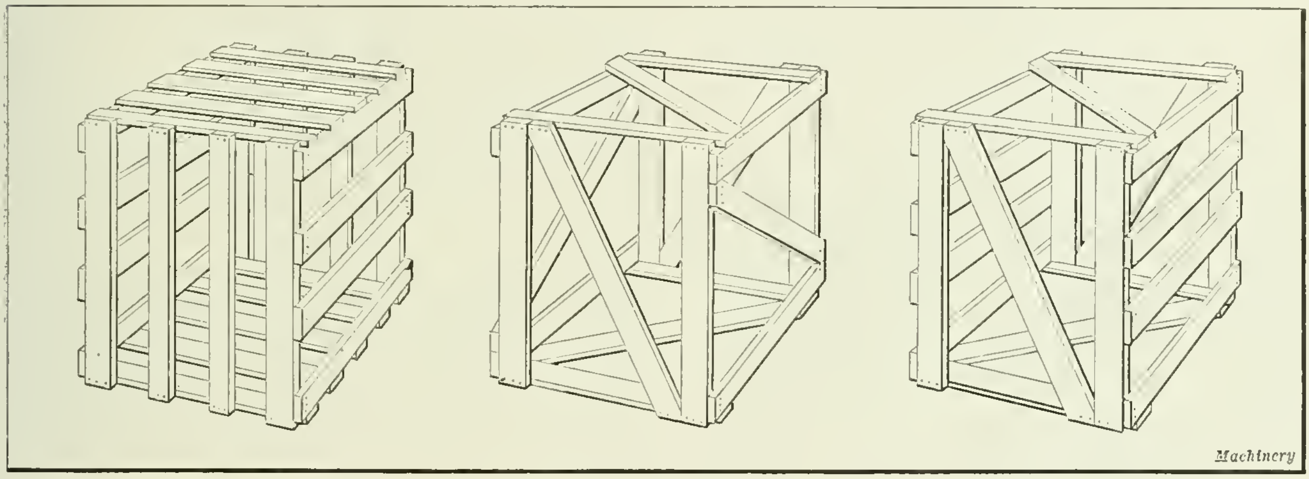


Fig. 1. Crate that is weakly braced **Fig. 2.** Crate having Maximum Rigidity **Fig. 3.** Combination Diagonal and Parallel Bracing

The best crate to use, as far as strength is concerned, is that shown in Fig. 2, which has diagonal braces on all six sides, giving the maximum rigidity for a minimum amount of lumber. Crates so braced withstand with considerably less distortion a diagonal compressing force than do crates constructed as in Fig. 1.

The combination of diagonal and parallel slat bracing shown in Fig. 3 makes the crate more rigid than parallel bracing alone, but not so rigid in all directions as cross bracing on the six sides. It may be found an advantageous construction in packing contents which need protection on the sides and are rigid enough themselves to withstand stresses in the direction in which the crate is weak.

* * *

During the first six months of the present year, the loss in wages due to strikes in the state of Pennsylvania alone was $117,500,000, exclusive of the railroad shopmen's strike.

Grinding in the Railroad Industry

Truing Worn Piston-rods—Grinding Guide Bars, Axles, Pins, Valve Gear Links, Slide Valves, and Car Wheels

By the Engineering and Educational Departments of the Norton Co.
Worcester, Mass.

Shops belonging to the railroad industry may be divided into three principal classes—those engaged in (1) the manufacture of rolling stock; (2) the repair of rolling stock; and (3) the manufacture of rails, switches, cross-overs and other track equipment. In the manufacture of rolling stock, many of the grinding operations are practically of the same nature as those performed in railroad repair shops, and this article will be confined chiefly to the latter, in view of the fact that most railroad shops are engaged in repairing. On the average, every locomotive in the country is dismantled for repairs once every year. The severe strain upon every moving part either wears or distorts it so that repairs are necessary.

In former years the machining of locomotive parts was thought of as a semi-precision operation. Now, with the advent of the grinding machine, much closer limits can be adhered to with little effort, and this improved quality of workmanship has been obtained, in many instances, in conjunction with greater efficiency. Grinding is applied in the production of new work and in connection with repairs as a means of truing worn surfaces of both hardened and unhardened parts. In performing this truing operation, it is usually essential to remove as little metal as possible, as in the case of piston-rods, links, etc., in order to prolong the life of whatever part is made true by the grinding operation. Grinding is the ideal method of truing such parts as rods, pins, bushings, guide bars, slide valves, links, or other parts that become worn from rubbing or sliding.

Piston-rods wear out of round and shoulders are formed at points representing the limits of travel through the packing. They are usually reground without removing the pistons from the rods. Sometimes the rod is first rough-turned in a lathe, but usually this operation is unnecessary and the rod is ground in one operation on a cylindrical grinding machine. In twenty minutes the whole rod can be finished, removing just enough stock from the diameter to true the rod, which is made round to within 0.0005 inch and with practically no taper. A piston-rod can be repaired in this manner many times before it has to be scrapped, less metal being removed by grinding than by turning and filing. An alundum or some other aluminous abrasive wheel should be used. Ordinarily, a wheel 24 inches in diameter by 3 inches thick, having a grain size of either No. 24 combination or No. 50 (half No. 46 and half No. 60) and grade L in hardness, is satisfactory (Norton grading).

A Norton grinder of the gap type is shown in Fig. 1 truing a piston-rod at the Kingsland shops of the Lackawanna Railroad. In this particular instance, an alundum wheel of grain 6624 and grade K is used. A new end has been welded to this rod, but when the operation is simply that of truing, the piston head is not removed, and then the extra swing obtained with the gap grinder is required.

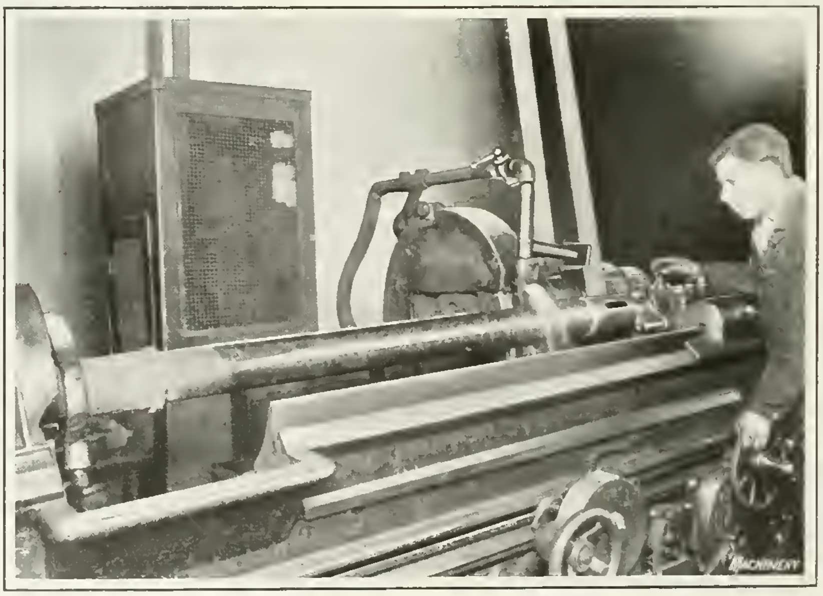


Fig. 1. Retruing a Worn Piston-rod by Cylindrical Grinding

Pin Grinding

Many small cylindrical locomotive parts are ground. Most of them, such as link-block pins and cross-head pins, both tapered and straight, are casehardened and must be ground. Such parts are ground on machines smaller than those used in grinding piston-rods. Aluminous abrasive wheels of grain No. 50 or No. 60 and grade K are employed. This conforms with the theory of "softer wheels for harder material."

Grinding Valve Gear Links

Links for the Walschaert or Stephenson valve motions must be accurately machined in order to obtain proper operation of the valves. By means of a link-grinding machine such as the Hammet or Newton, this can be accomplished readily. The operation of these machines is such that an adjustable radius arm gives the proper circular motion to the links. A Hammet machine is shown in Fig. 2 grinding one section of a link of the assembled type. The arm that controls the circular movements of the

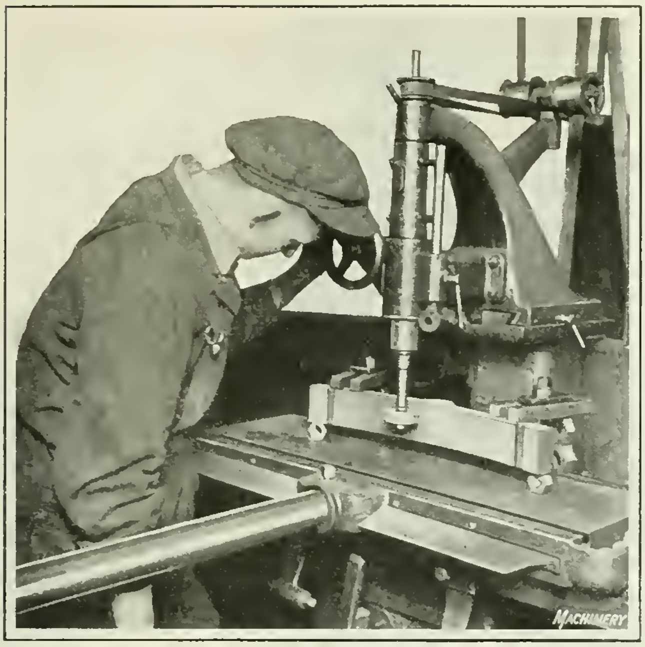


Fig. 2. Grinding One Section of a Reversing Gear Link

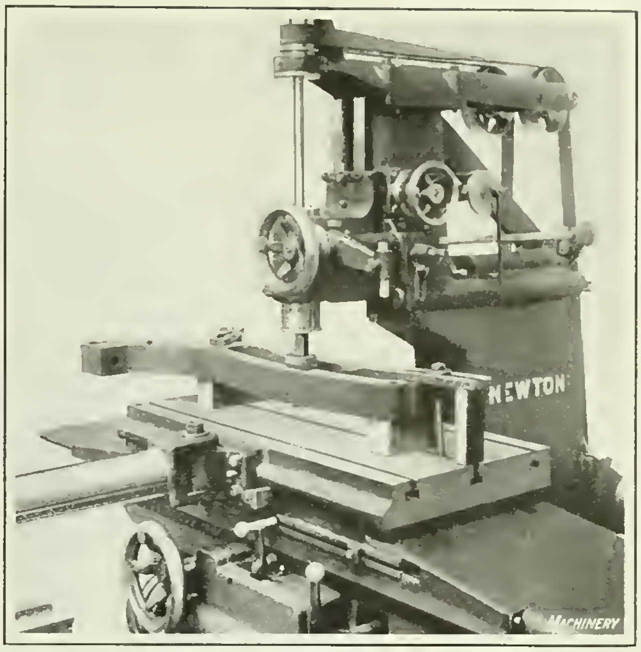


Fig. 3. Another Design of Link-grinding Machine

work-holding table extends out from the front of the machine, and swings about a bearing or pivot, which is adjusted to suit the link radius. The lower section of the work-table operates with a reciprocating motion, and the length of stroke is controlled by adjustable dogs or tappets. Machines of this type are also used for grinding solid or one-piece links which require a small grinding wheel because of the narrow clearance spaces at the ends of the link.

A Newton link-grinding machine is shown in Fig. 3. The circular motion of the work-table is controlled by a pivoted arm as in the machine previously referred to. This pivot or bearing may be adjusted along its supporting rail by a rack and pinion. The spindle slide has a reciprocating motion of ½ inch, which permits using a wide wheel that will cover the entire surface to be ground. When smaller, narrower wheels are required, an intermittent vertical feed may be obtained. The spindle head is adjustable on the upright for regulating the depth of cut. In some railway shops it has been the practice first to plane these "radius-links" on a planer equipped with a radius attachment, and then finish them by draw-filing. This method, however, requires considerable time and is, of course, less accurate than grinding.

Internal Grinding

Holes in such parts as eccentric rod connections, valve motion links, reverse shaft bearings, side-rods, large bushings etc., are ground most economically on a machine similar to the Heald cylinder grinding machine. In this machine a small wheel is mounted on a spindle which, in addition to rotating on its own axis, also travels in a circular path concentric with the circumference of the hole. The radius of the circular motion can be altered at will, by means of a micrometer adjustment, thus allowing for any size hole within the capacity of the machine. This type of machine allows the work to remain stationary, and is especially adapted for grinding parts that cannot be revolved readily, because of either their shape or size. The grinding of hardened steel bushings in the knuckle joint pin-hole of a connecting-rod illustrates the kind of work that cannot be revolved but is readily ground on a machine of the planetary type. Fig. 4 shows a Heald machine grinding a reverse shaft bearing which is located at one side of a heavy cast-steel bracket.

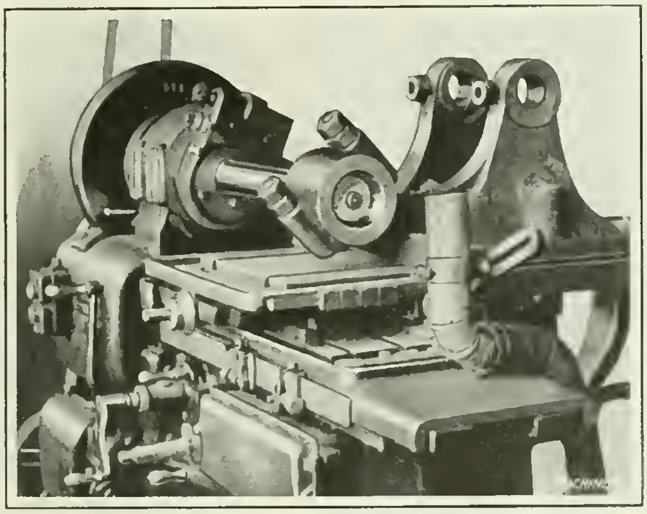


Fig. 4. An Example of Internal Grinding in a Railroad Shop

Surface Grinding Operations

Guide bars which have become worn due to the travel of the cross-head can be trued economically on an open-side type of grinding machine. Fig. 5 shows a Diamond face grinder truing one of these worn guide bars. This particular illustration shows a guide bar 5 feet 9 inches long, and 7 inches wide. About 1/16 inch of stock is removed from the face, and 3/64 inch from the two sides, and the bars are finished at the rate of six in an eight-hour day. This machine will remove about 0.003 inch of stock at each stroke of the table, and the wheel is dressed only twice a day.

Fig. 8 illustrates the use of a face grinder for grinding the sides of connecting-rods. Four of these rods are ground simultaneously by holding them against the face of a large magnetic chuck. By grinding these connecting-rods, the allowance for finishing may be reduced from about ¼ inch to 3/32 inch. Production was also increased from one rod in one hour twelve minutes to four rods in the same time.

Face grinders have proved efficient for many other operations in railroad shops, such as the grinding of slide valves, driving-box shoes, boiler supporting brackets, links, etc. A Bridgeport face grinder is shown in Fig. 6, grinding the sides of a pair of links. This operation is performed after the links have been casehardened. The wheel used in this particular instance is of the sectional type as the illustration shows

In general, the wheels used on face grinders are coarse and rather soft, because the contact area between the wheel and the work is relatively large. The Norton Co. recommends grain No. 14 or No. 16 and grade L alundum for grinding soft steel under average conditions, and the same grain size with grade K crystolon abrasive for cast iron.

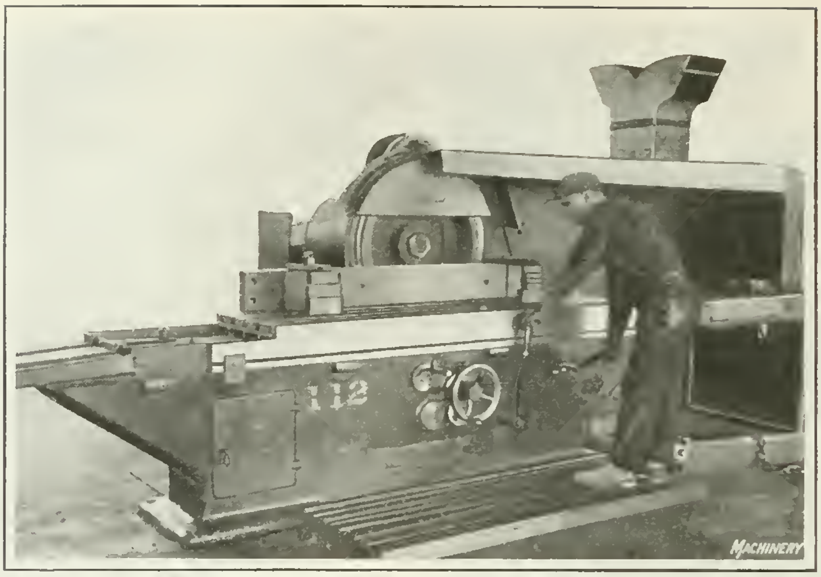


Fig. 5. Truing Worn Surfaces of a Guide Bar on a Face Grinder

Axle journals give the best service when ground cylindrically. The smoother and more accurate any bearing surface is, the less the friction will be, with a resulting improvement in wearing quality. Fig. 7 illustrates the grinding of the journal of a car wheel axle.

Car wheel grinding has always been done to a great extent but as yet not all car wheels are ground. Car wheels in general have soft iron centers with deeply chilled treads. It is economy to grind new wheels to prevent difficulties that arise from wheels being slightly out of round. Used wheels that have developed flat spots are economically salvaged by grinding. Owing to the fact that the metal in this case is cast iron, carbide of silicon instead of aluminous abrasive wheels are used. On the Norton car-wheel grinding machine (Fig. 9) wheels 24 inches in diameter by 4 inches thick are employed in grain sizes from No. 16 to No. 20 and in grades P and Q. Grades P and Q are harder than the grinding wheels ordinarily used on cylindrical grinding machines. They are used because of the type of machine and method of application. The work in this case is not traversed, but the grinding wheel is fed straight in, so that the entire surface of the tread is ground with the full width of the wheel.

The car wheels are usually not removed from their axles before grinding. During the grinding the car axles revolve on their journals rather than on centers. On this account some vibration takes place, which tends to disintegrate the wheel structure, and this, together with the very great pressures applied to hasten the grinding necessitates the use of the very hard wheels mentioned. Steel car wheels are ground with an aluminous abrasive, especially the so-called Davis wheel which has a manganese steel tread with a carbon steel center.

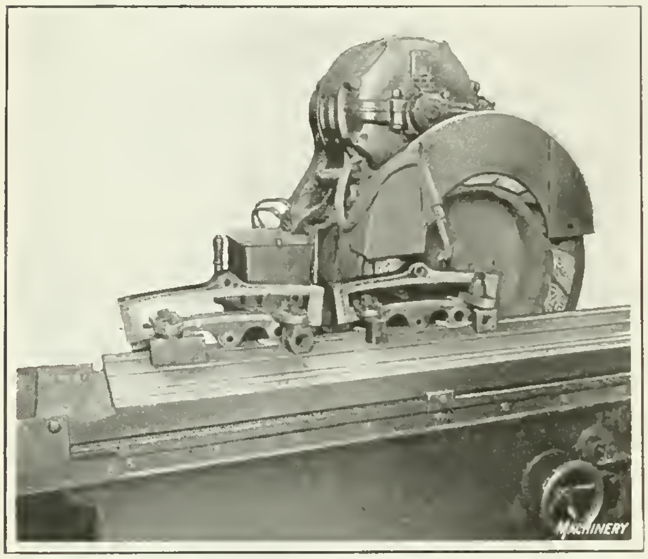


Fig. 6. Grinding the Sides of Links on a Face Grinder

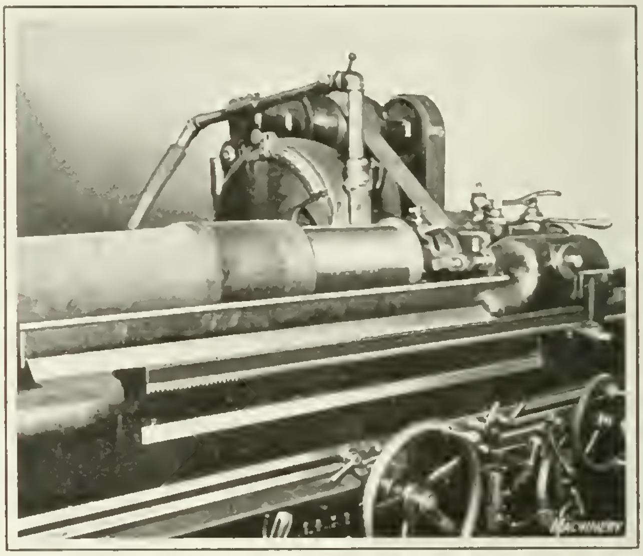


Fig. 7. Finishing the Journal of a Car Wheel Axle by Grinding

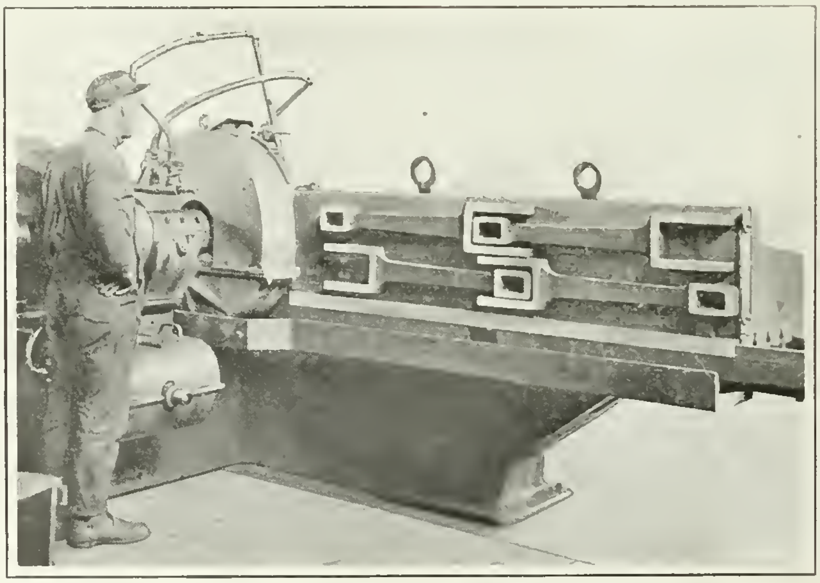


Fig. 8. Face Grinder arranged for grinding Sides of Connecting-rods

Very little grinding is done on the ordinary steel rail which is turned out in the rolling mill, but cross-overs and frogs and switches are made of manganese steel, owing to the severe use to which they are subjected, and since this metal cannot be machined economically with steel tools, grinding wheels must be used. These manganese steel parts are cast in molds. The first operation, therefore, is to remove the fins, gates and nails, by the use of swing-frame grinding machines (Fig. 10). Frogs and cross-overs are then generally finished on a large planer-type surface grinding machine. The casting is clamped on the table of the machine, and the tops of the rails are surfaced (Fig. 11). The next operation is the grinding of the line or groove in which the flange of the car wheel travels. This groove must be ground to the proper shape and depth. The cross-over is so clamped on the table of the machine that the grooves are in alignment with the table slide, so that the grinding wheel will follow them. A wheel 1¼ inches wide, properly shaped at the face, is generally used. Care must be taken to see that the grooves are ground to the same depth and that one groove is not ground lower than another at the place of junction at the corners of the cross-over. This prevents jolting when the flange of the car wheel bears on the groove bottom just at the point of crossing.

The sides of the eight ends must be ground smooth so as to make a proper seat for the fish plates (tie plates). The ends are also ground square so that a good butt joint will be made with the rail it ties to. Both of these operations are performed with portable grinding machines of the electric or pneumatic type, having wheels 8 or 10 inches in diameter, or by the use of special precision machines. Often the stubs of large wheels can be utilized for this work. In some plants precision grinding machines are not employed for surfacing and grooving the cross-overs. In such cases the work is done with swing-frame or portable grinding machines. Frogs and switches are likewise machined by grinding.

The limit of the application of the grinding machine in the railroad industries has by no means been reached. Each year adds new operations which formerly were accomplished by steel tools. Grinding wheels, both when used as precision tools and when used as tools for the rapid removal of metal in a rough, offhand method, are of great importance. Their success depends upon an intelligent understanding regarding their use.

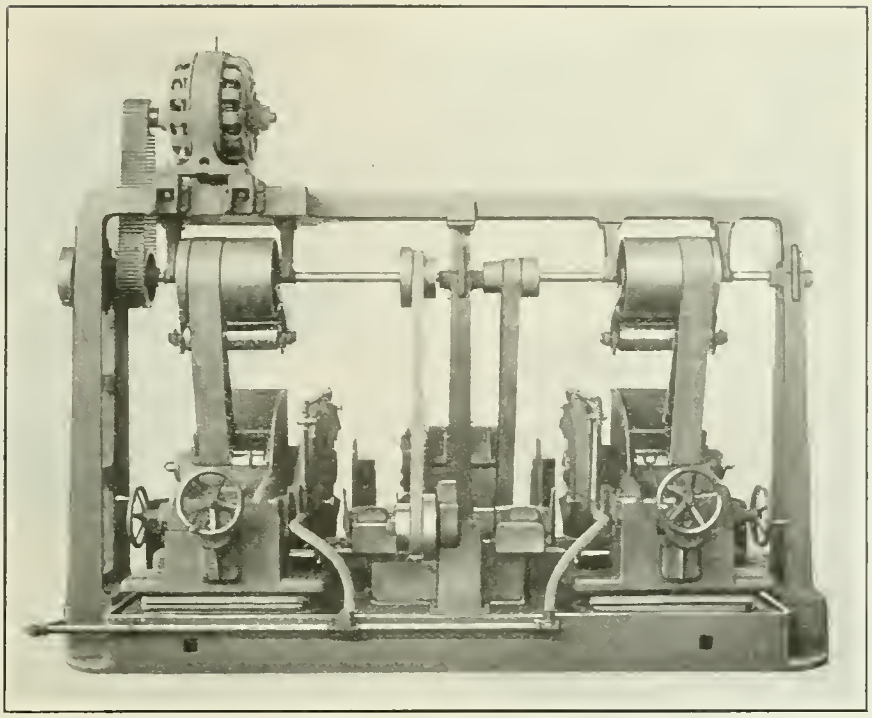


Fig. 9. Duplex Type of Car Wheel Grinder which finishes Entire Surfaces of the Treads as Grinding Wheels are fed in

* * *

STANDARDIZATION OF ELECTRIC DRILLS

What are believed to be the first standards for portable electric drills were adopted by the Electric Power Club on August 20, and are printed in Bulletin 7900, issued by the club. These rules are the nucleus of a complete group of electric tool standards, and what has already been accomplished includes a definition of what constitutes a portable electric drill, test requirements of the motors, performance specifications for drilling, standard sizes of drills, and the information which should be given on drill name-plates.

Electric drills are now widely used, not only for maintenance work, but also very largely as tools of production. The users of electric tools have felt for some time that these devices should be standardized, and it was to meet this need that the Power Club's Electric Tool Section, comprising the representative portable electric tool manufacturers of the country, has undertaken the work. The electric drill standards will be published in the next edition of the Electric Power Club's Handbook.

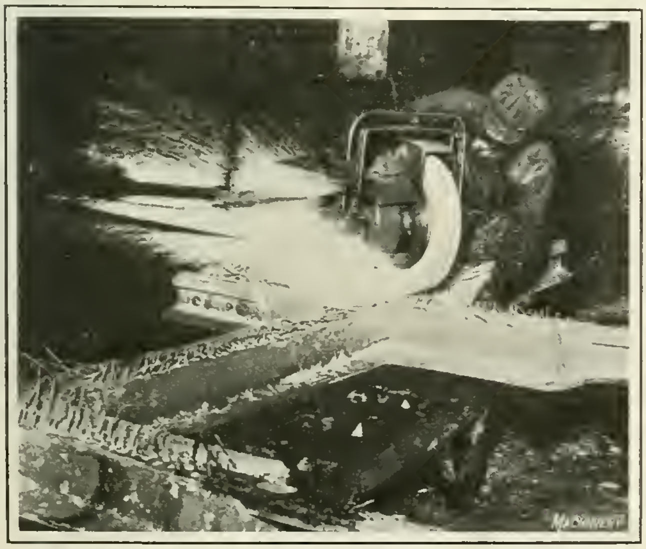


Fig. 10. Snagging a Cross-over by using Swing-frame Grinder

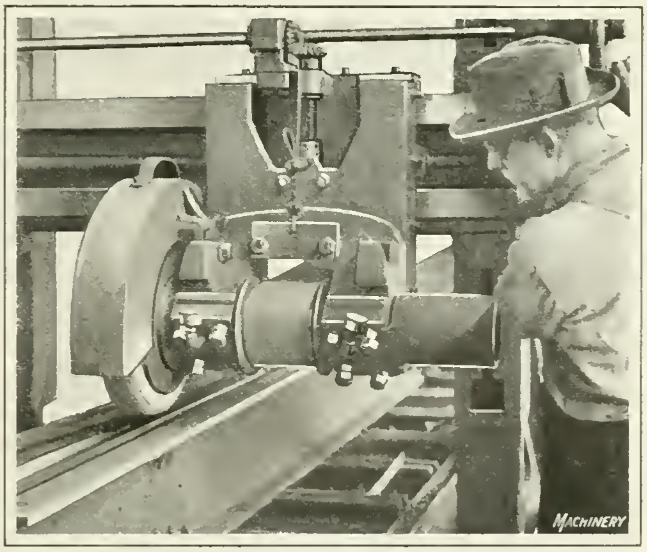
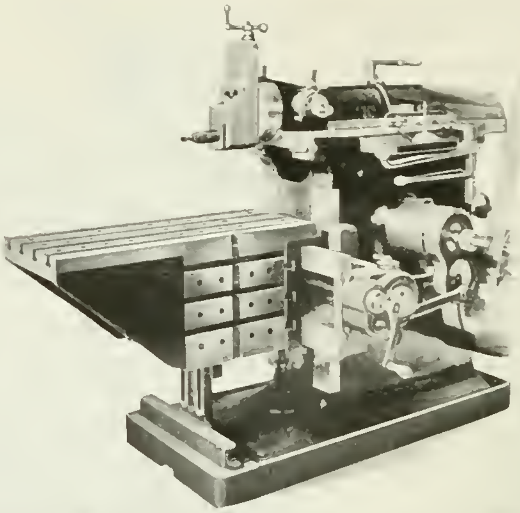


Fig. 11. Grinding Upper Surface of a Street Railway Switch

Shaper Table Supports

Devices Employed by Various Manufacturers to Counteract the Downward Thrust of the Cut

By FRED HORNER



As the shaper has a work-table supported at one end only, like the knee on a milling machine, the tendency of the cutting pressure is to spring the table downward. In the milling machine, braces are added to tie the over-arm to the knee, and often the latter to the base, these provisions compensating largely for the one-sided design of the knee. In the shaper, this provision was neglected, until the introduction of high-speed steels and high production rates forced consideration of this matter.

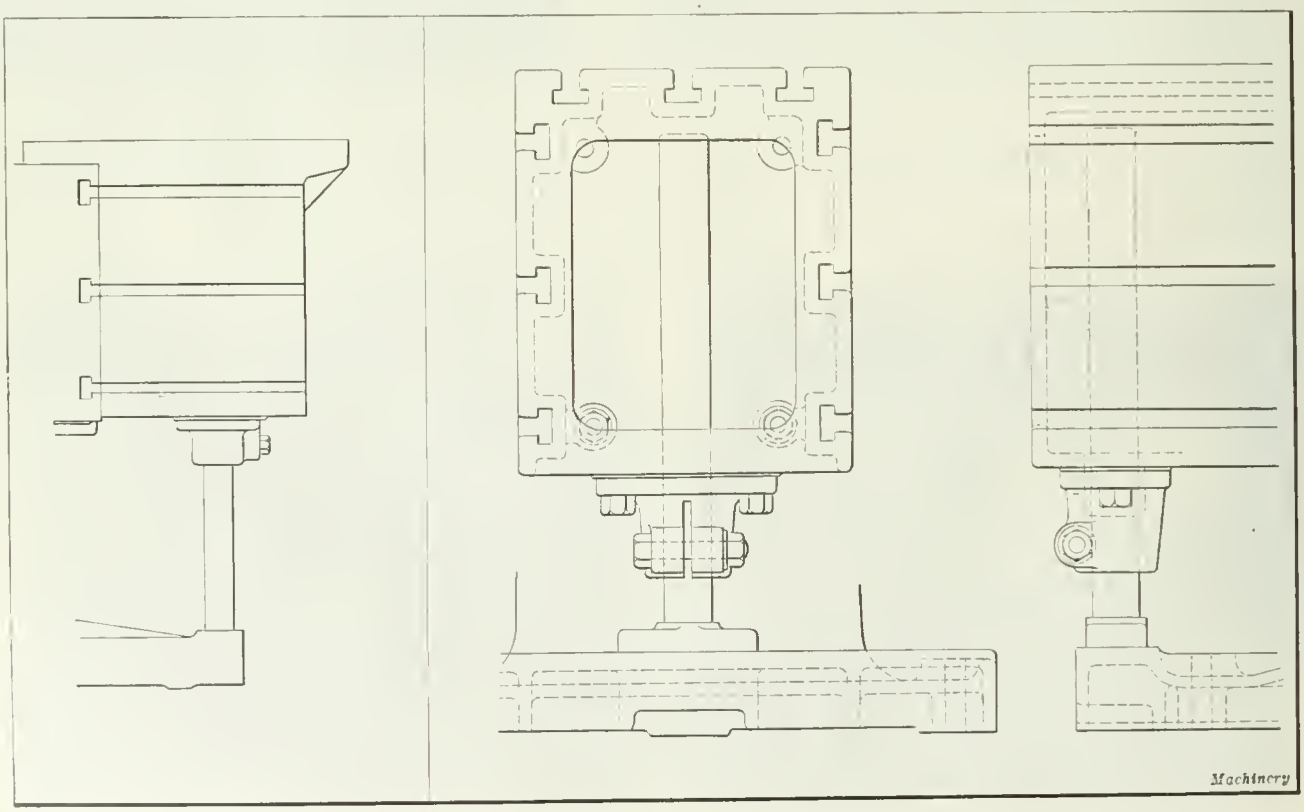
Points to be Considered in Providing a Support

Part of the table deflection due to the pressure of the cut can be prevented by an improved design of the gib arrangements, in which the top gib is of wedge shape, so that additional stresses on the table help to pull it harder against the contact faces. With the draw-cut shaper, the thrust of the tool is directed toward the column, and there the table is pushed against the saddle. But no device entirely prevents deflection so long as the table is unsupported near the extended end, as even the weight of heavy work will produce some deflection before the tool pressure is applied. An additional table support is therefore advantageous, not only to keep the table in the proper position under all circumstances, but also to relieve the saddle cross-rail and fastening devices of unnecessary strain.

The problem of supporting the table of a shaper is not quite the same as supporting the knee of a milling machine, because in the latter case the knee has no lateral movement. The shaper table has a lateral feed, and any support must allow for this movement. In some designs a machined base is furnished on which the support can run, while in others a narrow facing serves this purpose. There is much variety in the arrangements, the sliding action taking place on the base, on a ledge higher up, or on the under side of the table. If rigidity of construction is assured in any type of support, the next important thing is freedom from chips. In some designs where this vital point is neglected, the table is sprung upward by the supporting device riding on chips or grit. A further consideration in designing a support is whether it shall sustain only the downward thrust and the bending tendency, or whether it shall also take care of lateral and upward deflection due to cutting in those directions. Some supports are arranged to meet these conditions.

Simple Forms of Support

A round bar is used as a support on machines built by the Cincinnati Shaper Co., a bracket being attached to the table as shown in Fig. 1. The bar is gripped in this bracket by tightening a screw after the bar has been brought down to rest on the machined surface of the base. In order to



Figs. 1 and 2. Simple Designs of Round-bar Supports for Shaper Tables, provided to eliminate Deflection caused by Overhang of the Table

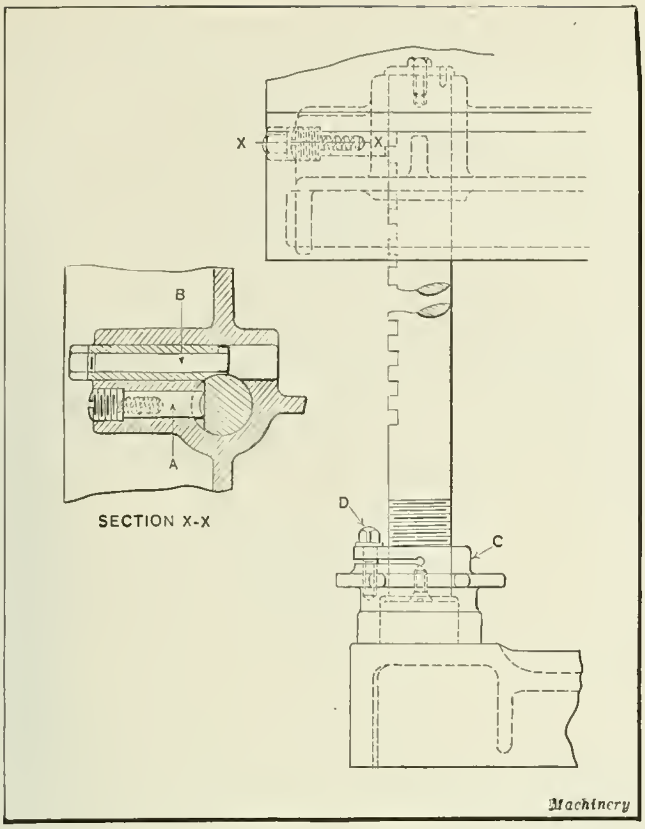


Fig. 3. Construction in which Slipping of the Support is prevented by a Plunger engaging Notches on the Support

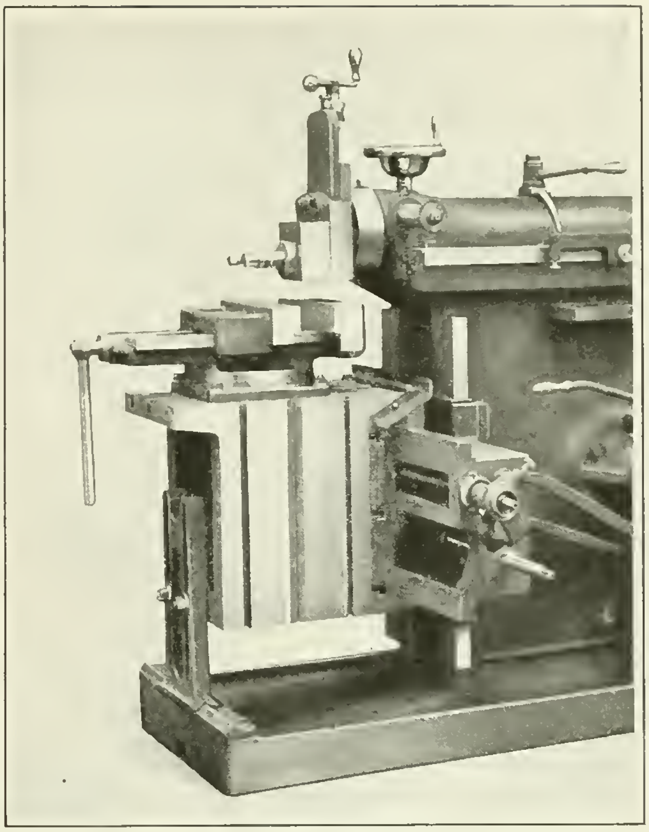


Fig. 4. Bracket Support in which the Lower End slides on a V-shaped Strip attached to the Machine Base

provide a larger sliding surface on the supporting member, some designers prefer a foot, as shown in Fig. 2, which also serves effectively to prevent tilting. The support in Fig. 1 is also often provided with a foot. That in Fig. 2 is found on shapers made by Greenwood & Batley, Ltd., Leeds, England.

The usual practice of holding the supporting bar by friction alone is modified in shapers built by the American Tool Works Co., by having a series of notches and a locking plunger that afford a positive check to slipping. This construction is shown in Fig. 3. Near the bottom of the table a spring plunger *A* engages one of the notches along the bar, and the bar is then held firmly by means of bolt *B* which has a machined surface at the end that engages the bar. Any slight adjustment that may be necessary is made by turning the split nut *C*, which is locked in place by tightening screw *D*. The Smith & Mills Co. also utilizes a bar support, but instead of traveling on the base, it always remains in a central position under the tool, the under side of the table sliding on the cap of the support. The arrangement is shown in Fig. 5. The machine base is recessed at the front, and a bracket is mounted on machined surfaces on each side. A sleeve set into a bearing at the top of the bracket permits vertical adjustments of the bar. This sleeve may be clamped in any required position.

Designs in which Brackets are Employed

In many instances a bracket of rectangular cross-section is substituted for the bar support, the bracket construction

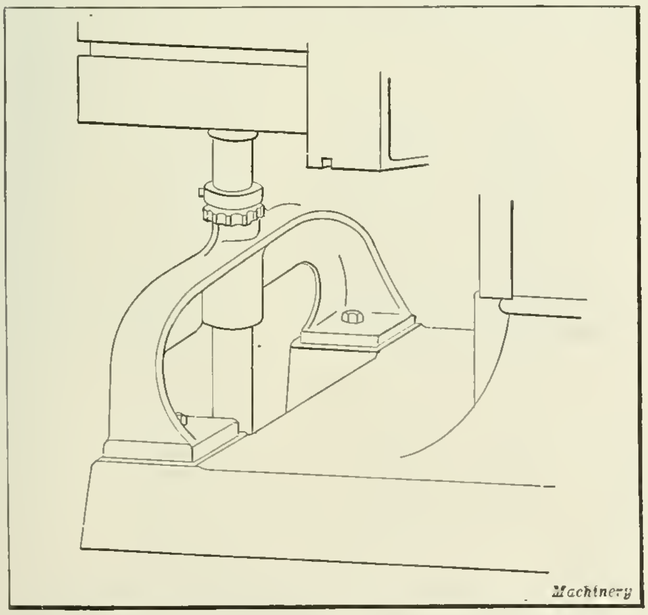


Fig. 5. Example in which the Supporting Bar extends through a Sleeve in a Bracket mounted on the Base of the Machine

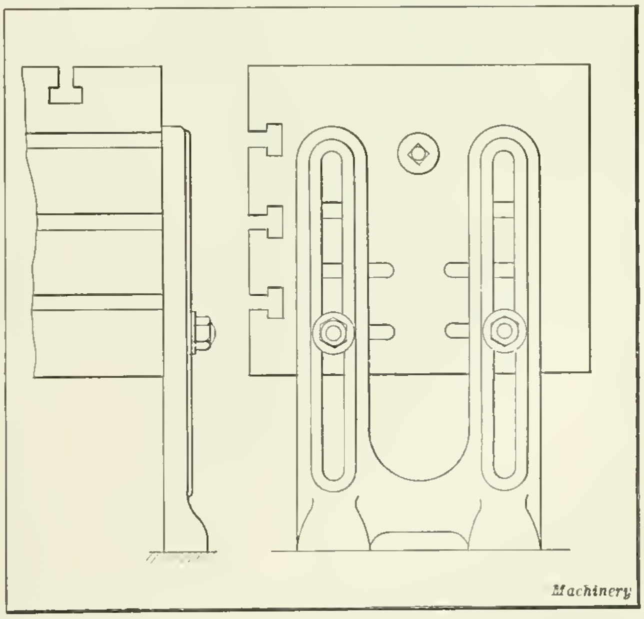


Fig. 6. Support for Shaper Table consisting of an Upright Bracket having Two Feet and Two Slots for Clamping Bolts

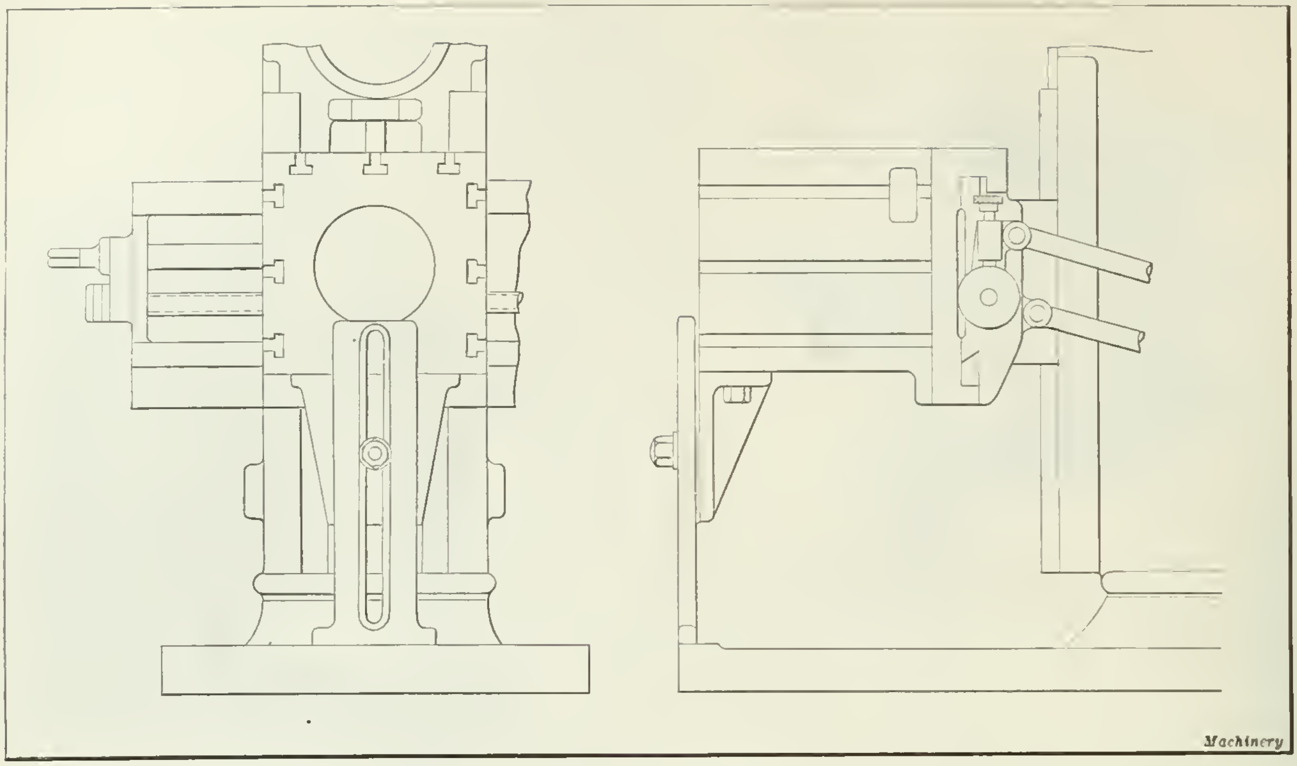


Fig. 7. Design in which the Upright is attached to an Angle-bracket fastened to the Under Side of the Shaper Table

being used to resist twisting stresses on the table. Sometimes this design is adopted in order to obtain an increased area of the wearing surfaces. Methods of jointing the bracket and table together vary. Some bracket supports are bolted directly to an ordinary table without any special provision for the purpose, while in other cases slots, surfaces, or apertures are machined for the support. Fig. 6 illustrates a plain two-slot bracket bolted to the front of the table on a large traversing-head machine built by Henry Holmes & Co., Halifax, England. This bracket has two feet. A similar example, but with a V-shaped foot having felt pads and sliding on a V-strip on the base is shown in Fig. 4. This design is found on shapers made by the John Bertram & Sons Co., Dundas, Ontario, Canada. The arrangement shown in Fig. 7, which transfers the clamping position from the front to the under side of the table, is a feature of the machines made by the Ormerods Tool Co., Ltd., Hebden Bridge, England. The angle bracket materially stiffens the slotted upright.

Giving the upright an inside location offers a slight advantage by leaving the front of the table practically clear. The Oldfield & Schofield Co., Ltd., Halifax, England, follows this method. From Fig. 8 it will be observed that the support extends through the bottom of the table and is clamped, by means of a T-slot and bolt, to an angle bracket attached to the table.

On Gould & Eberhardt shapers a lug is cast on the under side of the table as shown in Fig. 10. A finished surface on this lug affords a seat for the support, but instead of the latter being situated near the front of the table, a midway location is selected, so that the support will sustain much of the weight ordinarily placed on the cross-rail. The slotted upright has a series of serrations on each side of the opening and is fastened to the table lug by means of a stud bolt and a member which engages the serrations. Final adjustment for height is effected by set-screw A. The machine base projects well forward and has T-slots for holding certain classes of work.

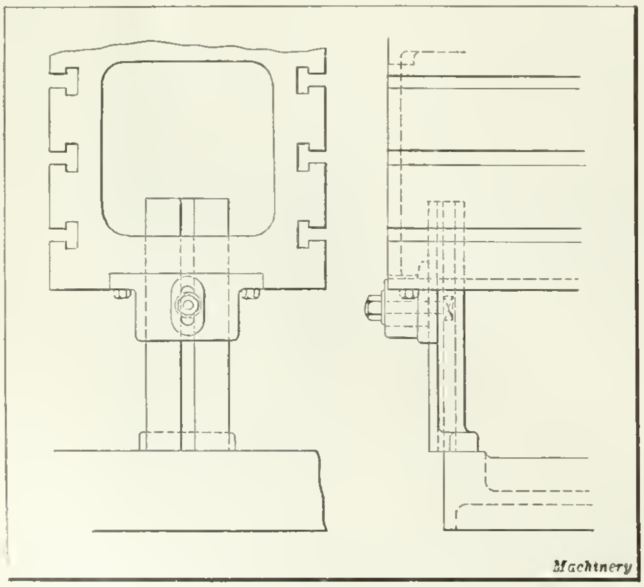


Fig. 8. Support extending into the Table so as to leave the Front Free from Obstruction

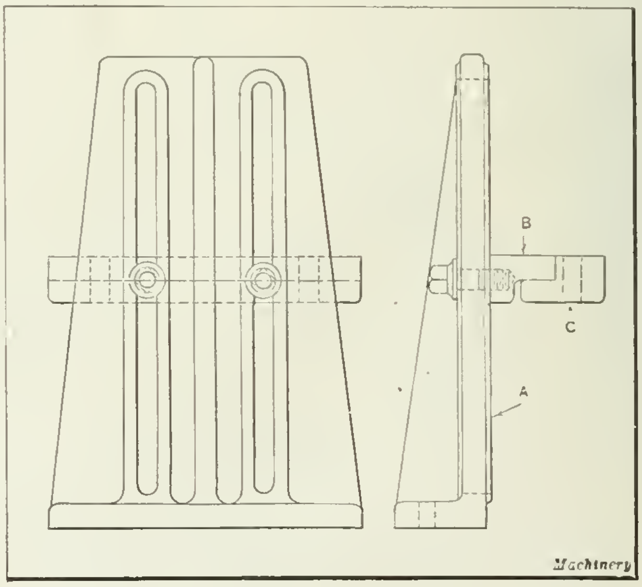


Fig. 9. Details of a Design which prevents both Lifting and Twisting of a Shaper Table

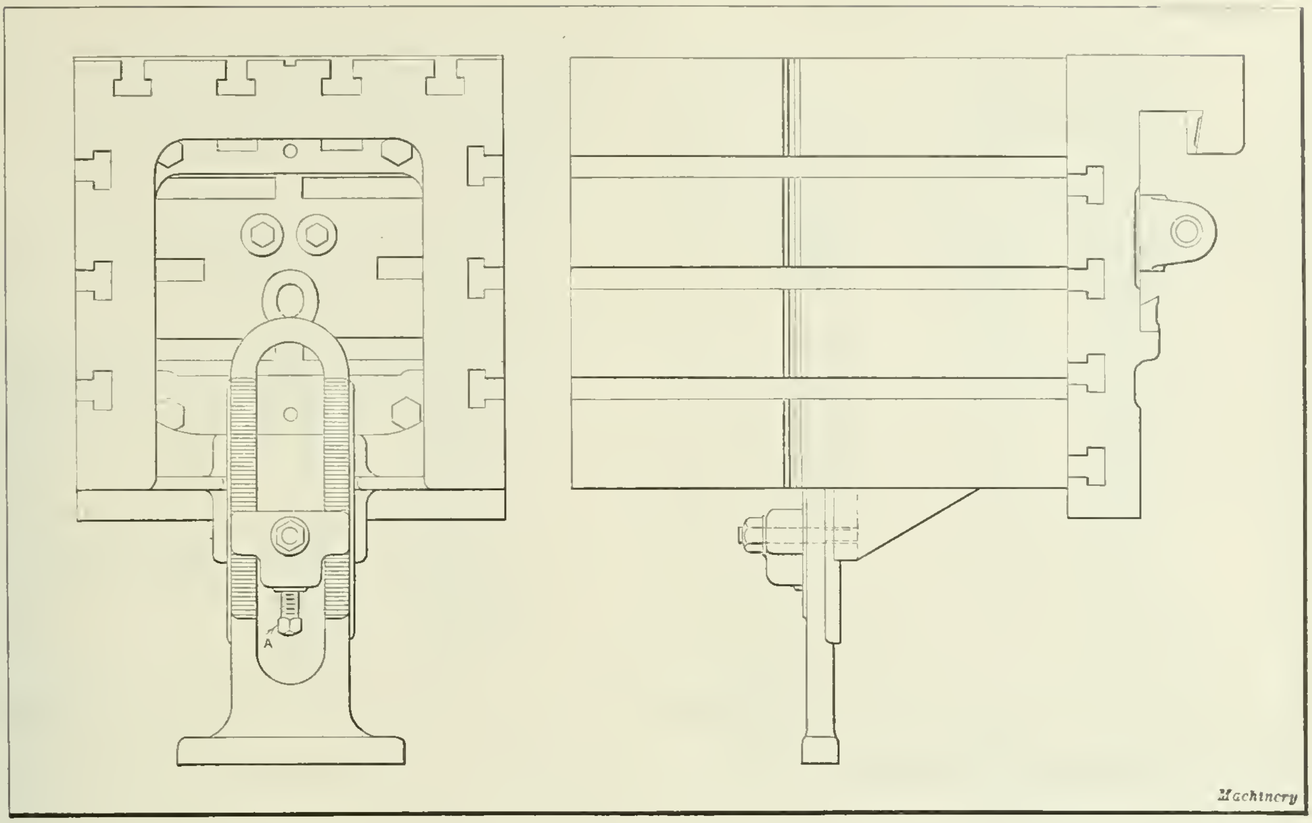


Fig. 10. Construction in which the Support is placed Approximately Midway beneath the Table so that it sustains a Considerable Part of the Weight ordinarily borne by the Cross-rail

The tables of Hendey shapers are also supported at about the center through the use of an angle bracket and a double-slotted upright, but instead of sliding the foot of the upright upon an exposed surface, a special channel-shaped guide is provided, as shown in the heading illustration. The top lip of this guide acts as a guard against dirt and chips. The table in this view has an extension doweled and bolted to the front end to accommodate long work.

Sliding Surfaces at Other Locations than at the Base

The sliding face on the base is avoided in several designs by having an inverted strip slide on a bracket attached to a fixed support bolted to the machine base. One such arrangement is illustrated in Fig. 11, the short angle-bracket *A* supporting the longer one *B* which is bolted to the table. In order to prevent the lifting or twisting of the table, the addition of a strip to resist such deflection is occasionally found advisable. The Streine Tool & Mfg. Co. employs the design illustrated in Fig. 9, which consists of the upright *A*, bearing strip *B*, and slide *C*. On the Queen City shapers a similar result is obtained by having a finished projecting lip at the bottom corner of the table, as shown in Fig. 12, and gibbing the slide casting to it. This prevents lateral or upward displacements and guards against chips.

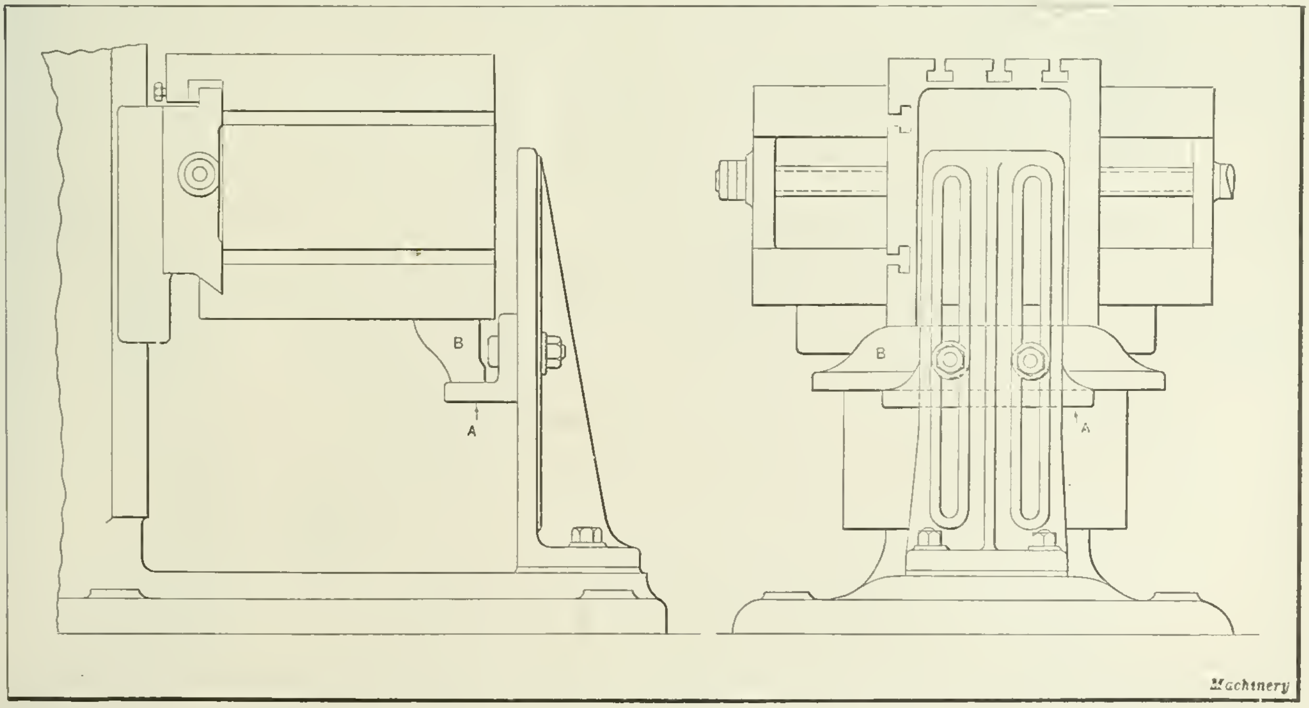


Fig. 11. An Example in which the Sliding Surface of the Support is brought close to the Under Side of the Table

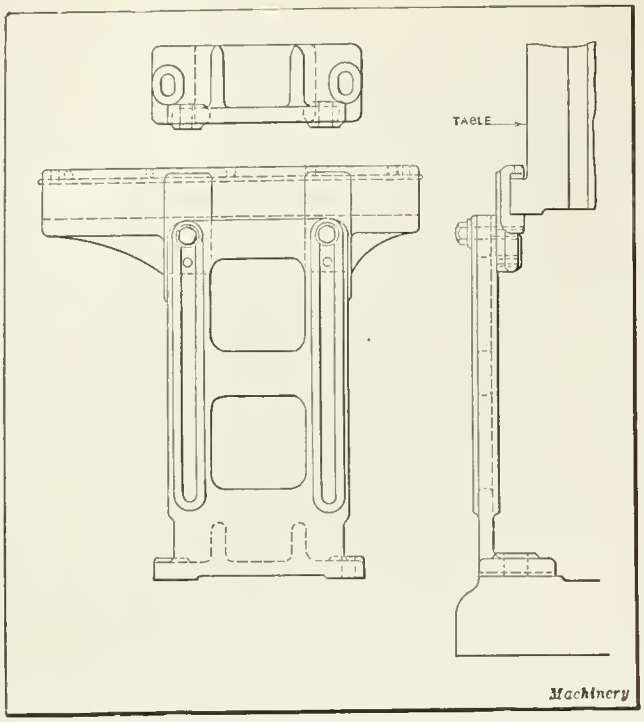


Fig. 12. Support having a Casting at the Upper End that is gibbed to a Machined Lip on the Table

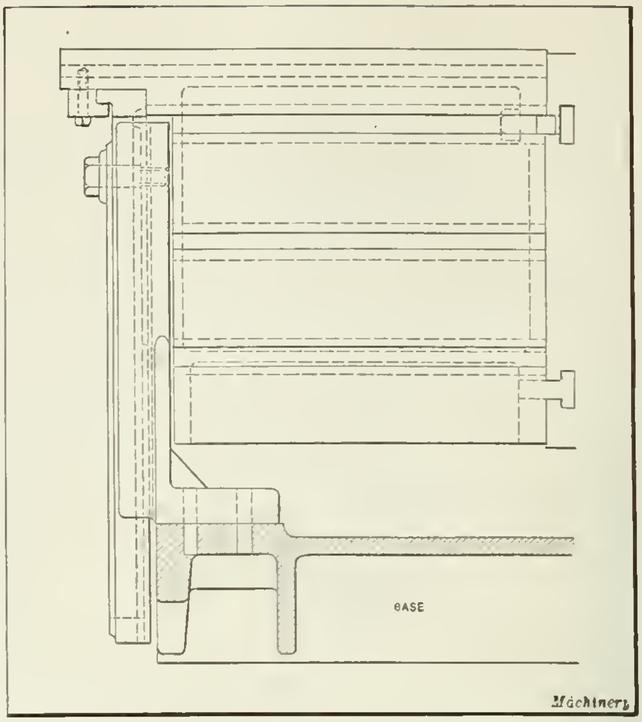


Fig. 13. Table supported by Means of an Overhanging Ledge at the Top near the Front End

Fig. 13 shows a radical difference in the location of the bearing surfaces, the adjustable section of the support reaching right up under the overhanging lip at the top of the table and being gibbed with a strip the full width of the table. This design is found on the larger sizes of machines constructed by the Davis Machine Tool Co. The smaller machines have the angular support illustrated in Fig. 14, which is bolted by means of two spreading feet to the cross-rail, and held rigid by a central foot which is supported on a vertical face on the column.

Supports provided with Rollers

Rolling contact is utilized only to a limited extent for the moving surfaces of shaper supports, and the choice varies between protected rollers on the foot and an inverted arrangement under the table edge. The simple design at *A*, Fig. 15, which is intended for a small shaper, is defective, because the roller rides over chips falling in its path. An end view of the roller is shown at *C*. By placing the roller under the table edge, the trouble from chips may be avoided. Several firms adopt this latter construction, including the Whipp Machine Tool Co., and the Steel Products Engineering Co. Such a design is shown at *B*, in which a well-ribbed bracket is bolted to the base, this bracket having a vertical slot through which passes the clamping bolt of the roller bracket. Some of the Morton draw-cut shapers have a roller bearing support traveling on a machined surface on the base, but protection is insured by felt wipers. This is also the case with the design shown in Fig. 16 in which the use of two rollers provides a good broad base. This type of support is employed on the machines manufactured by the Selson Engineering Co.

Supports for Swiveling Tables

Tables which have a swivel adjustment cannot be employed in conjunction with supports of the types hitherto illustrated, some extra provision being necessary to allow for swiveling. If the table revolves on a pivot extending to the front of the table, the support may be clamped to this pivot, but if there is no such pivot, the upper part of the steady bracket must be made with circular slots to correspond with similar T-slots on the table front.

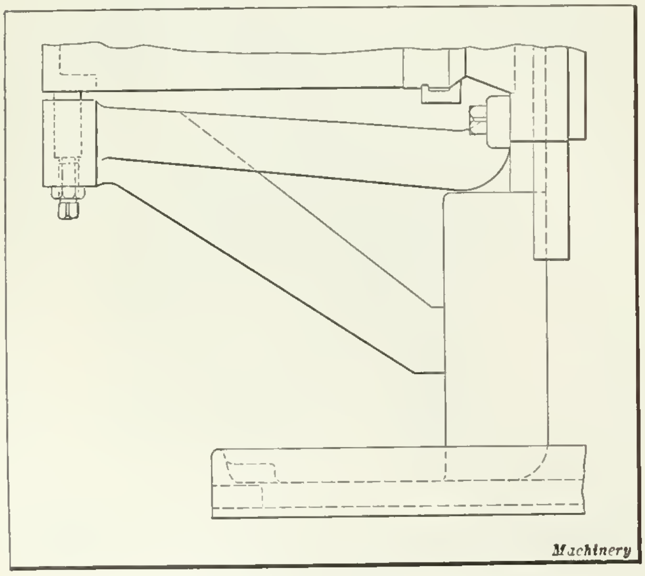


Fig. 14. Table Support having Two Spreading Feet bolted to the Cross-rail and a Central Foot that carries the Load

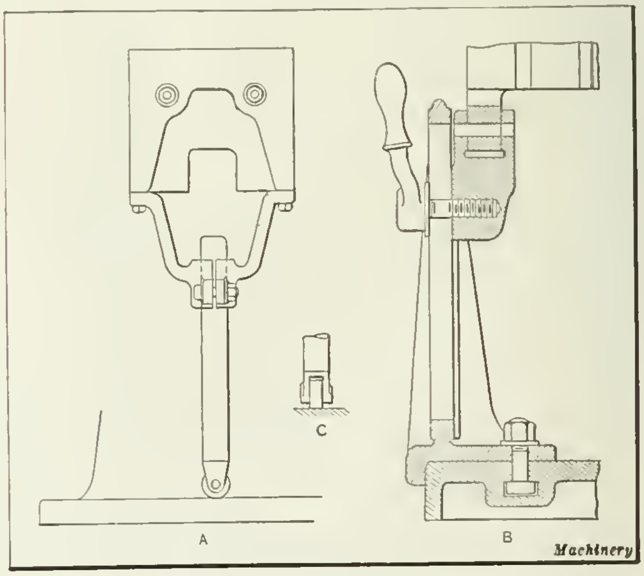


Fig. 15. Two Designs of Table Supports in which Rollers are employed instead of Sliding Members

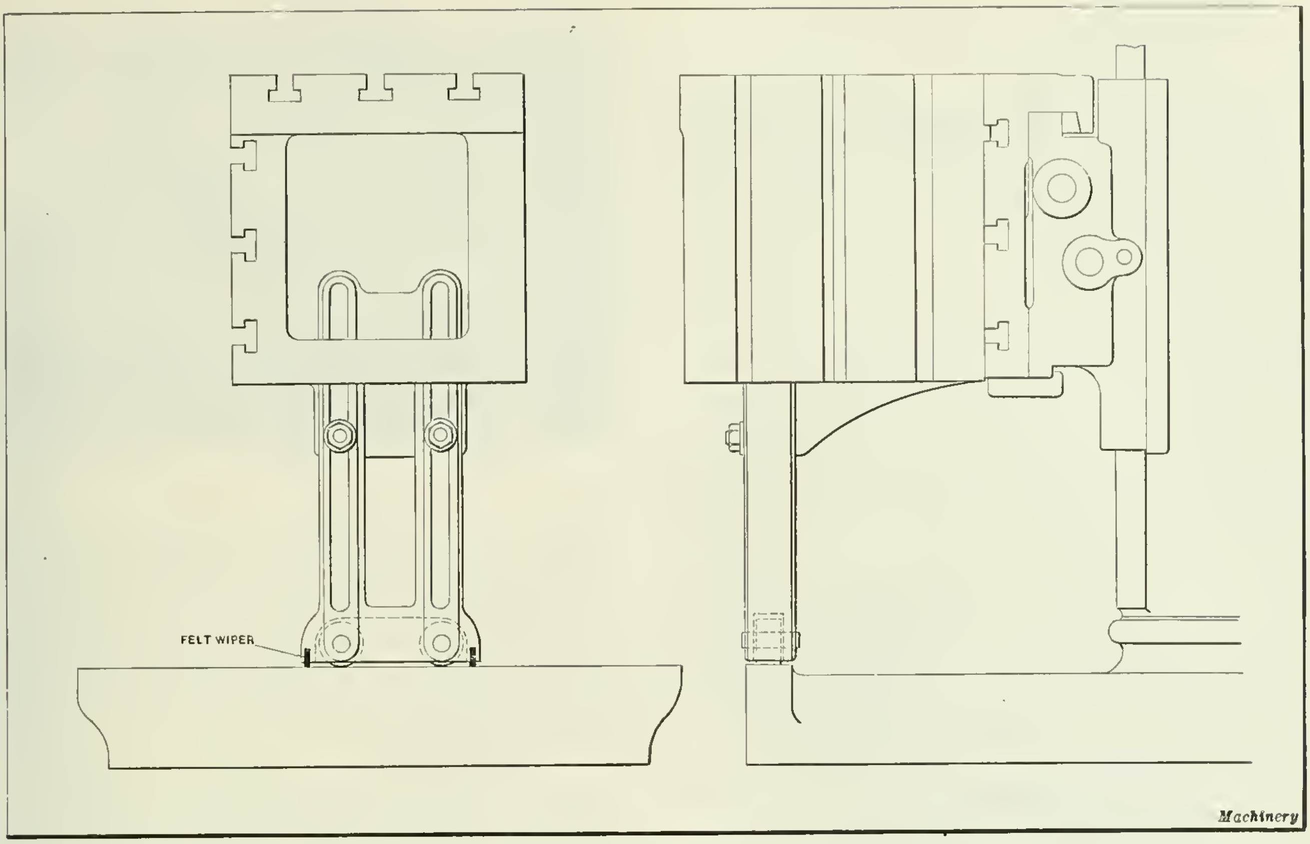


Fig. 16. A Double-roller Support in which Felt Wipers are provided at Each End to keep the Path of the Rollers Free from Dirt and Chips

Two or three bolts in these circular slots would enable adjustments to be made. The shapers made by the R. A. Kelly Co. are equipped as shown in Fig. 17. The plate *B* enables the table to be rotated 40 degrees each side of the vertical, the plate having a bearing edge that slides upon clamp *C*. The latter is secured at a suitable height on upright *A*. Plate *B* consequently remains level at all times, while the table can be swiveled after the bolts in the curved slots have been loosened. There are slots cut on the back of the upright which guide the tongues of the clamping strip; the latter has a ledge at *D* that prevents dirt and chips from falling on the sliding faces.

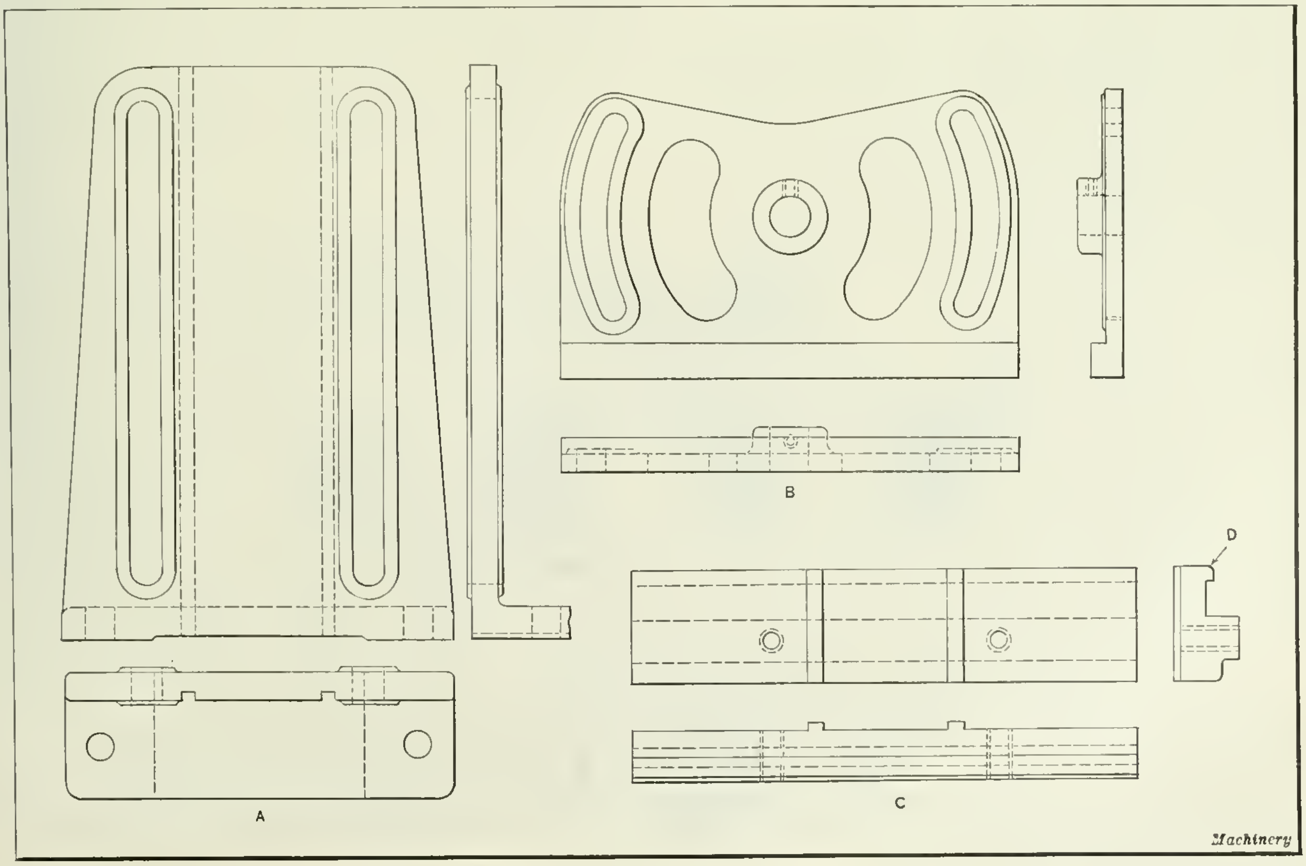


Fig. 17. Details of a Support for a Table which must be swiveled about a Horizontal Axis

Making Pressed-steel Bicycle Frame Parts

THE frame of a bicycle is made of seamless steel tubing joined at the corners by tubular "clusters" or special multiple elbows. Most of the pedal parts and the ball bearing retainers for the pedal shaft bearings are made of pressed steel. There are also many other members that are actually part of the frame—brazed to it—that are interesting examples of pressed-steel work. These include the seat-post cluster which connects the cross-bar and rear wheel upper fork; the crank hanger bracket which unites the frame at the lower "angle," furnishing the housing for the pedal-shaft bearing; and two similar corner pieces for connecting the steering-head section with the frame proper. The methods and special tools used in producing the seat-post cluster and the crank hanger bracket form the basis of this article.

Making Bicycle Seat-post Clusters

The design of the seat-post cluster is shown in Fig. 2. This part is made from No. 16 gage hot-rolled pickled sheet steel, 0.0625 inch thick, and is first blanked into the shape shown at *A* in Fig. 1 on a short-stroke Waterbury-Farrel power press. It is interesting to compare, at the outset, the evolution of the part from this irregular shaped blank to the completed cluster shown at *H*. After blanking, a No. 2½ Consolidated power press equipped with a double punch is employed to pierce two holes of special shape at the crotch and to slit the stock connecting these holes, as shown at *B*.

In the third operation, which is called the "breakdown," one punch is employed to form two circular bosses and at the same time offset the three sections that are later formed into the ends of the branches and finally brazed into the bicycle frame. The appearance of the work at this stage of manufacture is shown at *C*. This operation is performed on a No. 6 Consolidated press, using dies of simple design. The work is next delivered to the heat-treating department, where it is annealed by packing in pots in the regular way. The work is permitted to cool in the annealing pots.

The fourth press operation consists of forming all three branches to practically a U-shape and partially forming the stock to produce the seat-post hole. The work is done on the Bliss press illustrated in Fig. 3, which shows the dies used. The flat work is located on the lower die by two side blocks and a rear block. The upper die member has a former for the front branch and four others, resembling arms, for the other sections to be bent. Two of these are indicated at *A* in the illustration. For work of this kind, a cast-iron die-block is suitable, especially if the quantity of stampings to be formed is not large. This operation brings the part to the form shown at *D*. Before finish-forming the branches, two holes are punched in the previously drawn bosses. This operation is regularly performed on a No. 5 Consolidated press equipped with an overhead knock-out. Fig. 1 does not show a sample of the work after this simple operation.

The next two operations (the sixth and seventh in sequence) close the rear branches to an oval shape, as indicated at *E*, and partly close the main stamping as shown at *F*, both of these operations being performed on a No. 4 Consolidated power press. The eighth operation is sizing the upper end of the center hole *A*, Fig. 2, which after the seventh operation is left approximately oval in shape, as plainly shown at *F* in Fig. 1. After the eighth operation, the work looks like the sample shown at *G*. This operation is also performed on a No. 4 Consolidated press, using a plain cylindrical punch.

The last operation—the final closing of the cluster—is accomplished by means of the dies and arbors illustrated in Fig. 4. It will be seen that one shouldered arbor is used in hole *A*, Fig. 2, which fits the previously sized upper end, and that another arbor at 88 degrees with the first is inserted in hole *B* to obtain the size of this hole and establish the correct angularity of this end of the cluster with respect to the seat-post hole. With the work located in the die grooves by this means, a spreader block *A*, Fig. 4, hinged to the die, is employed to prevent the closing of the rear branches and establish the 19-degree angle. (See Fig. 2.) The die is so made that the spreader block can be replaced to accommodate clusters having rear branches that are to be closed to different angles. The spreader block is a wedge-shaped member and carries a small piece of rubber underneath it to act as a buffer and to strip the cluster from the die at the completion of the downward stroke of the press ram.

The upper die is of a simple design having grooves to match with those in the lower member, and

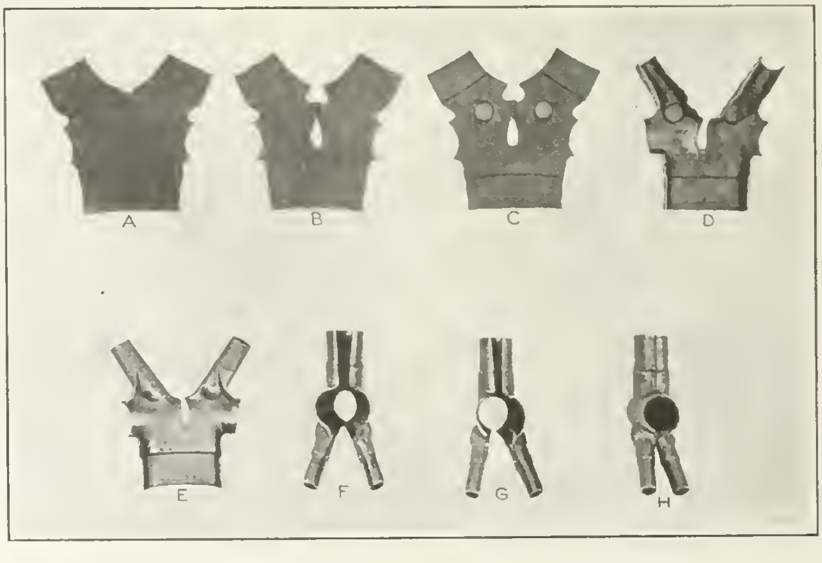


Fig. 1. Bicycle Seat-post Cluster in Various Stages of Completion

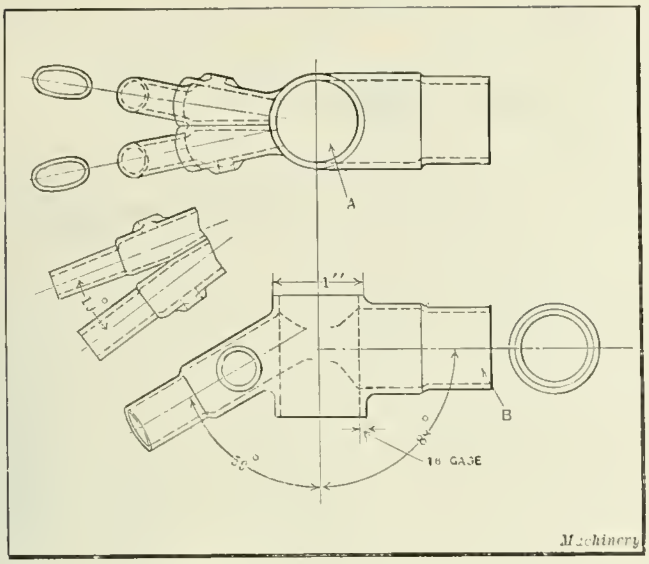


Fig. 2. Bicycle Seat-post Cluster

containing a clearance hole for one of the previously formed bosses. One additional operation is performed on the clusters after they have been taken from stock preparatory to shipment. This consists of sizing the front and rear branches to fit the particular tubing size specified by the customer. The finished cluster is shown at *H*, Fig. 1.

Making Crank Hanger Brackets

Bicycle crank hanger brackets of the type illustrated in Fig. 6 have the main part made from hot-rolled pickled steel, 0.095 inch thick. The brackets are drawn from a 5 19/32-inch blank into a cup in a number of operations. The bottom of this cup is finally punched out and the reinforcements *A*, *B* and *C* that fit the various sizes of tubing of which the bicycle frame is made, are assembled. After blanking, the shell is drawn to 3⅛ inches in diameter by 1⅞ inches deep (inside dimensions) on a Toledo toggle press. This shell, as well as the appearance of the work after each successive operation, is shown in Fig. 5, together with the reinforcements before and after being formed.

The shell is annealed to relieve the strains set up in the first drawing operation and oiled to preserve the dies in the subsequent operations. The first redrawing operation is performed on a Waterbury-Farrel 10-inch stroke press and produces a shell having a 2⅜-inch inside diameter and a 2 9/16-inch inside depth, as at *B*. The second redrawing operation is performed with the same type of equipment as the previous operation, the inside dimensions of the shell being 2 inches in diameter by 3⅛ inches deep. This shell is shown at *C*.

The irregular edge at the open end of the shell produced by drawing is then squared with a fly cutter, holding the work vertically on any convenient drilling machine. After squaring the open end, the bottom of the shell is punched out on a No. 54 Toledo straight-sided back-geared press. Two holes are next pierced midway between the ends of the shell, in which the two front reinforcements *A* and *B*, Fig. 6, are subsequently assembled. A similar punching operation is then performed for the two rear reinforcements *C*, which leaves the work as shown at *D*, Fig. 5. The punch and die used in punching the front reinforcement holes are illustrated at the left in Fig. 7.

The holes in the drawn shell are oval, as this shape is necessary to provide sufficient stock for drawing up the bosses, which is performed in a subsequent operation. The dies used consist essentially of slabbed arbors having steel bushings for the punches. The punch used for the front reinforcement holes is shown standing on the die plate. The shell is slipped over the arbor and stopped by a collar. After the first hole is punched, the shell is turned to locate it for the second hole, by a gooseneck lever *A* having an oval-shaped projection *B* which drops into the first hole punched when the lever is swung forward on its hinge.

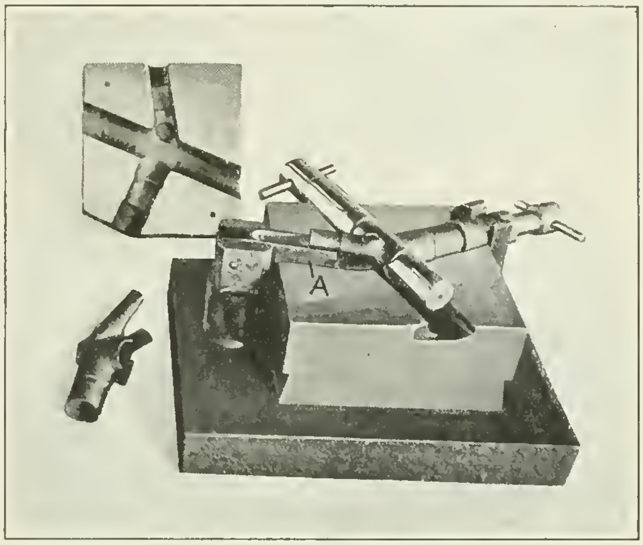


Fig. 4. Dies employed in the Final Closing of the Cluster

In punching the holes for the rear reinforcements, another arbor is used in this die; the die has two die bushings so that both holes can be punched at one stroke of the press. Their lateral position is determined by a collar-stop on the arbor and their angular position relative to the front reinforcement holes by the use of a gooseneck lever, similar to the method of locating the second front reinforcement hole. The angularity of the rear reinforcements *C*, Fig. 6, with the front reinforcement *A* is 61½ degrees, and that between the two front reinforcements, 65 degrees.

Drawing the Bosses and Assembling the Reinforcements

After punching the holes, the shells are annealed, pickled, and oiled. They are then ready to have the bosses drawn for reinforcements *C*, Fig. 6. The arbors used in drawing the bosses are of the same general design as those used in punching out the

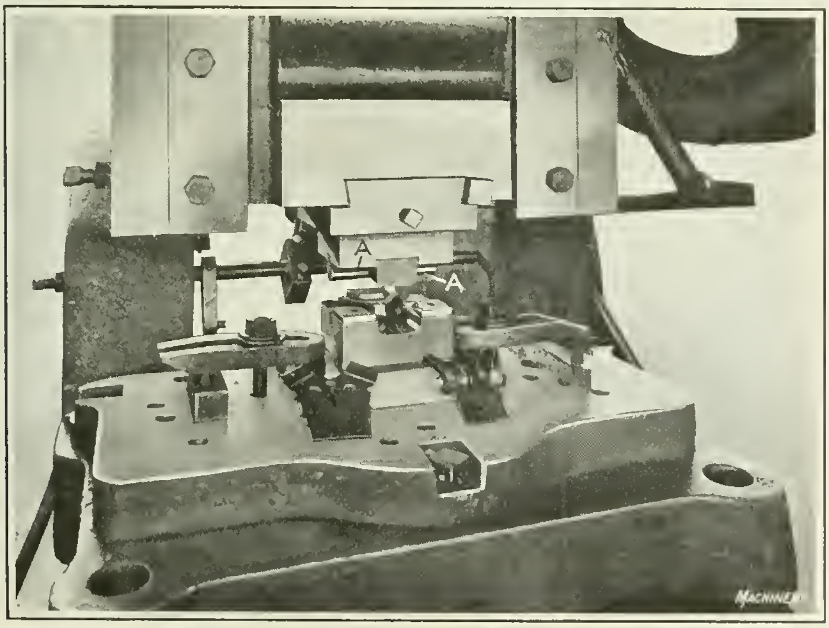


Fig. 3. Press with Dies used in the First Forming Operation on the Seat-post Cluster

holes around which they are drawn. These arbors are also shown in Fig. 7, at *C* and *D*, the former being used for the small reinforcement bosses and the latter for the larger ones. It will be noticed that the arbors have cylindrical bosses and that at the top of each there is an oval projection for locating the work. It will be understood that these arbors are held in a vertical post similar to the one that carries the arbors used in punching the holes. There is metal enough left around the oval holes in the work to draw over the cylindrical part of the arbor bosses and form the bosses on the hanger brackets. If these holes were punched round rather than oval, the amount of stock surrounding them would not be properly distributed to form a cylindrical boss; there would be too much material at some points and too little at others. If too much stock were left, that is, if the hole were punched round and to a smaller diameter than the major diameter of the oval hole, the stock would wrinkle at *E*, Fig. 6. Obviously, more stock is necessary at points *D* to draw the boss than is required at points *E*.

The bosses for reinforcements *C* are drawn first. The next operation in making the brackets is squaring both ends of the body to length, using a drilling machine as in the previous squaring operation, and a fly cutter. This operation is left until after the bosses for the reinforcements have been drawn, so that any irregularity in the ends of the work resulting from the boss-drawing operation can be corrected and a uniform over-all length established. After the ends are squared, the bosses for the front reinforcements *A* and *B*, Fig. 6, are drawn. The operations required in manufacturing the reinforcements are simply blanking out the work to the shape shown in Fig. 5, bending to a U-shape, and finally closing them over an arbor by using dies of simple design.

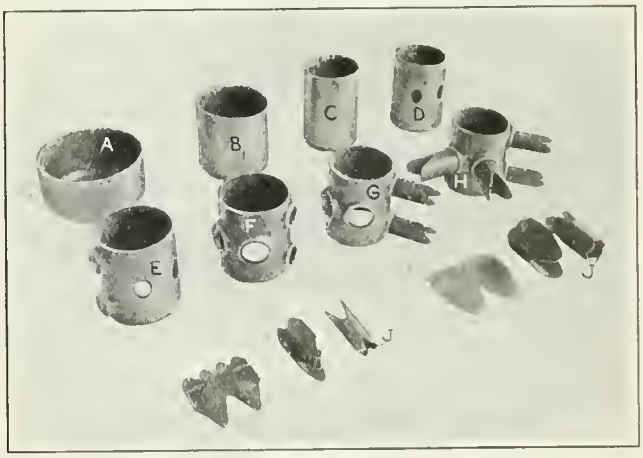


Fig. 5. Steps in the Making of a Bicycle Crank Hanger Bracket

Before the reinforcements are assembled, the holes in the four bosses are beveled slightly with a fly cutter, this work being done on a drilling machine. This gives the piece the appearance shown at *F*, Fig. 5. In assembling the reinforcements, a Waterbury-Farrel 5-inch stroke press is used. The reinforcements are slipped into the upper member of the die, where they are engaged between their prongs. On the descent of the press ram the lower end is forced through the holes in the tubular main body and against an arbor within, on which the work rests, until the four ears *J* of the reinforcements are spread and bent at a 90-degree angle so as to clinch them on the inside of the bosses.

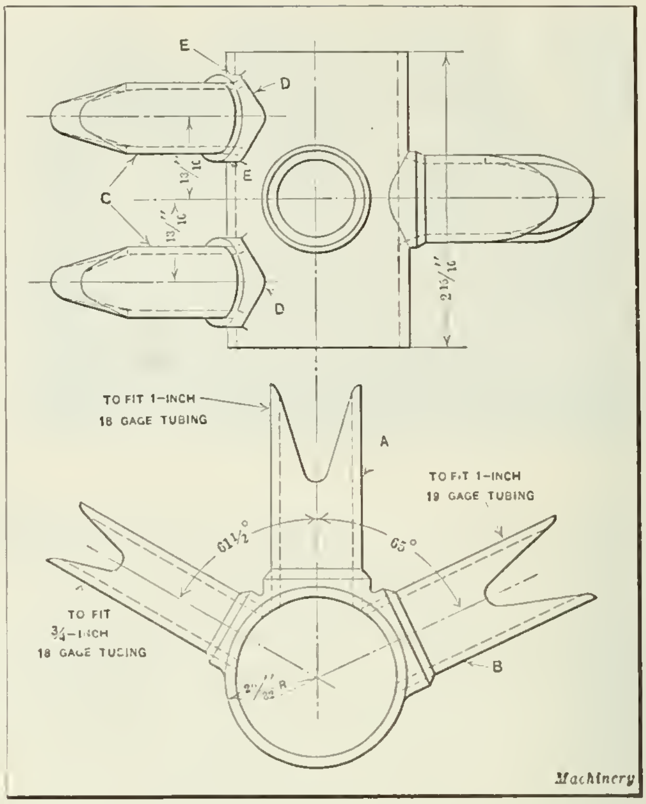


Fig. 6. Bicycle Crank Hanger Bracket

Both the front and rear reinforcements are assembled with the same style of equipment, the operation on the rear reinforcements being shown in the heading illustration. Finally, the assembled reinforcements are sized to fit the tubing to which they are to be brazed, for which purpose a simple die-block, a punch of suitable diameter, and a ring gage are used. The practice described in the foregoing is that followed by the New England Pressed Steel Co., of Natick, Mass.

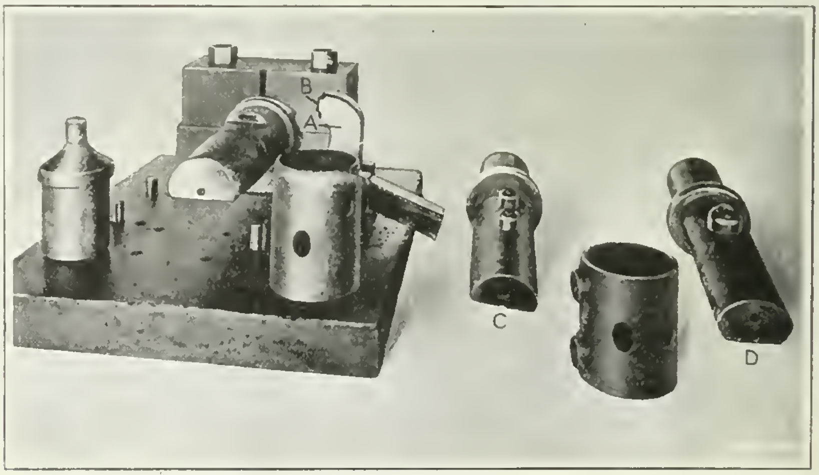


Fig. 7. Die for punching the Reinforcement Holes in Bicycle Crank Hanger Brackets, and Auxiliary Arbors for drawing up the Bosses

* * *

An interesting piston-ring testing apparatus has been devised by the firm of Adolphe Saurer, Arbon, Switzerland, for testing the uniformity of the pressure along the circumference of cast-iron piston-rings. This device enables the pressure of the piston-ring to be read off on a dial. A master piston-ring is used as a guide for determining the correct pressure of the piston-rings to be tested. The apparatus is adjusted to this master piston-ring, but it can be used for different sizes of piston-rings by making the required adjustments. This apparatus is made in seven sizes for testing piston-rings from 2 to 6 inches in diameter, each apparatus having a capacity range of about 5/8 inch.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, October 14

PRACTICALLY every branch of industry can now point to a slow but continuous improvement. This is all the more satisfactory in view of the somewhat pessimistic view that arose from the threatened trouble in the Near East. Although there is much hesitation in laying out capital for the development of schemes of any magnitude, confidence is undoubtedly returning, and taken in the aggregate, the leading branches of the engineering industry are receiving more orders, while manufacturing departments in most districts are engaged on somewhat larger outputs.

Conditions in the General Engineering Field

Although in the general engineering field many manufacturers are still only just able to keep their works running by selling products at practically cost price, the number of firms that are getting out of this rut is added to every week. Buyers are coming forward with more confidence and firms are steadily absorbing more men. Rolling stock makers and electrical engineering concerns continue to add to their list of orders. The activity among textile machine makers promises to continue, and the year's trading with this class of equipment for Japan, China, and India will represent a large total value.

The Machine Tool Industry

In the machine tool industry it is felt that business is definitely on the upward grade, although the movement is very slight and varies from week to week. Several prominent manufacturers are working at from 40 to 50 per cent capacity; one firm reports having sufficient orders on hand to insure working at the existing strength until practically the end of the year. Meanwhile, the prospect of obtaining additional orders is brighter. The heavy electrical trades and the railways, in particular, are said to be displaying a considerable amount of interest in the new machinery market. The latter, however, have not begun buying on a scale which the position demands, in spite of representations made by locomotive engineers to their directors.

Now that large stocks of finished machines have been depleted considerably, it is expected that the improvement in the trade will be directly reflected in increased activity in the shops. In the Manchester district the principal activity is on machines for India, Egypt, South America, South Africa, and Japan, where railway developments are the chief cause of the demand. American competition for this export trade is keen, and in several cases German manufacturers have made strenuous attempts to get a hold in these markets.

Machine tool makers have not been able wholly to convince customers that reduced costs have been anticipated and that no advantage could accrue from waiting. Prices today, however, are in some cases not more than 70 per cent above pre-war prices. Very little is heard now of machine tools being purchased from government war stock. Whether this is due to the fact that all salable stock has been disposed of, or to diplomacy on the part of the authorities, is not clear. Paris dealers are reported to continue to buy reconditioned British machine tools that had done duty on French munition work, and naturally this reacts unfavorably on British exports of machines to France. Makers of sheet-metal working tools in the Wakefield district report a healthier tone, and are finding their chief market in the home trade.

Exports and Imports of Machine Tools

Exports of machine tools in August showed a decided rise. The tonnage was 819, as compared with 536 for July, the values being £105,653 and £75,549, respectively. This is the first increase since last March when the tonnage reached over 1400. Imports also rose, the tonnage being 431 with a value of £56,604. The value per ton of exports fell from £140 to £129, but imports showed a rise from £121 to £131 per ton.

England is now exporting, in tonnage, about three-fourths the pre-war quantities, while imports are slightly above pre-war averages and there is a tendency to increase. Only in the classification "presses, punches and shearing machines" was the tonnage of machines exported less than those imported. All other classes of machine tools show a preponderance of export tonnage over import.

The Small Tool Field

In the small tool field makers have no hesitation in producing steadily for stock. This trade has never reached the stage of stagnation suffered by the machine tool industry, and the general improvement is already seen in the increasing number of orders which, though small, are sufficiently numerous to keep most makers busy. One firm in the Midlands has now more customers on its books than in normal times. In some districts the demand for jigs and fixtures is increasing, and tooling equipment designed particularly for use in connection with railway electrification has led to one or two firms receiving substantial orders.

The Automobile Industry

In the automobile industry, it is apparent that the end of the season has been reached, although many firms are still effecting fairly large outputs particularly those engaged in the light car field, and costs of production are falling rapidly. In the London district automobile manufacturers engaged on heavy commercial vehicles are busy and are finding an improved demand from overseas. Australia is especially mentioned. The inquiries from Brazil and the Argentine for road vehicles are also considered promising. In both those countries ambitious road extension and improvement schemes are in hand, and there will soon be an increased demand for automobiles. The Ford Motor Co. has acquired a valuable water site frontage at Millbrook, Southampton, for the erection of a factory, which is expected to give employment to 2000 men.

Iron and Steel

The relighting of furnaces in several districts is proof of a welcome awakening of activity in the iron and steel trades. There have been heavy shipments of pig iron to America, which has caused something of a scarcity at home, and in some cases quite heavy stocks, accumulated during the slump, have been practically disposed of. Shipments to the United States, however, are now diminishing. This activity has done good by causing the collieries to place orders for equipment. Competition for steel orders is keen.

Sales of finished iron and steel have been checked in the eastern markets, but this result of the political trouble has not spread to the home market or elsewhere. Continental makers still have to maintain their prices at too high a figure to obtain much business in this country. The total exports of iron and steel in August were 269,983 tons valued at £5,052,852, corresponding to £4,656,582 in July.

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STANDARDIZING BEARING BUSHINGS

Several years ago, one of the largest manufacturers of bearing metals and bushings for bearings undertook to standardize the extensive line of bushings used in machine construction. On examining the sizes ordered, he found that they comprised about 7500 bushings covering the usual range of sizes, but all differing in some one dimension. By careful study he reduced, with slight modifications, the number of bushings to 180, and notified his customers that those sizes would be considered standard and carried in stock, insuring purchasers prompt deliveries and a reduction in cost of about 50 per cent as compared with bearing bushings made to order.

This standardization work was completed several years ago, but although its advantages are obvious, the manufacturer has found it very difficult to induce his customers to change their bearings in some unimportant dimension so that his standard bushings may be used. There is no good reason why most new machines should not be provided with a standardized line of bearing bushings, and the adoption of stock sizes would decrease their manufacturing cost considerably.

The same advantages apply to the use of standard sizes of bearing bushings as to the use of standard threads and even standard gears. One of the large gear manufacturers carries a line of standard gears in stock so that customers may obtain from dealers located in all the large manufacturing centers, gears of given diameters and pitch, without the delay and expense of having them made to order. The adoption of standard bearing bushings should be a much simpler proposition, because not nearly so large a variety is required as in gears, where there are so many different combinations of diameters, pitches, and numbers of teeth.

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EQUIPMENT OF TRADE SCHOOLS

The young man who receives his shop training in a trade school should be given an opportunity to become acquainted with as wide a range as possible of the standard machine tools. A great many trade and engineering school shops fail in this respect. They order a large number of lathes, all of the same make and size, while other types of machine tools, as a rule, receive but scant attention. A better all-around training would be provided for the boys if the shop had a greater representation of the different types and makes of machine tools. Take the grinding machine, for example. In the machine shop of a large, middle-western university there is an ample supply of lathes and shapers, but only one grinding machine. Yet the grinding machine is now so important a part of shop equipment that unless it is given a prominent place in the school shop, students who go into practical work will have an erroneous idea of the relative importance of this machine. Even such machines as disk grinders should be installed in any well-equipped trade and engineering school. The disk grinder is an economical machine for a great number of operations, and students should become acquainted with its use and application.

The equipment in trade schools need not be heavy. The smaller sizes of the general types of machine tools are more satisfactory than the larger, but variety is required, and at least one machine of each of the more generally used types should be installed. Those in charge of trade and engineering school machine shops should realize that the most important thing is not that the boys acquire manual dexterity in the handling of tools, but an all-around knowledge and understanding of the uses and application of modern machine tools in actual production. If the trade school is to survive, it must provide a training similar to that of an apprenticeship system, and must give the engineering student a broad-gage idea of modern production methods rather than mere manual training.

* * *

TAKE CARE OF YOUR MACHINE TOOLS

Almost every manufacturer realizes the need of up-to-date machine tool equipment if the greatest possible production is to be attained; but many do not realize the importance of keeping their machine equipment in the best possible condition. Nothing so lowers the efficiency of the working force of a plant as rundown equipment. The operator of a machine that is in need of alignment or repair usually lacks the interest in his work that an operator has who is running a machine in first-class condition, and this results in a reduction in the efficiency of both the man and the machine.

During the war period when machines had to be used for two or three shifts, there was no opportunity to keep the equipment in good condition; but with normal use there should be no difficulty in so planning the work that machine tools can be regularly inspected and overhauled. With such attention, more and better work can be produced, the operators will take greater interest in their work, the machines will last longer and money spent in taking care of them will save some that otherwise would have to be spent for new machines.

Every manager of a machine shop, whether it is large or small, should make it his business to see that the entire equipment of his shop is regularly inspected for defects or breakages, and especially that all needed repairs are made as promptly as possible.

* * *

THE COST OF CHANGING LABOR

As industrial activity increases, the machine shops of the country will be confronted by the problem of training a new labor force. One of the troubles that follow trade depressions is that the old workers do not always return to their old jobs and in many cases the valuable experience of former employes is lost. Numbers of the new men are unfamiliar with the work and require a considerable period of training before they can produce as well and as cheaply as their predecessors did. The cost of training a new working force, or even a part of the force, in the machinery industries will run into large figures and must be reflected in higher prices for the product of the shops. This cannot be avoided, and is mentioned merely as one of the contributing causes to the higher prices for machine tools now being put into effect by many of the builders of machine shop equipment. Other causes are the increased prices for materials, and the high overhead per machine built, due to the comparatively small volume of business being handled at the present time.

National Machine Tool Builders' Convention

THE twenty-first annual convention of the National Machine Tool Builders' Association, held in Lenox Mass., October 3 to 5, was marked by a large attendance of the membership. A great many questions of importance in the machine tool industry were discussed. The topic of standardization was dealt with, and the association, working through special committees, will shortly take up important work in this direction, the first subjects to be considered being T-slots; tapers for lathes; drilling machines, grinding machines and milling machines; and spindle noses. The committee appointed by the association to cooperate with the Department of Commerce held its first meeting, and the second meeting of this committee will be held shortly in Washington. The subject of patents was ably dealt with by Joseph K. Schofield, chief of patent department, Niles-Bement-Pond Co., in a paper entitled "What Patents are Worth to the Machine Tool Industry."

Selling problems were dealt with in papers read by W. A. Viall, secretary, Brown & Sharpe Mfg. Co., Providence, R. I.; O. B. Iles, president, International Machine Tool Co., Indianapolis, Ind.; Frank N. MacLeod, president, Abrasive Machine Tool Co., East Providence, R. I.; and Paul E. Thomas, Kempsmith Mfg. Co., Milwaukee, Wis. The general manager of the association, Ernest F. DuBrul, presented a report for the year, which indicated a great deal of activity and substantial progress during the last twelve months.

The President's Address

The address by the president of the association, August H. Tuechter, of the Cincinnati Bickford Tool Co., contained a great many ideas of unusual value not only to the machine tool industry, but to all branches of the machine-building industry.

E. J. Kearney, Newly Elected President of the National Machine Tool Builders' Association

Mr. Tuechter first reviewed the work of the National Machine Tool Builders' Association, which has just completed its twentieth year. He mentioned the problems that the industry has had to solve, and those yet to be solved, pointing out the lines along which a trade association should develop to be of the greatest value in producing industrial stability, thereby promoting the best interests not only of its members, but also of the country at large. The constructive influence of the association was dealt with, and its progress reviewed. The necessity for improved cost systems was another topic that was covered.

Cost of Unavoidable Idleness in Machine Tool Industry

On the problem of the cost of periodical unavoidable idleness in the machine industry, Mr. Tuechter spoke as follows:

"We are apt to think that the excess capacity in our industry, which has loomed so large and so idle during the last two years, is wholly a result of the war activity, but this is only partly true. The machine tool industry has always needed a maximum capacity considerably in excess of its average demand, taken over a period of years. This is because our industry naturally suffers from what electrical engineers term a "bad load factor" in electric light plants, where a high peak load makes a large plant necessary, though the average load is low. The electrical people have given this load factor serious attention, and the peak load consumers pay rates in proportion to the expense of carrying idle equipment.

"It appears to me that we could well give the same kind of consideration to the financial effect of our load factor. False bases for costs make false bases for prices. Too many in our industry use the method of dividing the total amount of expense incurred for a given period by the productive hours for that period, and calling the quotient their burden. This has been truly described as a method of wasting money to give clerks exercises in long division to conceal costs.

"Basing prices on such figures in boom times simply blinds one's eyes to the necessary cost of idleness in this industry, and leaves that cost out of the price of the product. It prevents the accumulation of a necessary reserve to carry over the succeeding depression. It gives a false impression of profits during the peak-load period. It encourages unfair competition in times of depression, and makes for the cutting of prices below those of competitors who believe that honestly made goods are worth a fair price carrying a reasonable profit, and should not be sold below cost. It also keeps the whole morale of the industry low; it destroys our self respect; it prevents us from paying our employes what other industries will pay the same men; it makes our industry unattractive to the kind of men we ought to draw into it as engineers and salesmen; and it pays the industry's investors a smaller dividend than they can get on stocks bought in the open market, whose earnings are not so fluctuating and whose stockholders do not run the same risks as ours.

"Let us openly tell the world about the demand fluctuations this industry encounters and why its bad load factor necessarily increases the burden rate to a figure much higher than one in a more stable industry. Let us study these things ourselves and see that our customers recognize these costs as necessary parts of price, and we shall have no difficulty in getting fair prices for our product. Unless we, ourselves, study these things, our customers will not be convinced that the facts really exist. The man who is ignorant of his true costs never has a firm basis for his price policy and can never command the respect, either of his competitors or of his customers. In the cycle we are now entering, our members should revise their cost systems so as to prevent the errors of the past."

Exposing and Eliminating Trade Abuses

"A very constructive work of a trade association," said Mr. Tuechter, "is the exposure and elimination of abuses, and the study of causes and effects of mistakes in policy. Some buyers have put excessive pressure on machine tool builders, because such buyers have a very different situation as to demand than our industry has. It is good work to make plain to all the world that we must operate our business according to the nature of its demand. Ours is a secondary demand that increases and decreases with demand for the products of our customers and is affected only slightly, if at all, by the price of our product. We all know that when our customers' shops are largely idle, no price above a free gift will induce them to buy tools that they have no reasonable prospect of using. We cannot stimulate our market when direct costs of building machines are lowest—that is, during years of depression. Our customers buy when active business requires more production, and when the buyer feels sure that a profit will inure to him out of the larger product of our machines. If and when a user cannot figure such a profit, his ears are shut tight to the song of the machine tool salesman.

"We could never gouge our customers if we tried, because they could all make machine tools in their own shops, if our prices were so high that the cost and trouble would be less in making their own machines. The seller of machine tools can never break through these natural limits to price that protect the buyer.

"Economic law protects our customers, but it heavily penalizes our own deficiencies. Due to all these things, very great profits have not been reaped by machine tool builders, as compared to other industries, and perhaps never can be. But at least we should learn to avoid some mistakes that have reduced or even wiped out the naturally small returns that we could earn. It is constructive work to make these things clear to potential competitors so that they will not rush into this industry in ignorance and make a naturally bad situation worse.

"It is constructive work to stamp out all abuses. Taking advantage of the naturally weak position of the machine tool industry, some unscrupulous buyers have not hesitated to use falsehood and threats of loss of business to browbeat some of our members. It is constructive work to gather information as to the use of such methods to warn our members against their effects, and to point out the better way."

New Officers of the Association

The following officers were elected for the coming year: President, E. J. Kearney, Kearney & Trecker Corporation, Milwaukee, Wis.; first vice-president, Winslow Blanchard, Blanchard Machine Co., Cambridge, Mass.; second vice-president, O. B. Iles, International Machine Tool Co., Indianapolis, Ind.; treasurer J. N. Heald, Heald Machine Co., Worcester, Mass. The board of directors consists of the officers and August H. Tuechter, Cincinnati Bickford Tool Co., Cincinnati; E. P. Welles, Charles H. Besly & Co., Chicago, Ill.; Frank N. MacLeod, Abrasive Machine Tool Co., East Providence, R. I.; C. Wood Walter, Cincinnati Milling Machine Co., Cincinnati, Ohio; and H. W. Dunbar, Norton Co., Worcester, Mass. Ernest F. DuBrul was re-elected secretary and general manager.

E. J. Kearney, the newly elected president, is one of the most successful machine tool manufacturers in the country. He was born on a farm in the state of Iowa, in 1868; graduated from the Iowa State College, B. M. E., in 1893; entered the machine tool business via the drafting-room, under the instruction of the late Frank Kempsmith, in 1894; and formed a partnership with Theodore Trecker, to manufacture milling machines in 1898.

MEETING OF THE STEEL TREATING AND DROP-FORGING SOCIETIES

The annual meeting of the American Society for Steel Treating held in Detroit, October 2 to 6, was attended by a large proportion of the membership, and the exposition of equipment for heat-treating, hardness testing, forging, and diemaking, held in conjunction with the convention, attracted a great deal of attention. The exhibits covered a complete range of temperature-controlling apparatus, furnaces, and other hardening room equipment, as well as forging machinery. A number of machine tools, especially those suitable for making drop-forging dies, were also exhibited. The American Drop-Forging Institute held its annual meeting simultaneously with the Steel Treating Society, and this brought together a large number of men engaged in work in which the heat-treatment of steel is of particular importance.

Among the papers read, the following may be mentioned: "Carburizing and Decarburizing in Casehardening" by H. B. Knowlton; "Casehardening," by A. H. d'Arcambal; "Irregularities in Casehardened Work Caused by Improperly Made Steel," by E. W. Ehn; "Some Features of Industrial Heat-treating Electrically," by C. L. Ipsen; "Heat-treating in Lead," by R. B. Schenck; "Furnace Atmospheres and Their Relation to Formation of Scale," by G. C. McCormick; "Thermal Transformation of Some Chrome-Vanadium Steels," by J. S. Vanick; "Heat-treating of Automobile Springs," by A. E. Fuller; "The Uses and Abuses of Tool Steels from the Standpoint of the Producer and Consumer," by W. P. Woodside; "Effects of Structure upon Machining of Tool Steel," by J. V. Emmons; "A Metallographic Study of Hollow Drill Steel," by N. B. Hoffman; "Lathe Breakdown Tests of Some Modern High-speed Tool Steels," by H. J. French and Jerome Strauss; and "Heat-treatment and Properties of Duralumin," by H. C. Kneer.

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DETERMINING THE DIAMETER AT THE END OF A TAPERED ROD

By C. N. PICKWORTH

A simpler solution to the problem of determining the diameter at the end of a tapered rod than that presented on page 910 of July MACHINERY is given in the following. Referring to the accompanying diagram, angle a and radius r are given. It is desired to find diameter M at the end of the tapered rod before the end is rounded to radius r. From the diagram it is evident that

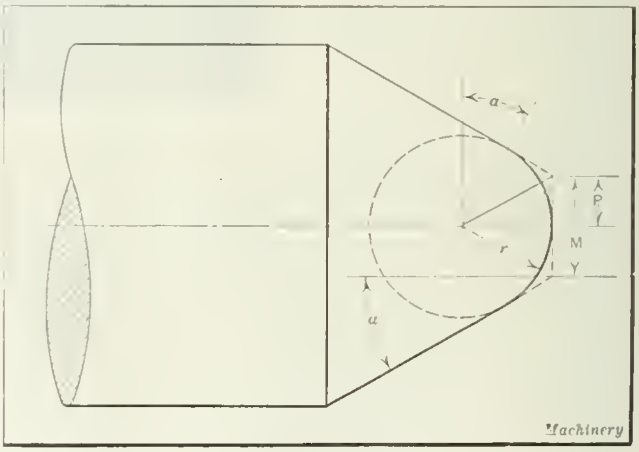

Diagram for finding Diameter at End of Tapered Rod

$$P = r\left(\tan\frac{90 - a}{2}\right) \quad \text{Hence,} \quad M = 2r\left(\tan\frac{90 - a}{2}\right)$$

American Gear Manufacturers' Convention

THE same close attention to standardization problems that has characterized the meetings of the American Gear Manufacturers' Association in the past, was the main feature of the semi-annual convention held in Chicago October 9 to 11. Nearly all of the ninety-five member companies were represented by one or more delegates. Three new companies were elected to membership: The American Gear Co., 549 E. Illinois St., Chicago, Ill., with J. A. Bedford executive member; Dalton & Balch, Inc., 2333 Michigan Blvd., Chicago, Ill., with M. E. Dalton executive member; and Manns Mfg. Co., 454 Golden Gate Ave., San Francisco, Cal., with R. Manns executive member. The office of the secretary of the association, T. W. Owen, it was announced, is now located at Room 107, 2443 Prospect Ave., Cleveland, Ohio.

Papers Read Before the Meeting

After the welcome extended to the visiting members by William Ganschow, president of the William Ganschow Co., the business of the convention was devoted entirely to the reading of papers and to committee reports, mainly on gear standardization. George L. Markland, Jr., president, Philadelphia Gear Works, read a paper on "The Evolution of the Gear," a historical review of the use of gearing in early days. P. C. Molter, superintendent of the department of industrial education, National Metal Trades Association, spoke on "Apprenticeships." L. G. Hewins, sales manager, Van Dorn & Dutton Co., pointed out the advantages of buying castings at a set price per piece, rather than on a pound basis, because when the foundry—as well as the forge shop, in the case of forgings—works by the piece instead of by weight, there is an incentive to work close to the finished size, thereby saving metal as well as time in machining.

Two addresses relating to investigations of gear noises were made, one by Professor A. E. White, director of the department of engineering research, University of Michigan, and one by Professor Daniel L. Rich, of the same university. Professor White's paper treated of engineering research in general, with special application to gear noises; Professor Rich spoke specifically on "Standardization of Gear Sounds." A method by which gear noises might be investigated in a scientific way was outlined, and a committee appointed to go further into this problem.

Reports by Standardization Committees

Nearly all of the standard committees on standardization presented progress reports. The Bevel and Spiral Bevel Gear Committee presented the Gleason system—as outlined in a paper before the last annual meeting of the association, published in June, 1922, MACHINERY—for adoption as "recommended practice," for generated bevel gears, and it was so accepted by the association. A table of formulas on spiral bevel gear axial thrust was also accepted as recommended practice. A copy of this table may be obtained from the Gleason Works, Rochester, N. Y. An amplification of the Gleason system was also presented. This is published on page 228 of the present number. It will be submitted to the members of the association after publication and presented for adoption at a coming meeting.

The report of the inspection committee was adopted as recommended practice. This report covers methods, rather than specific tolerances, and deals with the testing of the involute curve, angular velocity, threads when part of gear combinations, worms, and hobs. The practice adopted is as follows:

Involute Curves

In order to determine the accuracy of the involute curve, it is necessary to have some instrument that will check this curve in the same manner as it is unwound from a base cylinder. An instrument of this type should have a straightedge rolling on the base circle of the gear and an indicator fastened to the straightedge, the indicator point being in contact with the gear tooth to be tested. As the straightedge is moved along, it will roll on the base circle, and the indicator which is in contact with the gear tooth should register zero if the involute curve is correct. If it is not correct, it will show the amount of inaccuracy. It is necessary that a gear should have the correct involute curve in order to function properly, and the involute curve-testing instrument can determine whether a gear has been cut off center, and whether the pressure angle of the gear is correct.

Angular Velocity

If a pair of gears are properly mated, they should function with uniform angular velocity, but in order to determine this, it is necessary to have some instrument which will test it. The principle embodied in an instrument of this type should be to test a known motion, such as produced by a pair of rolls, against the unknown motion produced by the mating gears, and the variation of the gears should be automatically recorded on a paper chart. If the involute curves are correct and the spacing is correct the gears should run with uniform angular velocity; but if the involute curve is not correct, these instruments would show a variation in motion, and if the spacing of the teeth is not uniform, there will also be a variation in the motion.

Thread Inspection

"Go" and "Not Go" plug and ring gages of proved dimensions, the three-wire method for pitch diameter, or the projection method for pitch diameter, outside diameter, lead, angle, and form should be used. All plug gages and taps should be tested by the projection method.

If external threads are shown to be of proper diameter by the three-wire measurement, and at the same time are a good fit in a ring gage, they may be considered correct in lead, profile, and pitch diameter. On threads coarser than twelve per inch, good results can be obtained by the use of Prussian blue to prove up the bearing of the thread in the ring gage; if it is a good hand fit and shows good bearing surface, the lead, angle, and diameter are correct.

Internal threads that are tapped may be inspected by the "Go" and "Not Go" plug gage, but the tap should first be inspected by the projection method to insure correct lead, profile, and diameter. After an internal thread is smooth enough to show a good Prussian blue spotting off the plug gage, a half-section can be cut away and the plug rolled into the remaining half-section to show if the lead and angle are correct.

Worm Inspection

The lead of a worm should be tested by attaching the worm to the end of a master screw having the same lead as the worm to be tested and rotating the screw so as to feed the worm past a fixed indicator, bearing against the profile of the thread. The pressure angle of worms having rack type threads should be tested by inclining the worm from a vertical line the exact amount of the pressure angle, and sliding an indicator on a horizontal line with its working point on the profile of the tooth.

Worms having curved thread profiles should be tested for tooth form by running them, at right angles, with a master worm-wheel, and noting the bearing by the use of Prussian blue or some similar agent. On single jobs or small quantities, it should only be necessary to have the worm bear properly with its mating gear, unless special accuracy is specified.

Hob Inspection

"Go" and "Not Go" plug gages are to be recommended for testing holes. "Go" and "Not Go" plug gages with a key inserted are to be recommended for testing keyways, as the size of the keyway and alignment—in relation to the hole—can best be tested by this means. The concentricity of hubs, teeth and squareness of end of hub, can best be tested by the use of ordinary bench centers and a dial indicator.

Whether a gash is radial or not, can best be tested on bench centers, with a plug which carries a finger that can be inserted into the gash of the hob, and a sight reading taken. On straight-gashed hobs, it is necessary to test the parallelism of the gash with the axis of the hob; this can be readily done by mounting the hob on bench centers and passing an indicator along the gash. On spiral-gashed hobs, it is necessary to determine whether the spiral of the gash is correct or not; this can be tested either by the use of a form that has the correct spiral, or a special machine made with a taper attachment that will impart the necessary spiral rotation.

Ordinary gear tooth calipers are best adapted for measuring the thickness of all types of hob teeth. Where topping hobs, or worm hobs, are to be measured, the ordinary depth micrometer is recommended for measuring the depth of the tooth.

To measure correctly the contour of hob teeth, an instrument for this purpose is to be recommended. The hob should be mounted on a mandrel and a contact finger connected with an indicator should be passed along the contour of the hob. Any variations in the contour will be shown on the indicator dial. Charts can be made of the theoretically exact contour desired, and the hob teeth can then be checked against these charts.

The hob should be tested for lead, that is, to see whether all the cutting edges fall in a true helical path. A simple instrument is to be recommended in which a master screw with the same lead as a hob is used. The hob is mounted on the arbor end of this screw, and as both are rotated at the same time an indicator can be used to detect the variation in the cutting edges. In this test, it is desirable to plot charts and keep records of the actual condition of the hob.

History of Gearing

In his paper on the "Evolution of the Gear," Mr. Markland pointed out that the earliest toothed wheel on record dates back to 300 B.C.; this was evidently a metal pinion engaging a metal rack, and was the operating mechanism in a water clock used in Egypt. Reference to this timepiece is made by Thomas Humpage in the Minutes of the meeting of the Institution of Mechanical Engineers held at Bristol, England in July, 1908. Reference is also made by Mr. Humpage to a gear-cutting mechanism for cutting clock wheels, which appears to have been built about 1750; clock wheels were being cut on this device as late as 1908. The process of evolution seems to have made the greatest strides in clock gearing.

The epicycloidal teeth—at least shapes that may be termed epicycloidal—were the first in evidence. It appears that Leonardo da Vinci (1452-1519) took up the subject of the gear tooth. In an English book, published in 1702 written by Mandey, there is an essay on epicycloids and their use in mechanics.

Camus, a French engineer, who was born in 1699 and died in 1768, wrote an article on the teeth of gears about 1738. A translation was published in 1868. Camus goes into the epicycloidal form, but the translator, John Isaac Hawkins, while admitting that he was at first quite willing to agree that the epicycloidal was the only tooth form, states in an appendix that he has come to the conclusion that the involute curve will supersede it.

Engineering Research Work

In his address on "Engineering Research," Professor White pointed out the necessity for manufacturers to undertake more research work, because the ordinary engineering and technical society is not in a financial position to undertake work of this kind, although most of the leading societies would like to encourage such work if they were financially able to do so. It was pointed out that many universities are in a position to cooperate with either individual manufacturers or associations of manufacturers in carrying out research work. Gear noise is the particular problem of the gear manufacturer that requires more scientific analysis, to enable a determination of the causes that are most active in producing noise, and the influence of various modifications in design on the elimination of gear transmission noises.

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INCREASED PRODUCTION FROM IMPROVED TOOLS

By HARRY E. HARRIS

The writer read with interest the article "Increased Production from Improved Tools" on page 132 of October MACHINERY. While the improvement is marked in the designs shown in Figs. 3 and 4, the writer believes that the improvement would be even greater if pivot pins *C*, Fig. 4, as shown in the article referred to were relocated at the intersection of the center lines through the two drill bushings. Thus when the body of the jig was swung from one drilling position to the other there would be no necessity for moving the base of the jig on the drill table. With the design shown it is necessary to move the jig from side to side a considerable amount and realign it with the drill each time a hole is to be drilled. This causes an unnecessary loss of time. By widening the base and lengthening the rocking member of the jig the pivoa pins *C* could be readily located as suggested.

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SCULPTURING BY MACHINERY

A method of reproducing works of sculpture, as well as making works of sculpture from living models, that appears to introduce a new epoch in this art, has been invented by a Chicago engineer, W. F. Engelmann, 832 E. 51st St., of that city. Mr. Engelmann has published a booklet entitled "A New Sculpturing Method" in which he explains, how, by means of optical devices and machinery, he is able to do away almost entirely with the time consumed by the model "sitting" for the sculpture, as the presence of the model is required for a few minutes only. It is claimed that on account of the optical and mechanical means used an absolute likeness of the model is easily obtainable, and that reproductions can be made in any material and in any size from the largest in marble or bronze for monuments, to the smallest in gold for jewelry. It is further claimed that any person with very little training is able to make the most accurate reproductions, and that the time required is reduced to hours instead of days or months. The machines used for this method of sculpturing have been patented, and the pamphlet referred to contains a complete mechanical description of the mechanisms of the machines used.

MACHINING MOTOR TRUCK REAR AXLES

By HAROLD F. BLANCHARD

The machining operations on the rear axle of the Model AB Mack truck manufactured by the International Motor Co., New York City, are of particular interest because of the size of the piece and the accuracy required. It is believed that the drop-forging from which this axle is made is the largest used in the automotive industry. The forging weighs 350 pounds, is more than 5 feet in length and is made of chrome-nickel steel. It is delivered to the factory as a solid forging, and it is obviously quite a job to bore the large yoke opening at the center. This requires a machine of great size, having a large swing. The problem is also greatly complicated by the close limits of accuracy called for. The yoke is required to be faced within 0.004 inch and counterbored to within 0.003 inch of the exact size.

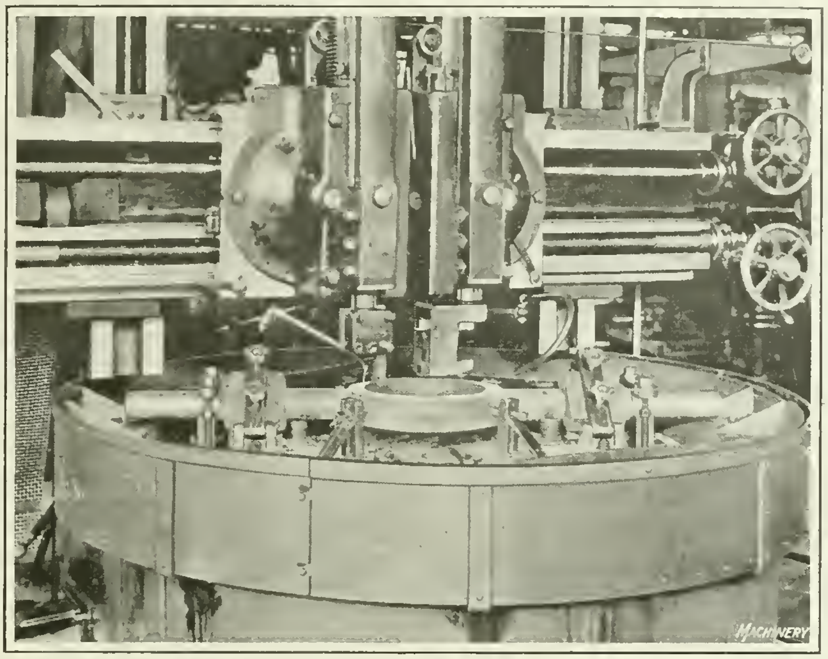

Fig. 1. Boring and facing Motor Truck Rear Axle

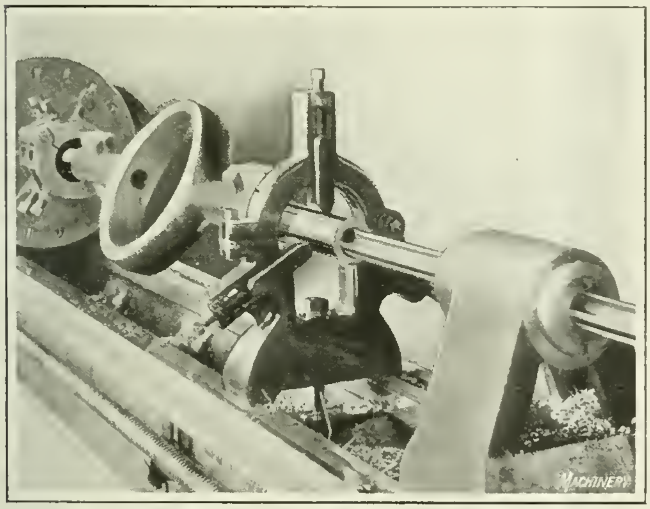

Fig. 2. Boring Axle Spindle with Gun Drill

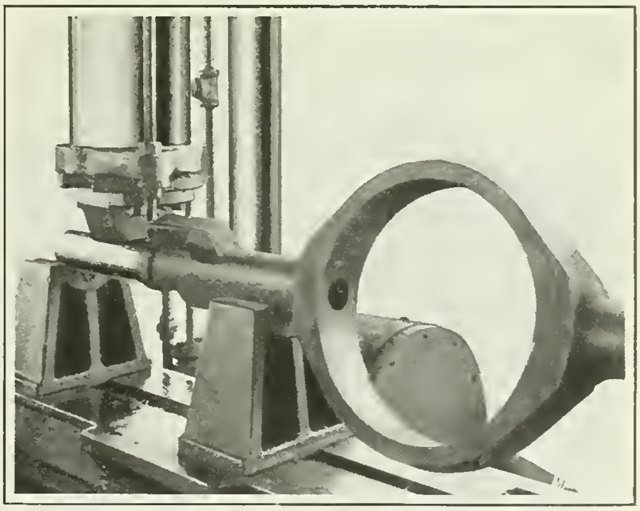

Fig. 3. Straightening Axle Forging after Heat-treatment

The machine used for performing the boring and facing operations on the axle is a Bullard "Max-i-Mill," specially equipped for this job. A general view of the machine with the forging secured to the fixture is shown in Fig. 1. In this illustration the tool in the left-hand holder is shown just starting the final counterboring cut. The holder at the right contains the facing cutters, which are so controlled that the two faces are cut simultaneously. In the illustration Fig. 4 is shown a close-up view of the facing cutters operating simultaneously with the rough-boring cutter.

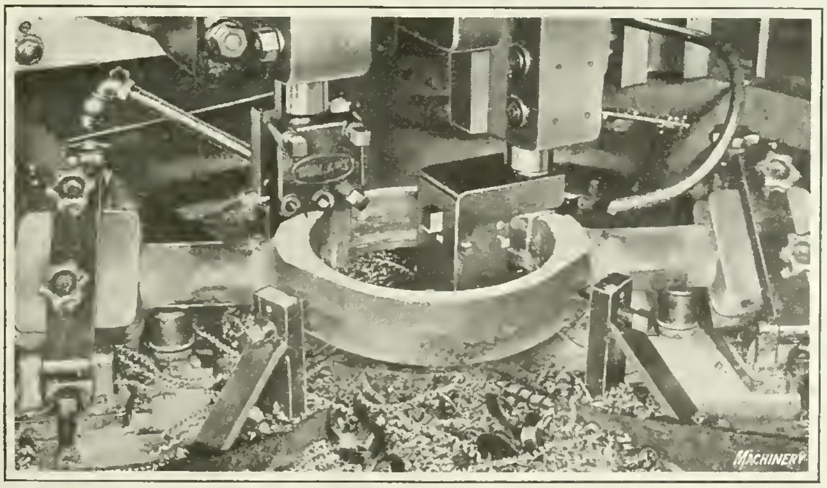

Fig. 4. Close-up View showing Boring and Facing Tools operating simultaneously

Another interesting operation on the forging is boring the holes in the long projecting bars that form the axle tubes. These holes must be bored out of solid metal, for which purpose a gun drill is used. The gun drill is provided with means of feeding lubricant to the point of the tool. The total length of the two holes is about 4 feet, and they are required to be aligned with sufficient accuracy to permit a drift bar with only 1/32 inch clearance to pass freely through the entire axle. This boring operation is accomplished on a large engine lathe equipped as shown in Fig. 2.

The axle is heat-treated between the roughing and finishing operations, being quenched while suspended vertically in order to minimize warpage. However, the nature of the material is such that a certain amount of warpage is unavoidable. This necessitates straightening the axle after it has cooled. The forging resists bending to such an extent that it is necessary to use a 350-ton hydraulic press for the straightening operation. An axle in position on the straightening blocks is shown in Fig. 3.

The spindles or turned ends of the axle are of rather large diameter and are exceedingly awkward pieces to turn. For this work, large and rigid bell extensions are mounted on the faceplate, and steadyrests are employed to enable the spindles to be kept within the limit of 0.0005 inch.

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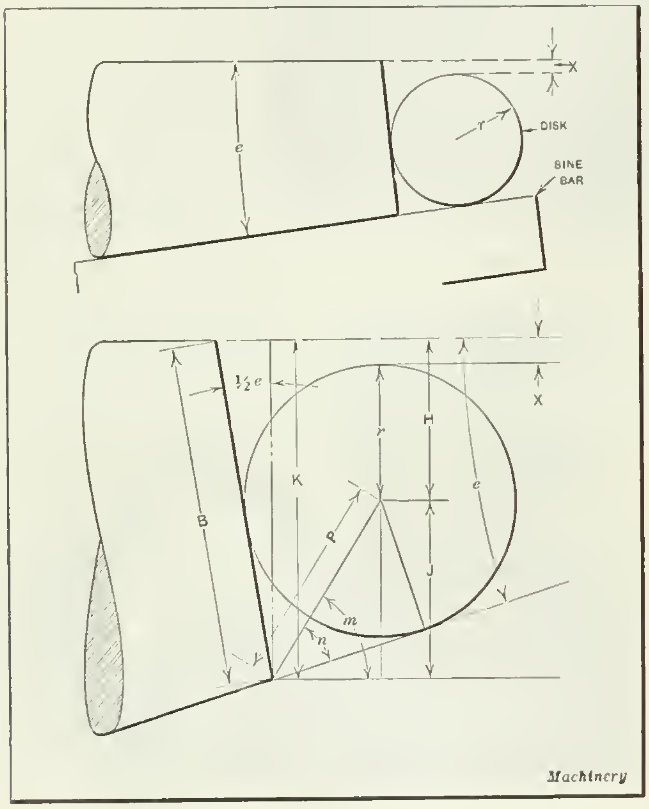
MEASURING DIAMETER AT SMALL END OF TAPER PLUG GAGE

By W. G. HOLMES

The method here described for determining the diameter at the small end of a taper plug gage has been found very satisfactory. The procedure is as follows: The plug is mounted on a sine bar so that the top edge of the gage is parallel with the surface plate. A disk is placed in the corner formed by the end of the plug gage and the sine bar, as shown in the upper view of the illustration. The end of the plug gage must, of course, be ground to a true flat surface and at right angles to its center line. A reading is taken over the plug gage and over the top of the disk by means of a height gage, the difference between these two readings giving the dimension X.



Method of measuring Diameter at Small End of Taper Plug Gage

The known dimensions then are:

e = angle of taper;
r = radius of disk; and
X = difference between readings over plug gage and over disk.

From the dimensions given it is required to find the diameter B at the small end of the plug gage. Now, we have,

$$H = r + X;\ n = (90 - \tfrac{1}{2}\,e) \div 2$$
$$m = n + e;\ P = r \text{ cosec } n$$
$$J = P \sin m;\ \text{and } K = H + J$$

Then

$$B = K \sec \tfrac{1}{2}\,e = (H + J) \sec \tfrac{1}{2}\,e$$
$$B = (r + X + P \sin m) \sec \tfrac{1}{2}\,e$$
$$B = (r + X + r \text{ cosec } n \times \sin m) \sec \tfrac{1}{2}\,e$$

FLEXIBLE COUPLINGS AND THEIR USE

Flexible couplings are the most common mechanical means of compensating for unavoidable errors in alignment of shafts and shafting. When correctly applied, they are highly efficient. For joining lengths of shafting without causing loss of power from bearing friction due to misalignment, and for use in direct motor drives for all kinds of machinery, the value of the flexible coupling is now generally recognized. The fact that lineshafting will sag if of considerable length, makes the use of a flexible connection essential. Flexible couplings are not intended to be used for connecting a driven shaft and a driving shaft that are purposely placed in different planes or at an angle, but simply to overcome slight unavoidable errors in alignment that develop in service.

For direct-driven machinery, where the motor and machine are installed on a concrete foundation, the machine bearings should first be carefully lined up with the armature shaft of the motor. The misalignment that is bound to develop afterward, as the grouting around the machine allows it to settle, may be guarded against by connecting the two shafts with a flexible coupling designed to take care of these small but serious errors in alignment. In hanging lineshafting, it is practically impossible to align the hanger bearings perfectly, but, as in the case of setting up a direct-connected motor-driven machine, the greatest care should be taken to keep the error as slight as possible.

Ordinarily, a flexible coupling will not transmit power efficiently where the offset is more than 1/16 inch or where the angularity is greater than 5 degrees. If the shafts are out of alignment more than these amounts, it is preferable to use universal joints or couplings of the Oldham type. The failure of flexible couplings to render the most satisfactory service is not due to any fault of the couplings but to an attempt to apply them where the conditions are altogether too severe.

Too great an angularity or too much offset between the connected members will usually cause the working parts of the couplings to rub and become heated, which means a loss of power. However, extreme cases can be more or less efficiently handled by using two couplings instead of one, connected by an intermediate shaft. This allows greater offset and greater angularity between the driver and the driven shafts. In one design of coupling the amount of misalignment permissible when using this arrangement is ¼ inch per foot of the intermediate shaft.

Types of Flexible Couplings

There is a wide variety of flexible coupling designs; most of them consist essentially of two flanged members or hubs, fastened to the shafts and connected by some yielding arrangement. These flanges may in some cases take the form of long sleeves, or they may be little more than connected disks. The flanges or other main coupling members are connected in various ways: They may be joined loosely with a rubber disk between them to permit change in position, or they may be connected by flexible pins constructed by laminations similar to a leaf spring; they may employ a connecting disk made of an insulating material with lugs alternately arranged on opposite sides, or they may include a flexible spoked wheel construction with the spokes made of laminated springs and engaging slots in a spider. Again, they may be connected by flat links hung from pins on two circles with the circles of pins on one member located on the driver and the other circle of pins on the driven member, or they may interlock and have rubber cushions or springs located between them. In other cases, they may be machined to engage each other through a set of sliding blocks contained within them; or they may be connected in any of a variety of other ways. One design of flexible coupling having the connecting members in the form of sleeves instead of flanges consists of one heavy coil spring as a driver and a smaller spring attached to the driven member. The smaller spring fits inside the larger one and is driven by friction.

Each type is a suitable transmitter of power, under reasonable conditions, and each contains some meritorious points of design. In general, it should be pointed out that the best results are most likely to be obtained where the couplings are of simple construction. Those that have as few working parts as possible and that are not too large, are desirable, provided they are capable of performing all the functions that a flexible coupling is intended to perform.

Factors Affecting Flexible Coupling Design

In designing flexible couplings, points that demand attention are the amount of power to be transmitted; the speed at which the machine, fan, blower or other device is to be driven; the likelihood of overload; the type of drive, that is, whether it is constant, intermittent or reversing; and special conditions regarding the operation of the machine that might affect the drive.

It has been stated that the construction should be as simple as possible; this will lessen noise and operating troubles and will make installation, adjustment, and replacement of worn parts easy. An ideal coupling would be one that could be installed and then forgotten. Certain types of couplings are designed to run without lubrication, but in most cases, means for lubricating the working parts are provided, especially where the design contains sliding members. Such a coupling, if run dry, wastes power. Some manufacturers recommend a soft graphite grease as a lubricant, while others prefer heavy cylinder oil. The choice, however, and in fact, the question of whether a lubricant needs to be used at all, is primarily a matter of coupling construction.

The members of a flexible coupling are usually attached to the shaft by means of keys, set screws, or both. It is dangerous, however, for the heads of set-screws to project and for the ends of keys to extend beyond the hubs of the flanges. When set-screws can just as well be dispensed with, this should be done, and when not, safety set-screws should be used. The coupling should not only be capable of driving in both directions, but it should also be able to make sudden stops, quick reverses, and should provide for a small amount of end play. End play, especially in the case of a direct-connected motor-driven machine, is necessary, because it allows the armature shaft of the motor or generator to center the armature in the magnetic field.

A close-connected coupling is an advantage, since it reduces the leverage between the operating parts. Silent operation is always a desirable feature in any transmission unit, and the simpler the coupling construction, the more likely it is to be noiseless. Balance has a good deal to do with the efficiency of flexible couplings, because they frequently operate at high speeds and consequently are subject to more or less vibration, the effect of which may best be minimized by a balanced construction. The simpler designs may not have certain features that may be considered desirable, such as automatic adjustment to compensate for increasing loads and to take care of exigencies such as overload. But it is questionable whether a complicated coupling with automatic features is preferable to a simpler construction which gives little or no operating trouble after the coupling has once been installed.

End Thrust and Balance

Flexible couplings should be so designed that no end thrust is developed, as this will prevent motor end play, and cause the motor armature to run out of its magnetic center. This is an important matter where couplings are used in connection with herringbone gears. In designing or purchasing flexible couplings, it is important to see that the contacting surfaces do not, through wear, develop a thrust which will cause loss of power and possible shutdown.

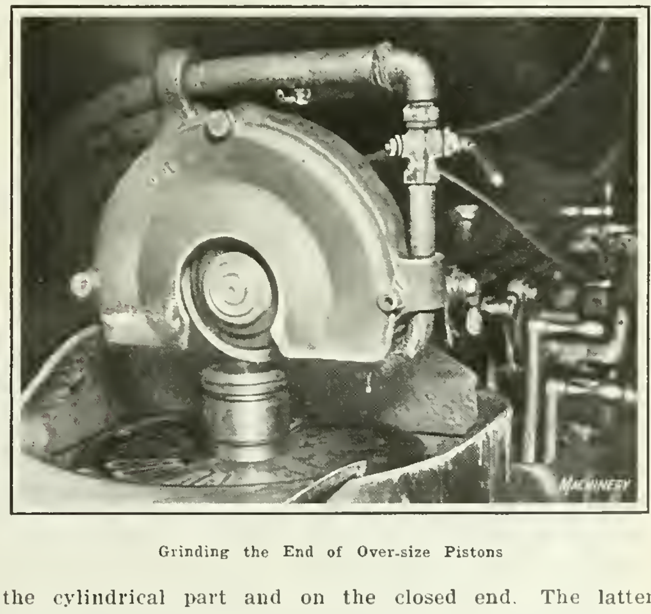
The question of balance is an important matter in coupling selection or design, as an increasing number of couplings are used in connection with steam turbines, high-speed motors, and many other classes of machinery. It is not sufficient that the coupling be perfectly balanced when installed, but it must remain in balance after wear has taken place.

As the majority of flexible couplings are used in connection with machinery that was formerly belt-driven, it is desirable to introduce a certain amount of resiliency in the coupling to take the place of that which was formerly supplied by the belt. Where ball-bearing motors are used to drive geared machinery or other shock loads, this is very important, as it relieves the balls from blows which may cause damage. This coupling resiliency reduces repairs to motor windings by freeing them from shocks and jars. As mentioned, several couplings on the market accomplish this more or less perfectly through the use of leather, rubber, or canvas under tension or compression and also through the use of coil or leaf springs. Couplings employing springs should always be lubricated, if possible; otherwise, the springs will cause loss of power.

* * *

FINISHING HEAD ENDS OF OVER-SIZE PISTONS

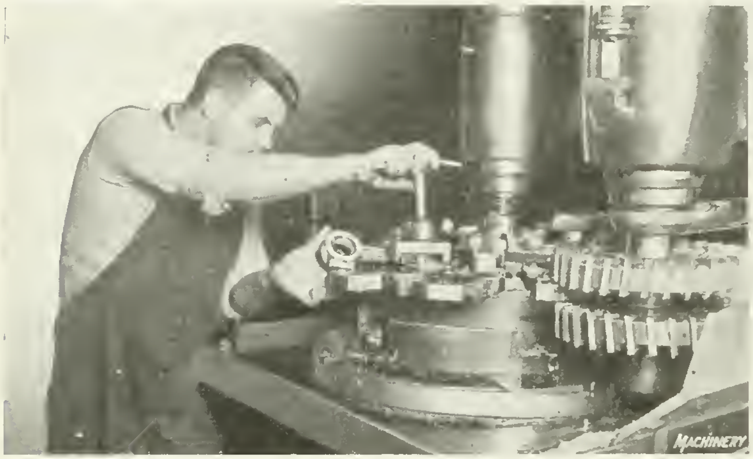
The head end of cast-iron pistons for automobiles is usually finished by facing, this operation being performed at the same time that the outside diameters are turned. For this work automatic lathes are commonly employed. An unusual method of finishing the ends of over-size pistons is employed in the factory of the Houpert Machine Co., Long Island City. Large quantities of semi-finished over-size pistons are carried in stock, and are taken from stock as the demands require, and finished by grinding both on the cylindrical part and on the closed end. The latter operation is the one to which attention is here directed. The purpose of this novel means of finishing is to prevent an excessive accumulation of carbon—a precaution which is rarely taken, even by the manufacturers of automobile motors.



Grinding the End of Over-size Pistons

The operation itself is extremely simple, and is performed on a No. 2 Heald rotary surface grinder, as shown in the accompanying illustration. The piston is centered on the magnetic chuck while the wheel is traversed across the piston to the center. Only about 0.004 or 0.005 inch of metal is removed in this operation, it being necessary merely to produce a highly finished surface on the end on which carbon cannot readily accumulate. A 24-C grain Norton wheel, grade F is used in this operation.

Making Wills Sainte Claire Connecting-rods



Methods Employed in the Plant of the Taft-Peirce Manufacturing Company, Woonsocket, R. I., for Machining High-grade Automobile Connecting-rods — First of Two Articles

By FRED R. DANIELS

THE connecting-rods of the Wills Sainte Claire eight-cylinder automobile engine are made from a molybdenum alloy steel—a material which is capable of withstanding the severe service to which automobile connecting-rods are subjected. The rods of opposing cylinders are yoked together at their crankpin ends by a bronze sleeve, the crankpin bearing of the plain rod illustrated in Fig. 1 being assembled in the fork of the rod shown in Fig. 2. In machining both these styles of rods at the plant of the Taft-Peirce Mfg. Co., Woonsocket, R. I., some unusual equipment is employed in order to attain the required accuracy. This and a concluding article to be published in December MACHINERY, will follow the manufacturing processes step by step.

The two rods are identical in the design of the straight H-section and the wrist-pin boss, and certain finished dimensions (including the center distance between holes) are also the same; this makes it possible to use the same or very similar tooling and fixtures for several operations on both styles. The forked rod is forged solid at the gap end, as indicated by the dot-and-dash outline in Fig. 2; on that account some extra operations are required for finishing this end. Both forgings are inspected, heat-treated, and straightened before machining.

Milling the Piston-pin and Crankpin Bosses

The first machining operation on both rods is straddle-milling the piston-pin and crankpin bosses. This is done on a Becker continuous rotary milling machine equipped with the familiar type of multiple fixture commonly used for operations of this nature. (See the heading illustration.) An allowance is left on the thickness of the large bosses for a subsequent grinding operation by means of which the side surfaces are finished. This allowance is a little greater for the springy forked rod than for the solid plain rod. The cutting speed for milling both rods is 90 feet per minute. If serious deflection of the forging results from this straddle-milling operation, it is, of course, important to straighten the connecting-rods before any further machining operations are performed on them.

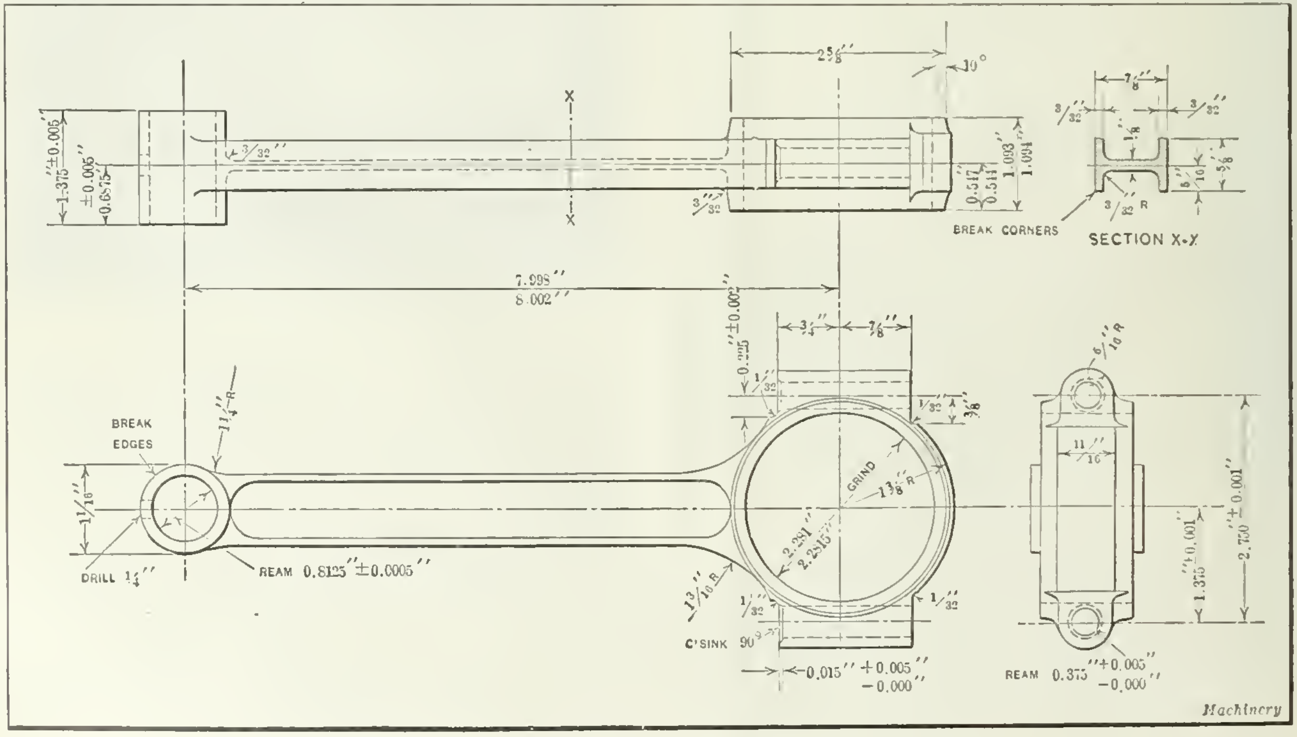


Fig. 1. Diagram illustrating Details of Design of the Plain Connecting-rod

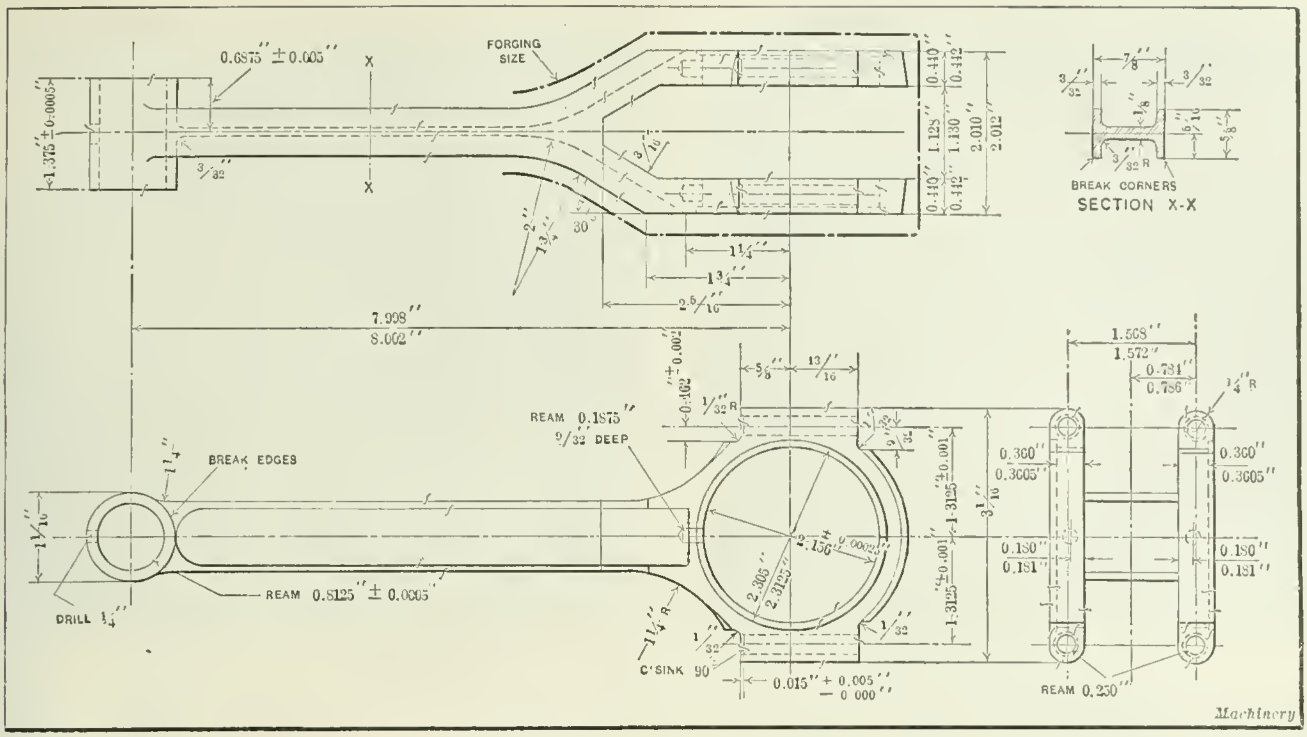


Fig. 2. Diagram illustrating Details of Design of the Forked Connecting-rod

The forked rod is now subjected to an extra operation, a light grinding cut being taken on the faces of the large boss to correct any inaccuracy that may have resulted from the milling. This leaves both rods with the sides of the bosses parallel and with about 0.023 inch of stock left for finishing. The piston-pin and crankpin holes are drilled and rough-reamed on a Foote-Burt four-spindle drilling machine, leaving about 0.013 inch of stock on the small holes for grinding, and approximately 0.085 inch on the large holes, which are bored before grinding. For drilling and reaming, the rods are securely located against V-blocks at the piston-pin end. Four-lipped drills are used for the larger holes, this type of drill being better adapted for this work than an ordinary twist drill, especially when a tough material like molybdenum steel has to be drilled.

Rough-milling the Gap in the Forked Rod

The next operation on the forked rod consists of rough-milling the gap. Fig. 3 shows the rod before and after this operation. Three cuts are taken, the roughing cut being performed with the equipment illustrated in Fig. 4, which is mounted on a Briggs milling machine. There are two fixtures on the table, one at each end, so that the inserted-tooth milling cutter can be alternately fed to the forging in each fixture. The crankpin end of the rod is located in the fixture by means of two expansion arbors which extend into the previously reamed hole from the sides. These arbors are operated by a knurled knob on each side of the fixture and locked by wing-nuts. The piston-pin end of the connecting-rod is located by an oval-section stud on the fixture. This stud fits in the hole in a vertical plane, but permits of slight variations in the center distance between the bosses which may exist at this stage of the manufacture. It may be mentioned that in all the milling fixtures used before grinding, this method is used to compensate for center distance discrepancies. The depth of the gap is limited positively by a stop located under the machine table at each end, and while the table is feeding toward one stop, the

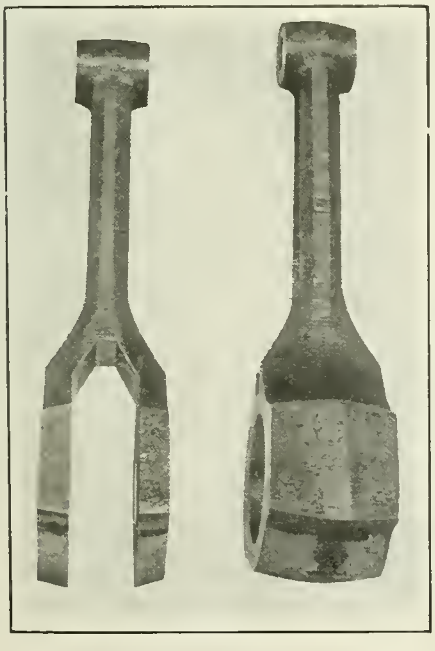


Fig. 3. Forked Rod before and after milling

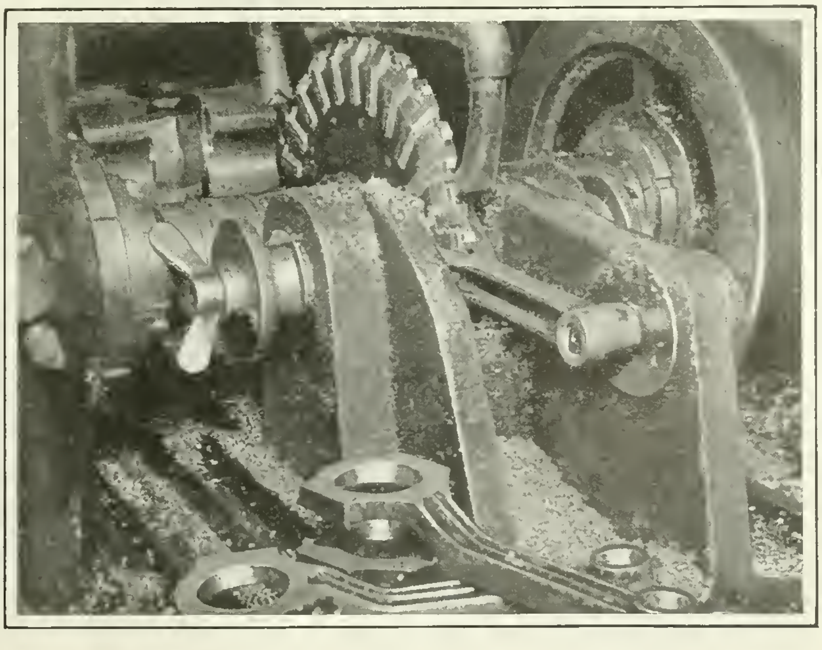


Fig. 4. Set-up used in milling Gap in Forked Connecting-rods

operator loads a rod into the opposite fixture. It is the usual custom for one operator to have charge of two machines.

A special inserted-tooth milling cutter, 11 inches in diameter, of the design shown in Fig. 5, is used in milling the gap. The two disks in which the blades are set are made of machine steel and pack-hardened. Both contain slots for the insertion of 25 blades, secured in the slots by straight slabbed pins, set at a 5-degree angle. All the blades in one disk are right-hand, and all those in the other, left-hand. The disks are screwed together with a sheet steel shim, 0.030 inch thick, between them, thus forming a staggered-tooth milling cutter. The type of blade used is shown in the detail view at the top of the illustration, from which it will be seen that the angular cutting edges of blades of opposite hands will produce the tapered shape at the crotch of the gap. In rough-milling the rod, about 0.020 inch of stock is left on each side of the gap for subsequent finishing. This stock is removed in two milling operations performed after the large hole has been finish-bored, which is done after the caps have been cut off and fitted. In the finish-milling operations on the gap, the set-up used is similar to that shown in Fig. 4, except that the milling cutter blades do not have angular cutting edges for finishing the crotch. In finish-milling, from 0.008 to 0.010 inch of stock is removed.

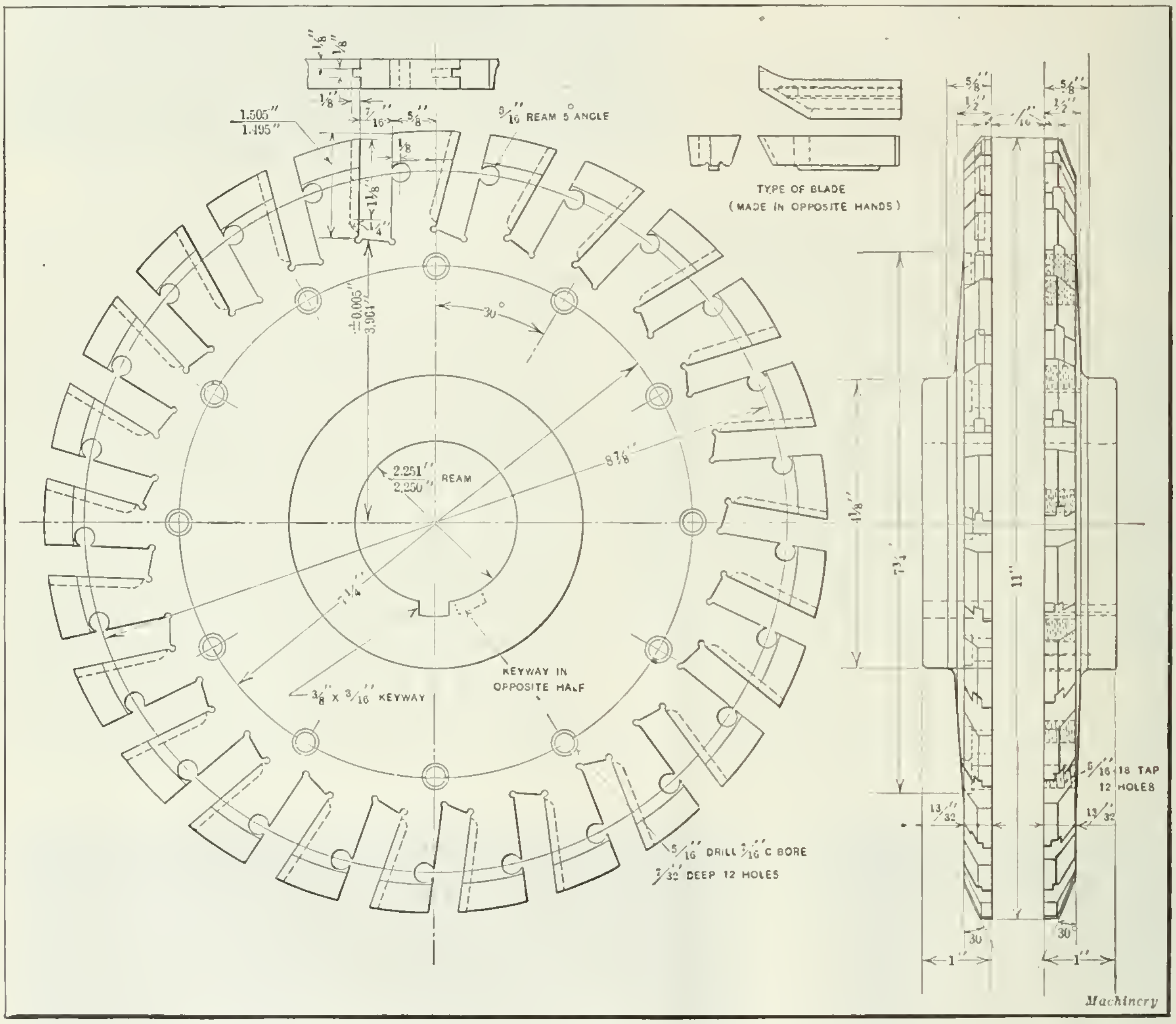


Fig. 5. Staggered-blade Cutter for milling Gap in Forked Connecting-rods

Milling the Bolt Bosses

The operation of milling the convex surfaces of the bolt bosses on the forked rod is illustrated in Fig. 6. This work is done on a No. 2 Brown & Sharpe milling machine, using an indexing fixture and four formed cutters. The fixture accommodates two forked rods mounted as shown, a spacing collar being used between each gap to maintain parallelism of the two bosses. The rods are secured in position by a strap. At the completion of one traverse of the table, the fixture is swung in a vertical plane, through 180 degrees, to bring the bosses on the opposite side of the work to the cutters. The knob at the front of the fixture operates a spring locking pin, and during the indexing a simple turn of the knob withdraws the pin and keeps it disengaged. An angular surface on the index-pin boss acts as a cam when the knob is turned, withdrawing the pin and compressing the spring, thus preventing engagement of the pin until the knob is again turned by hand. The finished rods shown lying on the table of the machine give an idea of the nature of this operation and the appearance of the work after it is completed. The cutter speed for this operation is 80 feet per minute, and the table feed, ½ inch per minute.

For the corresponding milling operation on the plain rods, a No. 1 B Milwaukee milling machine is employed, the set-up for which is illustrated in Fig. 7. Three rods are milled at a time by using spacing collars between them and fastening them on the arbor of the fixture by the simple means shown. The rods are placed on the arbor with the piston-pin ends extending alternately in opposite directions. They are supported in the proper horizontal position by a screw and check-nut. Flat springs which engage the piston-pin bosses prevent each rod from lifting from its seat on the screw head, due to the thrust of the cutters. This

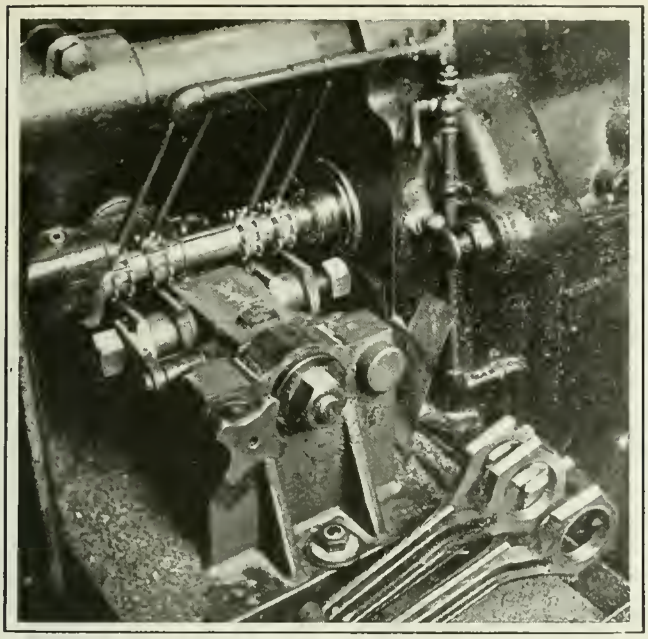


Fig. 6. Milling the Bolt Hole Bosses of Forked Rods

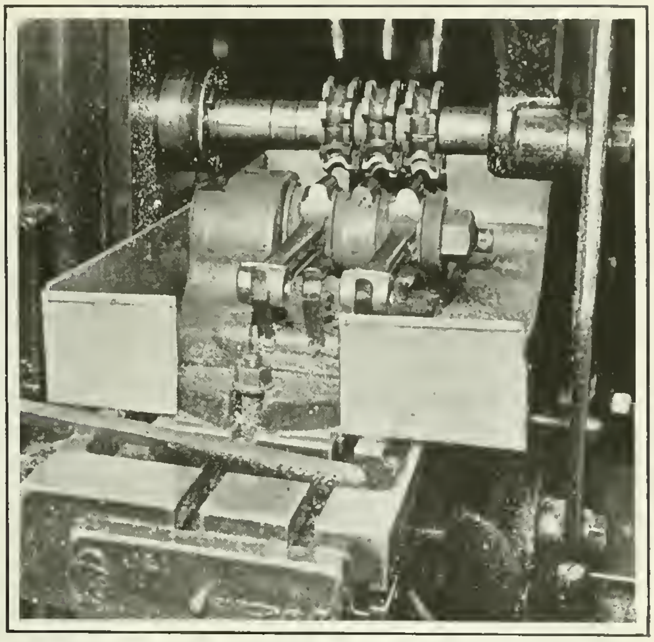


Fig. 7. Milling the Bolt Bosses of Plain Connecting-rods

fixture is not of the indexing type, and the rods must be reversed after each traverse of the machine table to mill the bosses on the opposite side. The cutter speed is 50 feet per minute, and the table feed, ½ inch per minute.

Milling Operations on the H-section

For milling the groove and edges of the H-section on the forked connecting-rod, a unique type of milling fixture is used. It will be seen from Fig. 2 that this section curves out to join the crankpin boss. It is to provide for this curve, which is indicated by the 1¾- and 2-inch radii that this fixture is especially designed. The operation is done on No. 1 Brown & Sharpe milling machines, the set-up for which is illustrated in Fig. 8. Two machines are attended by one operator.

The fixture occupies the entire table of the machine and has an auxiliary table, hinged on stud *A*, which passes through the fixture. Cam surfaces on the under side of the auxiliary table and a cam-roll over which its free end rides as the machine table travels back and forth, impart the necessary vertical movement to the auxiliary table for milling the curves. The auxiliary table has flanges extending on both sides to engage rolls *B* at the top, and to steady the work-holding part of the fixture. The roll over which the lower cam surfaces ride keeps the auxiliary table in contact with the upper rolls throughout the movement of the machine table. An eccentric sleeve is provided at the pivot, which enables longitudinal adjustments to be made when necessary.

The work, which is partially hidden in the illustration by the gang of milling cutters, is located on studs, the piston-pin stud being elliptical, as on the fixture previously described. The cut taken in this operation is rather heavy, and for this reason an auxiliary brace *C* has been attached to the machine to furnish additional outboard support for the over-arm. By using two machines the work is transferred from one to the other for milling opposite sides of the rods.

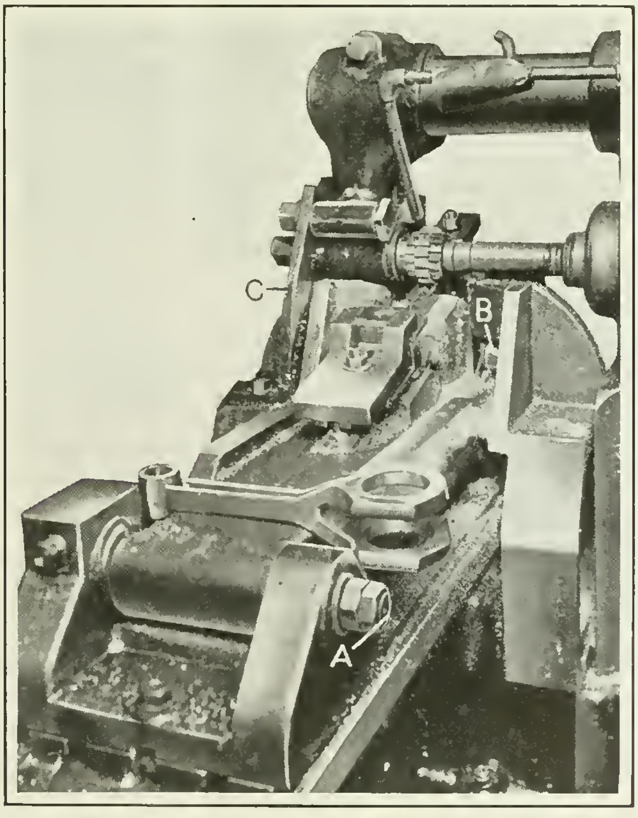


Fig. 8. Hinged Fixture used in milling H-section of Forked Rod

For the corresponding operation on the plain rods, it is not necessary to use this special fixture. The work is located on a fixture by means of studs, and a gang of three milling cutters is used, the same as in the operation just described. For both rods a cutter speed of 85 feet per minute and a table feed of 2 inches per minute are employed.

Milling the Rods to Final Shape

The piston-pin boss (except for its ends) and the curved surface which joins it to the top of the H section on both styles of rods are milled on a No. 1½ Milwaukee vertical milling machine equipped with a gear-operated fixture which revolves the work past the cutter. A fixture of identical design is used to mill the complete cylindrical surface where the boss projects from each side of the H-section. The surfaces machined in these two operations complete the shape of the piston-pin boss and blend it into the straight part of the connecting-rod. The type of fixture used is illustrated in Fig. 9, where it is shown in use on the cylindrical ends of the boss. By turning the capstan wheel, the fixture is revolved to pass the work under the end-mill which sweeps inside the projecting ends of the boss and simultaneously cleans off what stock may remain from the previous operation on the edges of the ribs adjacent to the boss.

The only difference in the set-up for milling the remainder of the boss is in the vertical position of the table, it being necessary only to raise the table until the cutter can sweep the entire length of the boss. The radius of the cutter is 1¼ inches to correspond to the radius of the curve which joins the boss to the H-section. Thus, as the fixture is swung around, the cutter first mills this curved surface on one side of the rod, then the entire length of the boss along the front, and finally the curved surface on the opposite side of the H-section. The operation has been performed on the work shown on the fixture. The cutter speed is 85 feet per minute.

There is one other important milling operation on the plain rods that is not required on the forked type, and that is form-milling the 1¾-inch radius (see Fig. 1) at the large end of the rod. For this purpose, a No. 3B Milwaukee milling machine is employed, equipped with a fixture and a gang of formed cutters, as illustrated in Fig. 10. The fixture accommodates twelve rods, six on each side, three in the front and three in the rear. This enables a high production to be attained. By the time the six rods at one end are finished, the operator is ready to feed the table across to the rods on the other end, and while these are being milled he replaces the finished rods with unmachined ones. The cutter speed is 70 feet per minute, and the table feed, ½ inch per minute.

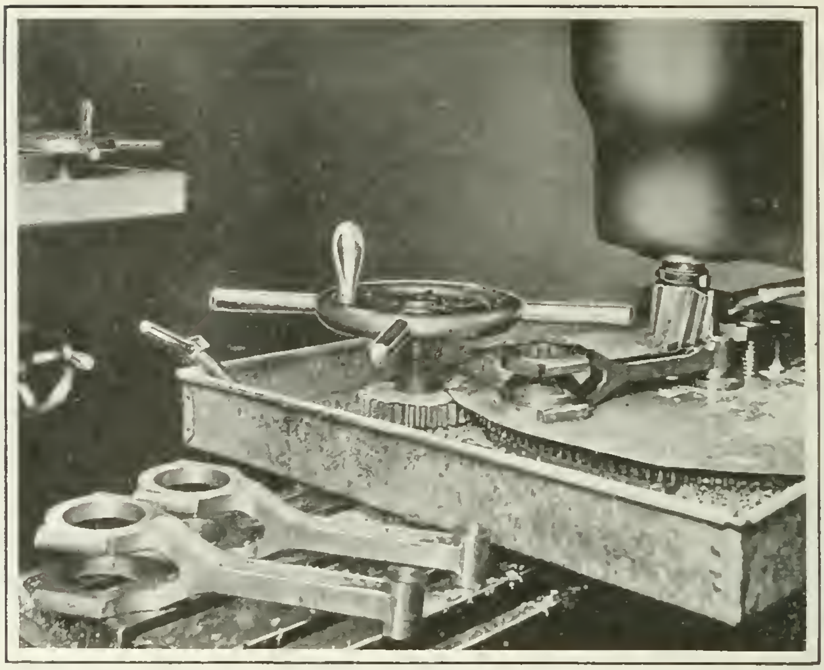


Fig. 9. Gear-operated Fixture used in milling the Piston Wrist-pin Boss

The second installment of this article will describe the operations required to complete the connecting-rods. These include the method of machining the cap-screw holes grinding the fitting surfaces for the crankpin bearing cap, refinishing after assembling the caps, grinding the piston-pin and crankpin bearing holes, and final inspection.

* * *

TECHNICAL LITERATURE AND THE ENGINEERING STUDENT

Is the engineering student being properly trained in the uses of the available technical literature, both that in periodical and in book form? How can he be trained to appreciate the value of engineering literature while in college? These questions are answered by E. H. McClelland, technology librarian of the Carnegie Library of Pittsburg, in an interesting article published in *Engineering Education*, in which the methods that should be used to interest students in studying engineering journals are referred to. To quote from the article, "With many students the appeal will be stronger if the assigned problems have a commercial or industrial trend. Set a student to determining what companies manufacture lathes, or locomotives, and in what part of the country the plants are. What are some of the largest companies and what is their organization? Who is the president or the purchasing agent of each? What journals would offer the most fertile field for advertising their product, and what kind of trade literature (catalogues, house-organs, etc.) do they issue? Not all this information can be found readily—that regarding smaller companies is particularly elusive—but the search for information of this nature will properly call into use a set of tools and aids entirely different from those used in obtaining information on engineering or purely scientific topics. This sort of problem in some form comes to libraries almost daily, which proves that it must be of an essentially practical character."

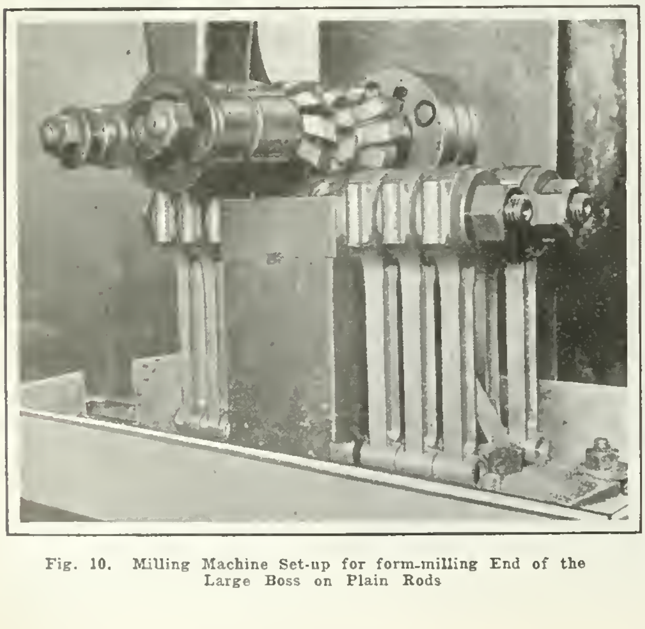


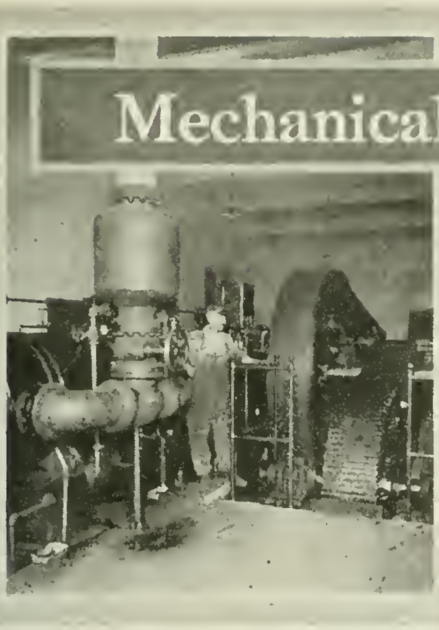
Fig. 10. Milling Machine Set-up for form-milling End of the Large Boss on Plain Rods

A good practical problem for acquainting students with current literature is to ask them to imagine themselves ordered to a foreign country remote from libraries and book stores, and ordered to assemble and take with them a good working library on any engineering subject, be it a chemical laboratory or a machine-building plant.

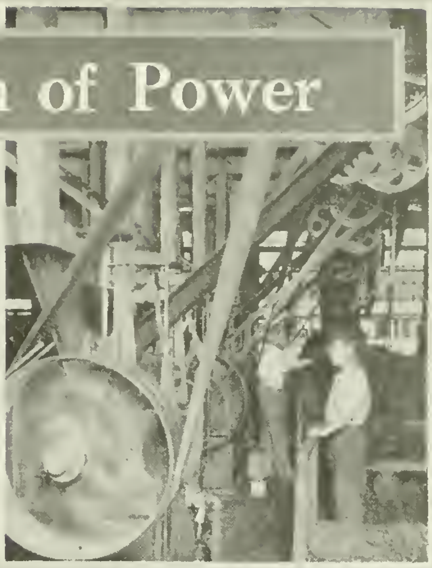
The way in which to test the general acquaintance of the student with the best engineering magazines in the field is to read to them the titles of some rather specialized articles and have them indicate the branches of engineering to which the articles belong and the name of the journals in which the articles would be expected to appear. Another question that would make it necessary for the student to become acquainted with a variety of the more important technical literature available would be to ask him to name the most important handbooks in different engineering fields in use in the United States. He should not only be acquainted with books, but also with the leading publishers of engineering books, and the author of the article puts as a test question to the student to name for each field an American publisher who is prominent in the field of (1) chemistry, (2) electrical and mechanical engineering, (3) works on machine shop practice, and (4) manuals on operation of prime movers.

There is no doubt that both students in engineering colleges and men engaged in practical engineering and machine shop work would be greatly benefited by a more intimate acquaintance with the sources of information available to them in current mechanical literature, both in magazines and in technical books.

Mechanical Transmission of Power



By FORREST E. CARDULLO
Chief Engineer,
The G. A. Gray Co.,
Cincinnati, Ohio
and
FRANKLIN D. JONES
Associate Editor of MACHINERY



Power-transmitting Capacities of Different Types of Gearing—Concluding Installment

SINCE gearing provides the means of transmitting motion and power in a large percentage of mechanical appliances, its practical application must necessarily be based upon a great variety of conditions. Because of these numerous variations, gears differ greatly, not only as to type, design, and size, but also as regards accuracy, methods of mounting, etc.; consequently, in determining by calculation the power-transmitting capacities of gearing in general, as covered in this review of the subject, it is necessary to consider as far as possible average conditions.

Frictional and Toothed Gearing

The term "friction gearing" is commonly applied to that type consisting of a driver made of some substance such as fiber or leather and arranged to operate by rolling in contact with a metallic driven wheel. The driving and driven wheels may be either cylindrical for driving parallel shafts or conical for driving shafts at an angle; when speed variations are required, a small driving disk may be arranged to revolve in contact with the side of a comparatively large driven disk, which also provides for reversing the rotation merely by shifting the driver to the opposite side of its central position on the driven disk. With the latter arrangement, pure rolling contact is not obtained when using a driver of cylindrical form, since it makes contact with the driven disk at various diameters.

Friction gearing provides a smooth, uniform drive, but toothed gearing is superior for most purposes because of its positive action and greater power-transmitting capacity. The latter may also be designed to transmit much more power, and at the same time insures maintaining the same relative positions between the driving and driven members, which is important for many classes of mechanism. The common forms of gearing for connecting parallel shafts are spur gears, single helical or twisted gears, and double helical or herringbone gears.

Spur gears are the simplest to design and cut, and meet the requirements for a large percentage of parallel shaft drives. Single helical gears are used extensively for electric railway service, as the helical teeth are conducive to smooth continuous action which prolongs the life of the gearing as compared with spur gears. The helix angle of the teeth is quite small (usually from 7 to 10 degrees), so that the end thrust is well within the capacity of the oil film on standard armature end-thrust collars and on axle collars. The standard helix angle adopted by the R. D. Nuttall Co. for railway gears is 7½ degrees.

Herringbone or double helical gears neutralize the end thrust, since they have right- and left-hand sections, and such gears are especially applicable for high velocities and ratios in connection with turbine reduction gearing or for installations requiring a minimum of vibration and noise.

Gear Ratios and Speed Variations

Proportioning a train of gears to obtain a given velocity ratio, or possibly a given series of speeds, is frequently encountered in the design of geared transmissions. When the problem is simply that of obtaining a given velocity ratio, and when the latter is so large that more than one pair of gears should be used, a uniform reduction between the different pairs is conducive to the highest efficiency. Whenever this arrangement is practicable, the ratio of each pair in a train may be determined by extracting the root of the total ratio. If there are two pairs of gears, extract the square root; for three pairs, extract the cube root, etc. For example, if the total ratio between the first driving and the last driven gear is to be 125 to 1 and three pairs of gears are to be used, the ratio of each pair should preferably equal 5 to 1, since $\sqrt[3]{125} = 5$.

In designing gear combinations for varying spindle speeds or feeding movements, it is general practice, among machine tool builders particularly, to vary the speeds in geometrical progression, successive speeds being obtained by multiplying each preceding term by a ratio or constant multiplier. Thus, if the slowest speed is 50 revolutions per minute and the ratio is 1.3, the succeeding speeds will equal

$$50 \times 1.3 = 65$$
$$65 \times 1.3 = 84.5$$
$$84.5 \times 1.3 = 109.8$$

When the fastest speed F and the slowest speed S in a series are known and also the total number of speeds N, the ratio may be determined by the well-known formula:

$$\text{Ratio} = \sqrt[N-1]{\frac{F}{S}}$$

Since logarithms would ordinarily be used for the extraction of this root, the ratio may be obtained as follows:

Rule—Subtract the logarithm of the slowest speed from the logarithm of the fastest speed and divide the difference by the total number of speeds minus 1; the result will equal the logarithm of the ratio.

In actual practice, the exact progression obtained may be modified slightly to permit using gears of a certain diametral pitch. For machine tool transmissions, the speed ratio should, as a general rule, be between 1.3 and 1.5, as otherwise there will be either too small or too great a difference between successive speeds. There would be no practical advantage in a series of speeds varying by small increments equivalent to a ratio of say, 1.1, whereas, if the ratio were 1.7 or possibly 2, the changes from one speed to the next would be excessive. Feeding mechanisms may be designed for ratios of 1.2 or less, depending on the type of machine.

Speeds of machine tool drives and especially feed changes are sometimes varied according to "chromatic scale progression," with a ratio of either 1.4142 or 1.189 in case a lower ratio is required. The first ratio is the square root of 2, and the second the fourth root of 2. The object of using these particular ratios is to obtain a series of speeds or feeds containing the even ratios, 2, 4, 8, 16, etc.

Designing Spur Gears for Transmitting a Given Horsepower

When it is required to know the diametral pitch for transmitting a given horsepower, this may be determined directly by the following formula, based upon the well-known Lewis formula:

$$P = \sqrt{\frac{S_s A V Y \pi}{H \times 55\ (600 + V)}} \qquad (1)$$

in which

P = diametral pitch;

S_s = allowable static unit stress or the stress at "zero velocity" = 8000 for accurately cut cast-iron gears, 15,000 for steel containing about 0.30 per cent carbon, 25,000 for steel containing about 0.50 per cent carbon, 9000 for semi-steel, 5000 for rawhide, bakelite, formica, and condensite, and 12,000 for phosphor-bronze;

A = a factor which is usually 3 or 4 for cut gears, the assumption being that the face width is to equal 3 or 4 times the circular pitch which is the general practice;

V = pitch-line velocity in feet per minute—preferably limited for average conditions to about 1200 feet per minute for cut spur gears of ordinary quality to avoid excessive noise;

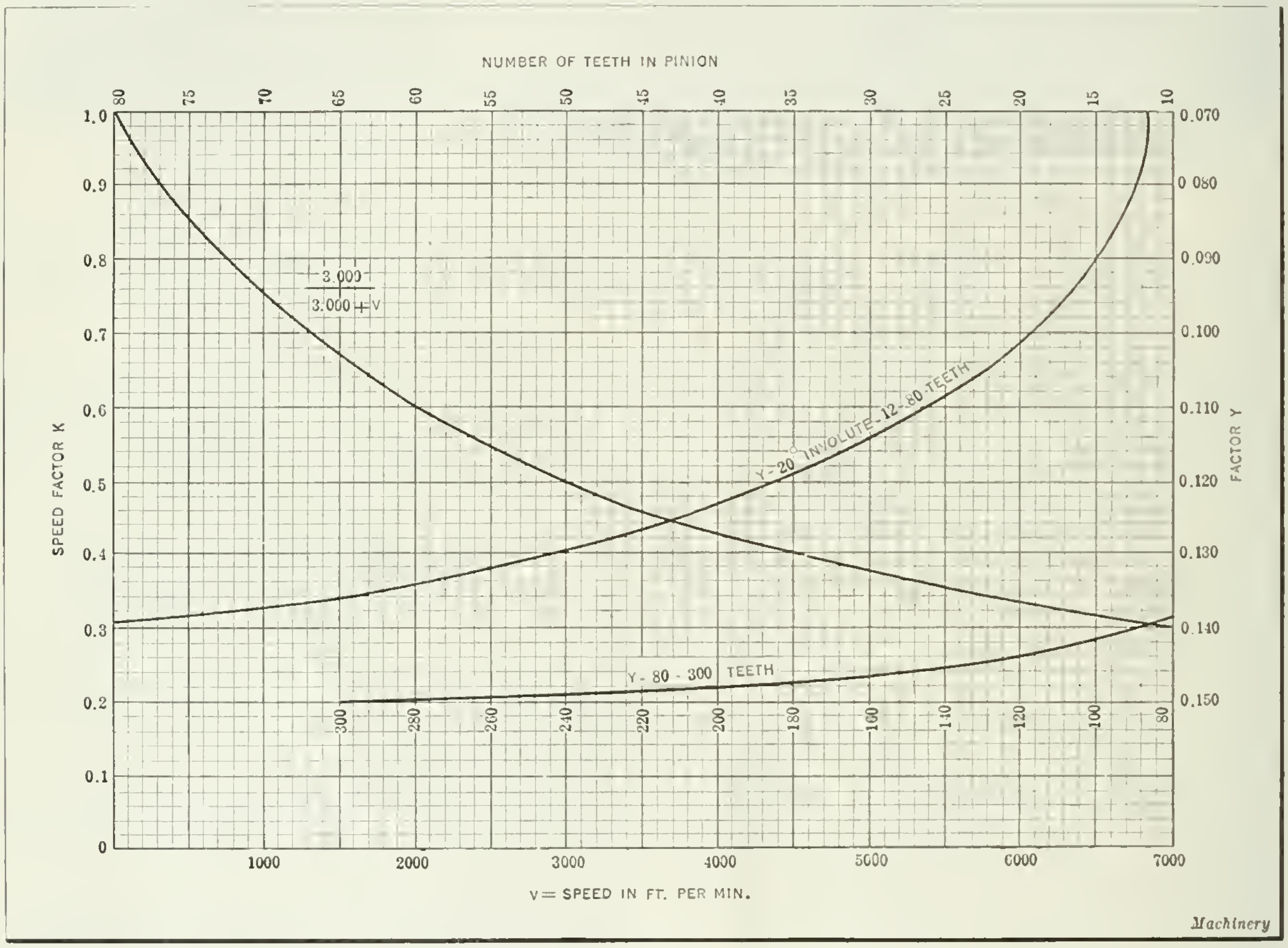
Y = Lewis formula outline factor for a given diametral pitch and pressure angle (see MACHINERY'S HANDBOOK, page 595); and

H = horsepower.

When the diametral pitch and velocity are known, the horsepower that can be transmitted by a gear of given material may be determined by the following formula, which is also derived from the Lewis formula:

$$H = \frac{S_s V F Y}{P \times 55\ (600 + V)} \qquad (2)$$

in which F = face width in inches. The notation otherwise is the same as for Formula (1).



Factors used in determining Power-transmitting Capacity of Herringbone Gears

When gears have stub teeth, the two pitches indicating the proportions of the teeth represent also the approximate increase in strength, as compared with standard teeth. Thus a stub-tooth gear of 6-8 pitch would transmit a load equal to approximately 8/6 of the safe load for a standard gear of 6 diametral pitch. When the teeth have full shrouding, they are about 100 per cent stronger, ordinarily, and 50 per cent stronger for half shrouding.

Power Transmitted by Herringbone Gears

Accurately cut herringbone gears represent the most efficient type of geared drives for parallel shafts. Gears of this type are adapted for higher velocities and ratios than spur gears. Accurate and well-made herringbone gears are often operated at pitch line velocities of from 3000 to 5000 feet per minute in connection with steam turbine reduction gearing, and the ratios may be 10 to 1 or higher for some installations.

In designing herringbone gears, the total face width, including the clearance space at the center (for gearing having such spaces), should be equal to at least six times the circular pitch for a 23-degree helix angle, to insure proper overlapping of the teeth or continuous contact. The following formula for determining the power-transmitting capacity of herringbone gears is recommended by a committee of the American Gear Manufacturers' Association.

In this formula

W = allowable tangential load in pounds at pitch line;

S_s = working stress in pounds per square inch for zero velocity = 15,000 for chrome-nickel steel heat-treated, 12,500 for 0.50 carbon forged steel, 10 000 for 0.30 carbon forged steel, 7500 for cast steel. and 4000 for cast iron;

P' = circular pitch;

Y = factor obtained from curve on accompanying chart;

K = speed factor, also obtained from the accompanying chart $= \dfrac{3000}{3000 + V}$.

The notation otherwise is the same as for spur gears.

$$H = \frac{WV}{33{,}000} \qquad W = S_s P' FYK \text{ for well-oiled gears}$$

For grease lubrication, multiply W by 0.8 to 0.62, depending upon the degree of lubrication.

The preceding horsepower formula takes into account the wearing quality of the gearing as well as the strength, and it is applicable to helix angles of about 23 degrees and a pressure angle of 20 degrees on the axial section of the hob.

To illustrate the application of the formula, assume that the capacity of a chrome nickel steel pinion, heat-treated and having 33 teeth of 2½ diametral pitch, is to be determined for a pitch-line velocity of 1860 feet per minute, a face width of 28 inches, and oil bath lubrication. Then,

$$W = 15{,}000 \times 1.256 \times 28 \times 0.118 \times 0.62 = 38{,}550$$

$$H = \frac{38{,}550 \times 1860}{33{,}000} = 2170 \text{ horsepower, approximately}$$

Helical gears have several inherent advantages as compared with the spur type. First, the action is distributed over more than one tooth, and all phases of tooth engagement, such as sliding and rolling contact, occur simultaneously, which tends to equalize wear and preserve the correct tooth shape. The load is transferred gradually and uniformly as successive teeth come into engagement, and the bending action resulting from the tooth load is less than for a spur gear, because the line of contact extends diagonally across the meshing teeth; the tooth load of a helical gear, however, is higher because of the angular position of the teeth, and the normal tooth section is, of course, smaller than that of a spur gear of the same circular pitch.

Power Transmitting Capacity of Helical Gears

Helical gearing for driving shafts which are not intersecting and not parallel is generally considered a rather treacherous type to use, when the amount of power is relatively high. In most installations, the power transmitted is much less than the maximum capacity of the gearing, and whenever the amount of power is likely to be anywhere near the maximum, it is preferable to use worm-gearing, the worm having as many threads as are required to give the desired velocity ratio. Helical gears which have caused trouble due to abrasion resulting from the small contact area and highly localized pressure, have often been replaced by worm-gearing with satisfactory results.

The advantage of the larger bearing surfaces of worm-gearing is illustrated by the following example and practice: A pair of helical gears were made, the smaller gear being made of hardened steel and the larger gear of cast iron. The helix angle was satisfactory, but when the gears were operated under working conditions they began to heat immediately and were worn out in a few hours. A second set was beginning to heat and show signs of wear, and would evidently have worn out as rapidly as the first set, but it was suggested that the cast-iron gear which was partly worn, be polished. After this was done, thus converting the helical gear partly into a worm-wheel, the gears operated without further difficulty. In this case the helical gears were changed by abrasion into worm-gearing, practically, and polishing the surfaces of the teeth merely arrested the wear that had started. Whenever there is any doubt about the power-transmitting capacity of helical gearing, it is not advisable to rely upon calculations, but to determine this capacity by an actual test with all running conditions, as regards speed, lubrication, and load, duplicated.

Application of Bevel Gears

Bevel gears are of the most important class of gearing for connecting shafts located at an angle. The straight-tooth form is applied to angular drives on practically all classes of mechanism, and the spiral type bevel gear for certain special applications, as, for example, the rear axle drives for automobiles.

The power transmitting capacity of bevel gearing may be determined by a formula based on the Lewis formula. A factor is introduced which represents approximately the relation between the strength of a bevel gear and that of a spur gear having the same number of teeth and pitch. There is also another modification in that the outline factor Y is not selected for the actual number of teeth in the gear.

In this formula C = the pitch cone radius; otherwise the notation is the same as that used for spur gears.

$$H = \frac{S_s VFY\,(C - F)}{55 \times PC\,(600 + V)}$$

To determine the outline factor Y, first divide the number of teeth by the cosine of the pitch cone angle. The quotient represents the number of teeth in an equivalent spur gear, and the table of outline factors for spur gears is used.

Capacity of Spiral Bevel Gears

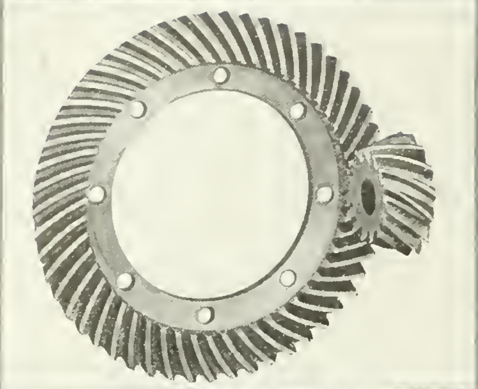
Spiral bevel gears have a load-carrying capacity that is somewhat greater than that of straight-tooth bevel gears of similar proportions. The difference in capacity, however, is not very great, and the formula for straight-tooth gears may also be applied to the spiral bevel type. One of the principal reasons that spiral bevel gears are slightly superior to the straight-tooth form as power transmitters is that there are more teeth in contact and the load on any one tooth is less. Another reason is that the load is never concentrated on the point of a tooth throughout its whole length. When there is contact at the point at one end, the contact is toward the flank at the other end, and the average height from the root, at which the load is applied, is much less than the total height of the tooth. The smoothness of operation is another favorable factor tending toward greater load capacity, as in the case of herringbone or double-helical gearing for connecting parallel shafts.

The tooth of a spiral bevel gear has to take both the transmitted load and the thrust load. This total load A equals the transmitted load B divided by the cosine of the spiral angle. For a 30-degree spiral angle, the total load is about 1.15 times the transmitted load. This additional tooth load on a spiral bevel gear tooth, as compared with a straight tooth, is more than offset by the increased number of teeth in contact.

While the tooth thickness of the spiral bevel gear is less than that of the straight gear, the length of the curved tooth is correspondingly greater, so that the sectional area on the pitch cone surface is practically the same for the straight and spiral forms of teeth of corresponding pitch.

* * *

According to figures published by the Department of Commerce, 246,941 automobiles were produced in August as compared with 81,693 in January, each month having shown a considerable increase.



Cutting Spiral Type Bevel Gears

By FRANKLIN D. JONES

Principles of Spiral Bevel Gear Cutting—Operation and Adjustment of Generators Designed for Cutting Gears of Different Sizes

SPIRAL type bevel gears have been used widely in automobile rear axle drives in preference to bevel gearing having straight teeth. There has also been an increasing demand for this type of gearing for other purposes. The spiral design operates more smoothly than bevel gears with straight teeth and has certain other advantages. The relation between spiral and straight tooth bevel gearing is practically the same as the relation between ordinary spur gears and helical gears applied to parallel shafts. The teeth of spiral bevel gears are not a true spiral, although the actual curve, when developed on a plane, closely approximates the spiral curve. A tooth having a curvature that meets practical requirements can be cut readily on a manufacturing basis, and there is no good reason for attempting to obtain a true spiral.

Two Methods of Cutting Spiral Bevel Gears

There are two general methods of cutting spiral bevel gears on Gleason generators. One is known as the "standard" or "single-side" method, and the other as the "spread-blade" method. With the standard method all the teeth are formed first on one side (when taking the finishing cuts); then both gear and cutter are adjusted slightly, and the opposite sides are finished. This method is recommended when a relatively small number of gears are to be cut—say fifty or less. The spread-blade method is so named because the cutter used has its blades spread far enough apart to form both sides of a gear tooth space at the same time. Since all the gear teeth are formed while the blank is indexed one revolution, instead of two revolutions as with the standard method, there is a saving in the cutting time for a gear of 40 per cent or more. This does not apply however, to the mating pinion, assuming that the latter is cut by the standard or two-side method, which is the usual practice. Most spiral bevel gears are now cut by the spread-blade method, which is recommended for cutting duplicate gears on a quantity basis. The generator to be described may be used for either method of cutting if equipped with a cutter adapted for the method employed.

Spiral Bevel Gear Generator

A 15-inch Gleason generator designed for cutting spiral type bevel gears is shown in Fig. 1. The action of this machine in forming the tooth curves, is based upon the same fundamental principle as that of the generators used for gears having straight teeth; that is, the cutter and gear blank are rolled together in order to generate the tooth curves. A rotary type of cutter, however, is used on the spiral type of generator to form curved teeth. The cutter-head *A* has a number of equally spaced blades or cutters, and the curvature of the gear teeth depends upon the radius of the circle with which the cutting edges coincide. Every other blade around the cutter-head cuts on the outside, and the remaining blades cut on the inside. It is evident then that the concave sides of the teeth are formed by the outer edges, and the convex sides by the inner edges. Each blade is ground on the cutting side to the pressure angle of the gear, except for a slight modification referred to later, and the opposite side has clearance. These inner and outer blades have top rake, and slope in opposite directions, or away from the cutting edges, to give a better cutting action.

This machine is designed primarily for finishing teeth that have been roughed out on another machine, although it may also be used for roughing cuts. The generator is used for stocking out gears by changing the feed-cam and running the machine without any rolling motion. When pinions are roughed out on this machine, the generating motion and finishing feed-cam are used, so that the machine set-up, with the exception of the cutter and cutter settings, is the same as for finishing. Separate stocking cutters having different point widths are usually required for the gear and the pinion. The finishing cutters will be the same for each member when the standard or single-side method of cutting is used, but will be different when the gears are cut by the spread-blade method.

Action of Spiral Type Bevel Gear Generator

A geared drive is used to roll the cutter and work together, instead of the master and crown gear segments employed on the straight-tooth generators. Column *B* supporting the cutter-spindle is mounted on a cradle *C* which has circular, segment-shaped ways and receives a rolling motion through a worm and a large worm-wheel segment. The amount of rolling motion is regulated by change-gears and a reversing mechanism making a fixed number of turns in each direction. This reversing drive is also connected to the work-spindle through permanent gears, change-gears, and a worm and worm-wheel segment, which transmits motion to the work-spindle through the indexing worm-gearing. The relative amount of rolling motion between the cutter and the work is controlled by compound change-gears located in the drive to the work-spindle. The cutting or generating of the tooth curves occurs while the cutter and work are rolling upward, and during the downward rolling motion a feed-cam swings the gear away from the cutter. The indexing movement then takes place, after which the gear is returned to the cutting position. This feed-cam is timed with the reversing mechanism previously referred to.

The cutter-head can be adjusted both vertically and horizontally for different cone distances and spiral angles. Scales and graduating dials reading to thousandths of an inch indicate the extent of these adjustments. As the cutter blades are shortened in grinding, the cutter-spindle may be adjusted lengthwise to locate the outer ends of the blades in a vertical plane coinciding with the center of the machine. If the center of the cutter-head is below that of the work, when cutting a pinion, the cutter center will be located above the center of the work when cutting the mating gear, because the curvature of the pinion teeth must be in the opposite direction.

Determining Blank Dimensions and Angles

In spiral bevel gear calculations, the angle of the blank, root angle, outside diameter, pitch diameter, and pitch cone angle are all calculated the same as for straight-tooth bevel gears. The same values are also used for the diametral or circular pitch. These gears are cut for 14½-, 17½-, and 20-degree pressure angles. When the angle is 14½ degrees, under-cutting of the pinion is avoided by using long and short addendum teeth. Pinions for automobile drives were formerly made with an addendum equal to 0.7 of the working depth, the addendum of the mating gear being 0.3 of the working depth. The latest practice is to proportion the teeth for each ratio to give the best rolling conditions and still avoid undercut, taking into account the number of teeth in the gear and the pinion, and the pressure angle.

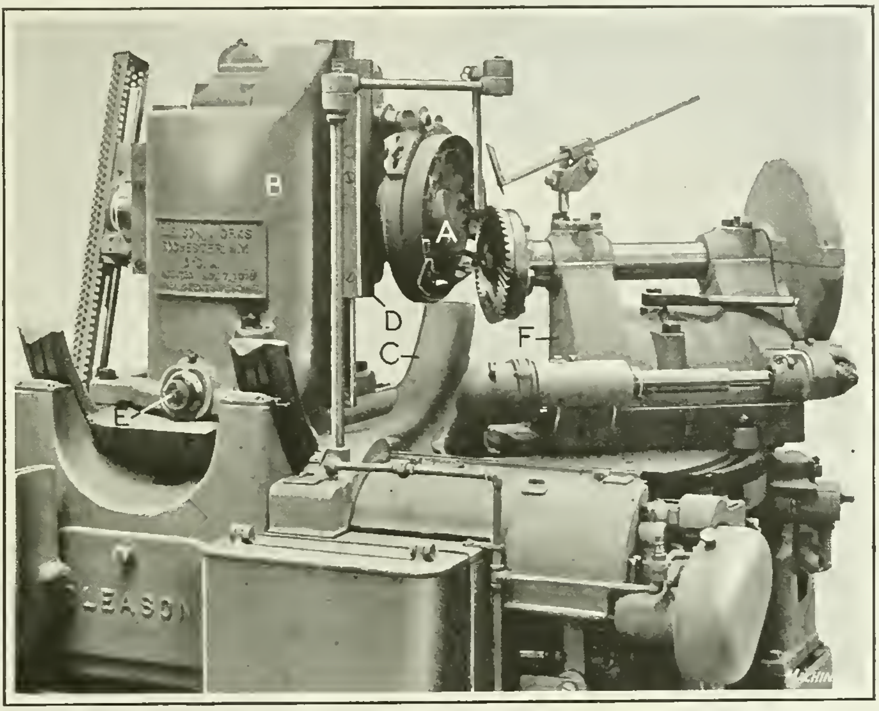


Fig. 1. Cutting a Spiral Type Bevel Gear on a 15-inch Gleason Generator

Left-hand cutters should always be used for finishing, so that the thrust of the cut will oppose the rolling movement of the work and give better control during the generating process. Roughing cutters, whether used on this machine or on a special rougher, should be of the same hand as the gear; that is, for a left-hand pinion and a right-hand gear a right-hand roughing cutter should be used. Then the cutter will always work from the small end of the tooth toward the large end when roughing the gear, and the thrust of the cut will be against the chucking plate. The "hand" of the cutter is determined by the direction in which it revolves, as seen from the rear side.

Because of the circular path followed by the blades when cutting spiral bevel gears, the pressure angle on the outside and inside edges is modified; thus the angle is not exactly 14½ degrees, 17½ degrees or 20 degrees, as the case may be. The angle of the inside-cutting blade is somewhat greater than the nominal pressure angle, and that of the outside-cutting blades is somewhat less. However, the effective pressure angle of the engaging teeth, measured with relation to the pitch cone surface, is the same for the engaging teeth of the gear and pinion. It is evident, therefore, that the effective pressure angle is not the same as the angle of the cutter blade. The cutter settings are so computed as to make the effective pressure angles equal for the gear and pinion teeth in mesh.

A series of finishing cutters is provided for each pressure angle. These are designated by numbers, and the selection depends upon the spiral angle desired. The sine of the pitch-line spiral angle obtained with a given cutter is found by dividing a constant by the sum of the block or dedendum angles of the gear and pinion, expressed in minutes. The constant is equal to the number of cutter multiplied by 20, the cutter number being a measure of the pressure angle correction.

When both gear and pinion are cut by finishing each side of the tooth space separately, the same cutter is used for the gear and pinion. When both sides of each tooth space on the gear are finished simultaneously by the spread-blade method, a cutter with the blades separated enough to obtain the proper tooth thickness must be used for the gear. A cutter of standard dimensions is used for the pinions, since the latter have each side of the tooth space finished separately, except in the case of small gearing, as explained later.

The method of measuring the angle of spiral is indicated by the diagram Fig. 2, which also shows the meaning of the term "lead" as applied to this type of gearing. To insure quiet operation, the angle should be sufficient to give a lead that is equal to from 1¼ to 1½ times the circular pitch. A spiral angle of about 30 degrees is usually the most satisfactory for automobile gears of 4 to 5 diametral pitch. For finer pitches, an angle between 25 and 30 degrees is sufficient. The angle should never be greater than about 35 degrees.

In setting up the machine for a new gear-cutting job, the cradle supporting the cutter-head should be at the center of the generating or upward rolling movement. The cam that imparts a swinging motion to the work-head should also be in its central position, as determined by a zero line on the cam and a fixed pointer. When the cam is in this position, if the cradle is not central, it can readily be adjusted. The rolling motion of the cradle is controlled by change-gears, and the extent of this movement must be determined by trial. For instance, a movement of 45 to 50 degrees will probably be necessary for a flat gear, whereas about 23 degrees is sufficient for a pinion of 3 or 4 to 1 ratio. The motion will be less for a pinion of higher ratio. The only requirement is that the cutter shall have rolled clear of the tooth before the generating movement is reversed. Another set of change-gears, selected for different combinations by referring to a table accompanying the machine, is used to give the proper relation between the rolling movements of the cradle and work.

Checking Angle of Rolling or Generating Motion

The ratio of the compound change-gears which govern the relative amount of rolling motion between the cutter and work, depends upon the pitch cone angle of the gear or pinion to be cut. If the angle through which cradle *C* (Fig. 1) moves, is divided by the angle through which the gear

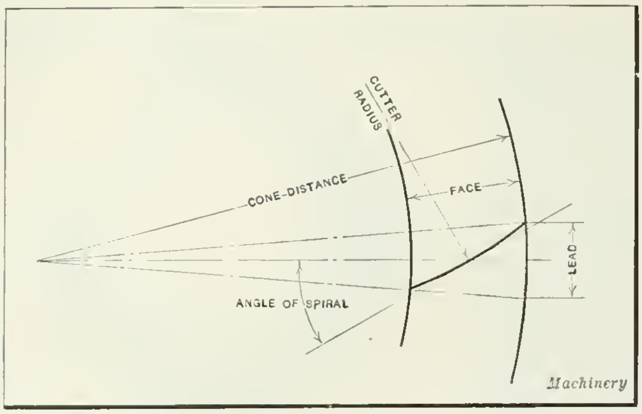


Fig. 2. Diagram showing how Angle of Spiral Bevel Gear Tooth is measured

rolls, the quotient should equal the sine of the pitch cone angle of the gear. In determining the change-gear combinations as listed in the table, it is necessary to consider the fixed or permanent gears, which are represented in the calculation by a constant.

To illustrate the relation between the generating motions and the angle of the gear, assume that the gear is to have 49 teeth and the pinion 13 teeth. The tangent of the pitch cone angle of the gear equals the number of teeth in the gear divided by the number of teeth in the pinion, or 49 ÷ 13 = 3.769; hence, the angle of the gear is 75 degrees 8 minutes. If the angular motion of the cradle is assumed to be 30 degrees, then the angular motion of the work equals 30 ÷ sin 75 degrees 8 minutes = 30 ÷ 0.96653 = 31.038 degrees. The rolling motion of the work during the 30-degree movement of the cradle can be checked by means of graduations and a vernier scale located at the outer end of the work-spindle. In this instance the cradle is moved through an arc of 30 degrees, and the vernier scale will show whether or not the angular motion of the gear to be cut equals 31.038 degrees, which is the correct amount for cutting the gear of this particular combination.

Shop Test for Generating and Indexing Movements

In making the shop tests for checking the ratio of the rolling movements, the machine is stopped when the cradle stands exactly on the 15-degree position. The vernier at the back of the work-head is then set at zero by turning the vernier-carrying dial. After securing this dial by a thumbscrew, the machine is started and run until the cradle stands at exactly 15 degrees on the other side of the zero position. The angular movement of the work-spindle on the opposite side of zero is then noted, and should correspond with the "test roll" given in connection with the table of ratio change-gears. The foregoing ratio test is for use in cutting gears. The same method is followed for cutting pinions, with the exception that the rolling movement of the cradle should be either 8 or 6 degrees each side of the center.

The indexing movement can be checked in connection with the test for the ratio of the roll. The vernier dial at the end of the work spindle should be left as previously set. The machine is then allowed to run until the cradle has passed the lowest point in its rolling movement, and has rolled up to exactly the angular position at which it was set for the ratio of roll test, which is 15 degrees for gears, and either 8 or 6 degrees for pinions. The machine should now have completed one cycle and indexed one tooth, and the vernier reading at the end of the work-spindle should equal 360 degrees divided by the number of teeth in the gear or pinion to be cut.

Adjustments of the Cutter

The horizontal and vertical adjustments of the cutter relative to the cone center of the gear or pinion, differ somewhat for roughing and finishing cuts, although, as previously mentioned, spiral bevel gear generators are ordinarily used for finishing gears that have been stocked out on a machine designed especially for this purpose. When the sides of the tooth spaces are finished by taking separate cuts, the vertical position must be changed slightly, first for cutting the teeth on one side and then for the opposite side. The method of determining these adjustments depends not only upon the gears or pinions to be cut, but also on the method of cutting—that is, whether by the single-side or spread-blade method. In ordinary practice the shop man is, of course, given the dimensions required for making these horizontal and vertical adjustments. The formulas needed for calculating these dimensions are supplied by the Gleason Works.

For adjusting the cutter horizontally, the column supporting the cutter is moved laterally on the cradle by means of an adjusting screw *E*, Fig. 1. A scale at the base of the column, reading to tenths of an inch, and a dial on the screw reading to thousandths are used in making these adjustments. The vertical position is regulated by raising or lowering the slide *D* carrying the cutter-spindle. This slide is adjustable along the face of the column, and a vertical scale, in conjunction with a dial on the crankshaft, serves to set the cutter at the required height.

Whenever a cutter is mounted on the spindle, either after sharpening or when changing from one cutter to another, the cutter-spindle must be adjusted lengthwise to locate the points of the blades in a vertical plane coinciding with the center of the machine or the apex of the pitch cone of the gear. A gage is used to check this adjustment. It is also necessary to test the radial position of each blade; in fact, it is very important to have all the cutting blades set at exactly the same radius because if a high blade does most of the finishing, the teeth will have a series of flats formed on them. To secure a fine adjustment, each blade rests on a wedge which may be moved in or out by a screw, thus changing slightly the radial position of the cutting edge.

There are two non-adjustable master blades in each cutter-head, one of which cuts outside and the other inside. In adjusting the blades for cutting outside, the dial indicator used for testing is first set to zero when in contact with the outside-cutting master blade. All the other outside blades are then adjusted to give zero readings, after which the inside-cutting blades are set with reference to the master blade in the same manner. In sharpening a cutter, the radial position of the cutting edge is affected. In order to reduce the time required to true up the cutter to a minimum, it is desirable to have each blade sharpened so that its cutting edge is on the same radius as the master blades. The Gleason spiral cutter grinder is equipped with a worm-wheel so that each blade can be indexed around, and its correct angular distance from the master maintained.

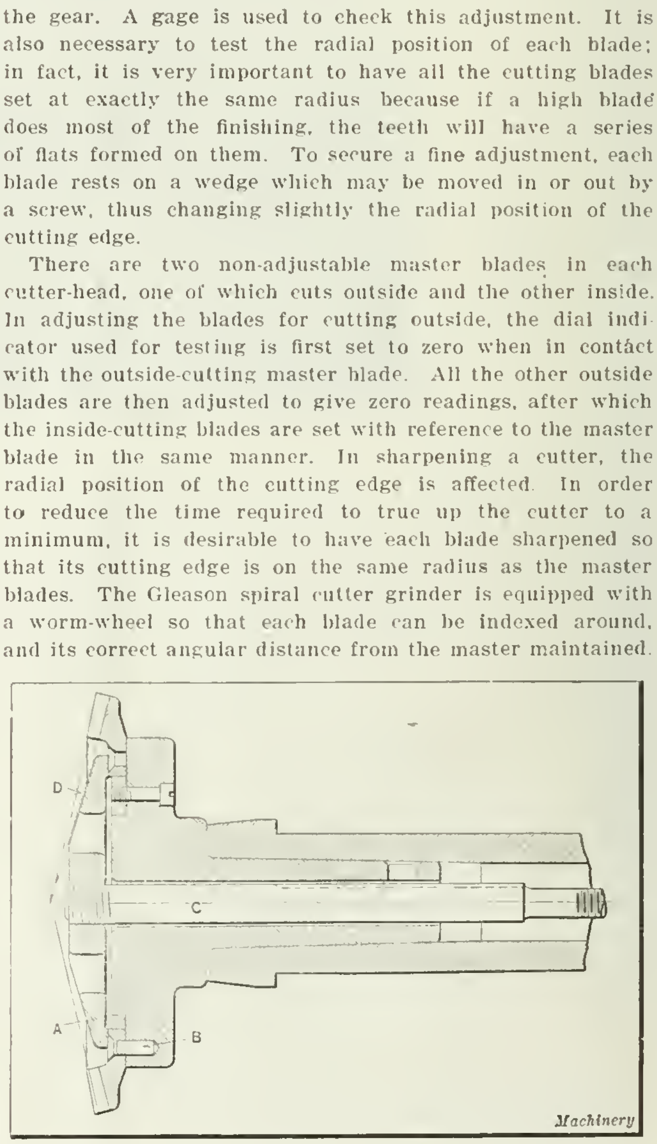


Fig. 3 Arbor for holding Ring Gears on Spiral Bevel Gear Generator

Swinging Movement of Work-holding Head and its Angular Position

The angular movement of the head *F* (Fig. 1) which carries the work-spindle is obtained by subtracting the root angle of the gear or pinion from the face or blank angle (as measured from the axis) and then adding one degree for clearance. This angular movement is regulated by an adjustment of the cam-lever through which motion is transmitted to the head. Graduations on the side of the lever are referred to in making this adjustment.

In order to locate the gear at the correct angle relative to the cutter, and at the proper distance from the center of the machine, the work-spindle head is first set to the face angle of the gear (one-half the included blank angle). Graduations on the segment-shaped base are used in making this setting. A feed change-gear is next removed to permit running the cutter by hand, while the rest of the machine is idle. The work-spindle head is then moved forward carefully until the ends of the cutter blades just scrape the face of the gear blank. The reading on a scale at the side of the work-spindle head is then noted and marked down, as this reading is needed later in adjusting the cutter for generating the top sides of the gear teeth. The head is now moved backward for clearance and is set to the root angle.

Regulation of Feed and Speed Changes

The speed of the entire machine, except the cutter drive, is regulated by the feed change-gears, which control the rate of feed or the time per tooth, in accordance with the pitch of the gear and the material. For low-carbon nickel-steel commonly used in automobile practice, and for diametral pitches up to 4, the time per tooth, when using the spread-blade method, may vary from twenty to thirty-five seconds for the gear, and is somewhat longer for the pinion. The cutter speed is regulated by speed change-gears, according to the nature of the work. For nickel-steel a speed of 90 to 100 feet per minute is a fair average.

Setting Cutter for Finishing Top and Bottom Sides of Teeth

When the convex and concave sides of the teeth are finished by separate cuts, the cutter-slide is first set in the correct vertical position for finishing the top sides of the gear teeth. Then, with the cradle at the center of the generating or upward rolling movement, the work-spindle head is set, by means of the scale along its base, to the reading previously obtained at the time when the gear blank was adjusted until the cutter blades just scraped the face.

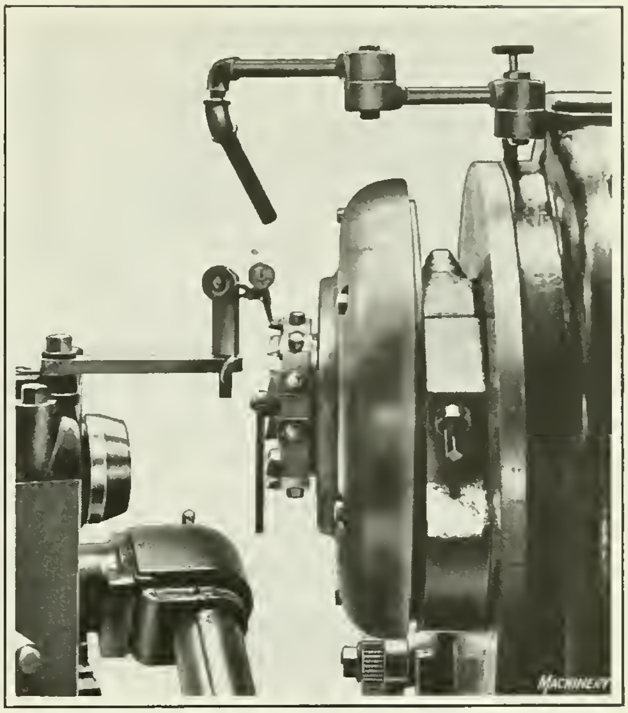


Fig. 5. Testing Radial Positions of Cutter-head Blades

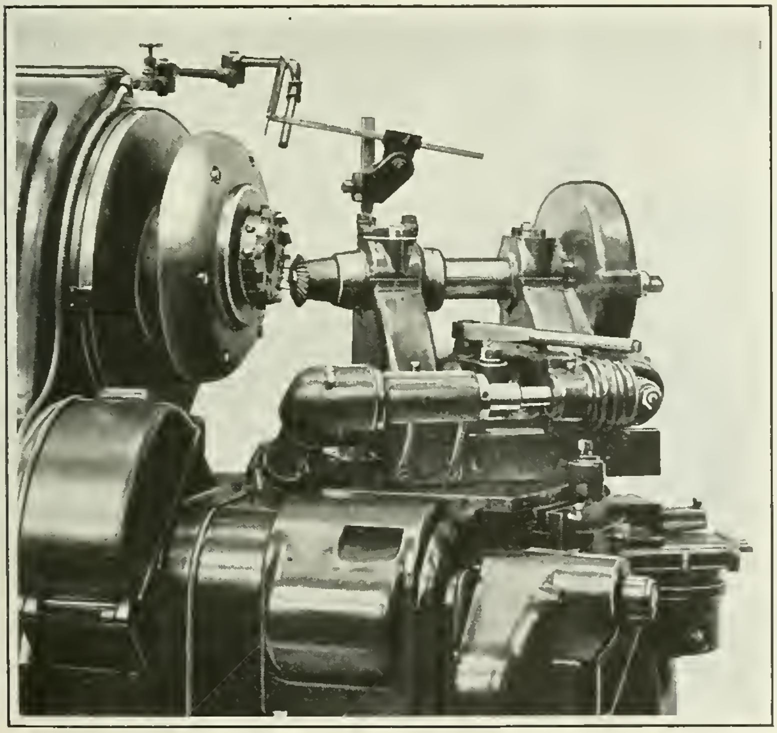


Fig. 4. Spiral Bevel Gear Generator of Eccentric Head Construction

To do this, it is necessary to disengage a clutch on the worm-shaft of the index mechanism until a roughed out tooth space in the gear blank is in alignment with the cutter blades. The indexing worm is revolved slowly until the top side of the gear tooth just touches a cutter blade which operates on this side. The index clutch is then closed, and the machine is run until the gear is swung out far enough to clear the cutter. The clutch is next disengaged, and one half is moved several notches relative to the other half, in order to shift the top side of the gear tooth toward the cutter. This adjustment should be sufficient to remove approximately one-half the stock left for finishing, and it must be found by trial.

After all the teeth have been finished on the top side, the vertical position of the cutter is changed for finishing the bottom side. The tooth thickness is regulated by disengaging the index-clutch and turning the work-spindle back enough to permit the cutter to true up the bottom side of one tooth. Two or three teeth are then cut, and the thickness measured; if necessary, repeated adjustments are made by means of the index clutch until the thickness is correct. By noting the adjustment of the clutch, which has a graduated ring that can be set to zero as a starting point, the same setting can be used for duplicate gears, provided no changes are made in the position of the cutter.

Adjustments when Both Sides of Tooth Space are Cut Simultaneously

When the spread-blade method is employed, the adjustments differ slightly from those made for the standard method. The work-spindle head is set to the proper angular and lengthwise positions, as previously described, but it is necessary to have only one cutter blade in the roughed out tooth space, in order to permit swinging the gear blank around until the bottom of a roughed out space is up to the point of the cutter blade. The work-spindle is adjusted for

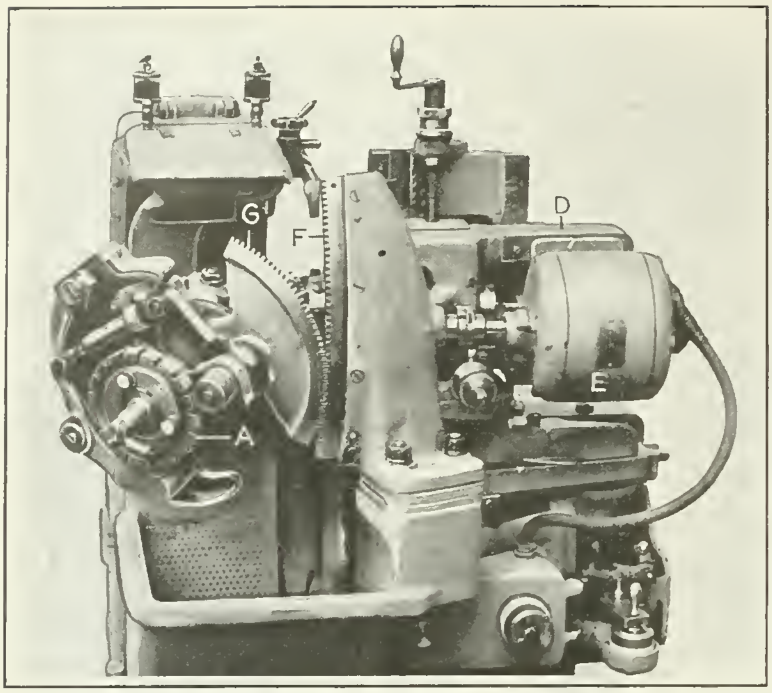


Fig. 6. Generator designed for cutting Small Spiral Bevel Gears

dividing the amount of stock that is removed from each side of the tooth space, by disengaging the index clutch and changing its position as may be required. As both sides of the tooth space are finished simultaneously, there is only one vertical position for the cutter. The tooth thickness depends upon the cutter dimensions, and cannot be regulated by the operator.

Method of Holding Spiral Bevel Gears

When cutting spiral bevel gears, the work is ordinarily held either by a keyway previously cut or by a dowel-pin in the case of ring gears. A positive method of mounting is preferable, partly because the thrust of the cut is to some extent circumferential, and partly because the keyway or dowel provides a convenient means for locating the roughed-out gears on the generator, so that the amount of stock removed from opposite sides of the teeth by the finishing cuts is approximately equal and it is not necessary to use the stock dividing gage.

An arbor for holding ring gears on a spiral bevel gear generator is illustrated in Fig. 3. This arbor has a centering plate *A*, which fits closely into the bore of the gear, and the latter is prevented from turning by pin *B*. The clamping plate is engaged by the threaded end of draw-bolt *C*. An arbor of this kind must be designed so that all projections clear the root line *D* of the gear.

Spiral Bevel Gear Generator of Eccentric Head Construction

The 8-inch Gleason spiral bevel gear generator shown in Fig. 4 operates on the same general principle as the 15-inch machine previously described, but the design is somewhat different, particularly the construction of the cutter-spindle head. On the smaller machine a circular generating plate having a bearing around the entire circumference serves the same purpose as the segment-shaped cradle of the larger machine. The work-spindle is mounted eccentrically in a drum-shaped member, which is also located eccentrically within the generating plate. With this eccentric construction, the cutter can be adjusted vertically and laterally relative to the center of the gear blank, the same as though it were mounted on a column and slide having lateral and vertical adjustments, as on the larger machine. The generating plate and work-spindle are rolled together to provide a generating movement which is controlled by suitable combinations of change-gears.

In setting up the machine, many of the adjustments are practically the same as described for the 15-inch size. Owing to the eccentric construction, the cutter is set according to angular graduations instead of by linear dimensions. The "eccentric angle" is indicated by degree graduations on the eccentric drum and minute graduations on the dial of the adjusting handwheel. In setting up this machine, the cutter-spindle must be adjusted lengthwise, so that the points of the blades are in a plane with the cone center of the machine, this adjustment being the same as when setting up the larger generator.

The cutter blades must also be adjusted carefully to the same radial position. Fig. 5 illustrates the dial indicator used for checking their position. When a second cutter-head is available, this adjustment may be made on a cutter-truing fixture in order to reduce the idle time of the machine, but when cutting pinions this test should preferably be made while the cutter is on the machine, because the effect of a high blade is more pronounced on the profile of a pinion tooth.

Cutting Small Spiral Bevel Gears

The Gleason machine shown in Figs. 6 and 7 is used for cutting small spiral bevel gears having pitch diameters ranging from 3 inches for a 1 to 1 ratio, up to 4 inches when the ratio is 4 to 1. These gears are of the class used on sewing machines, motion picture machines, and various other kinds of apparatus. This machine usually finishes the teeth from the solid in one operation, the spread-blade method being used; the method whereby one side is cut at a time is sometimes employed.

This machine differs from the other types of Gleason generators described, particularly in regard to the generating motion. All of this motion is applied to the gear being cut, instead of rolling the gear and cutting tools together as is done in the other generators. The action applied to the work is similar to that of a bevel gear rolling on a

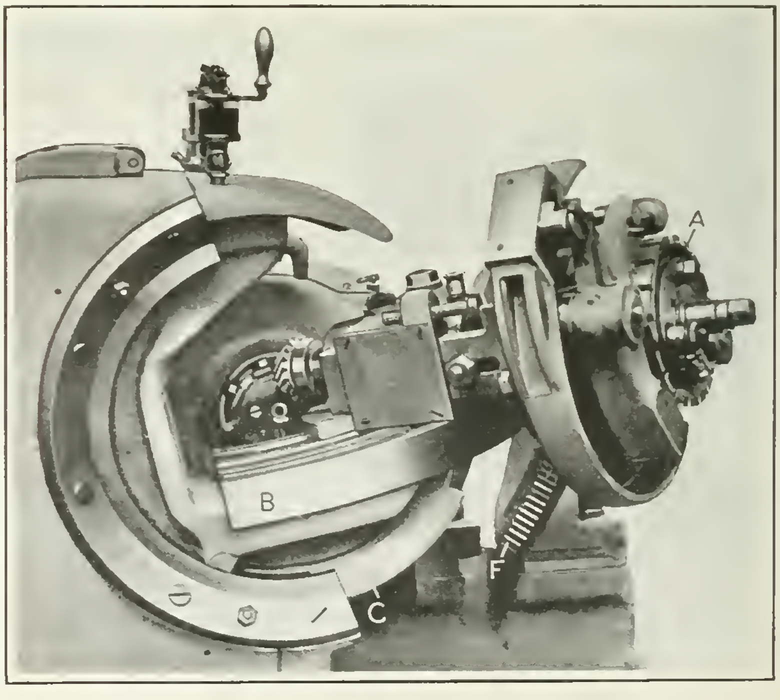


Fig. 7. View of 4-inch Generator, showing Cutter and Gear

stationary crown gear. The other generators for both stationary and straight-tooth bevel gears are so designed that the action is similar to that of a bevel gear being revolved by a crown gear.

The diagrams *A* and *B*, Fig. 8, illustrate the difference between the two motions. When the small spiral bevel gear generator is at work, the axis of the revolving cutter remains in one position (see diagram *A*), while the gear blank rolls bodily about an imaginary crown gear *c*, far enough to permit the cutter to generate a tooth space. Arrow *a* indicates the swinging movement of the work about the axis of the crown gear, and arrow *b* illustrates the rotation of the work about its own axis. When the generating motion is applied to both gear blank and cutter, as indicated by diagram *B*, the axis of the gear blank remains stationary and the gear turns about this axis as the cutter is given a swinging movement, just as though the working part of the cutter were the tooth of a crown gear rotating in mesh with the gear being cut. The two circles *d* and *e* represent the swinging movement of the cutter, which must be great enough to permit generating a tooth space. The 15-inch spiral bevel gear generator has the generating motion illustrated by diagram *B*.

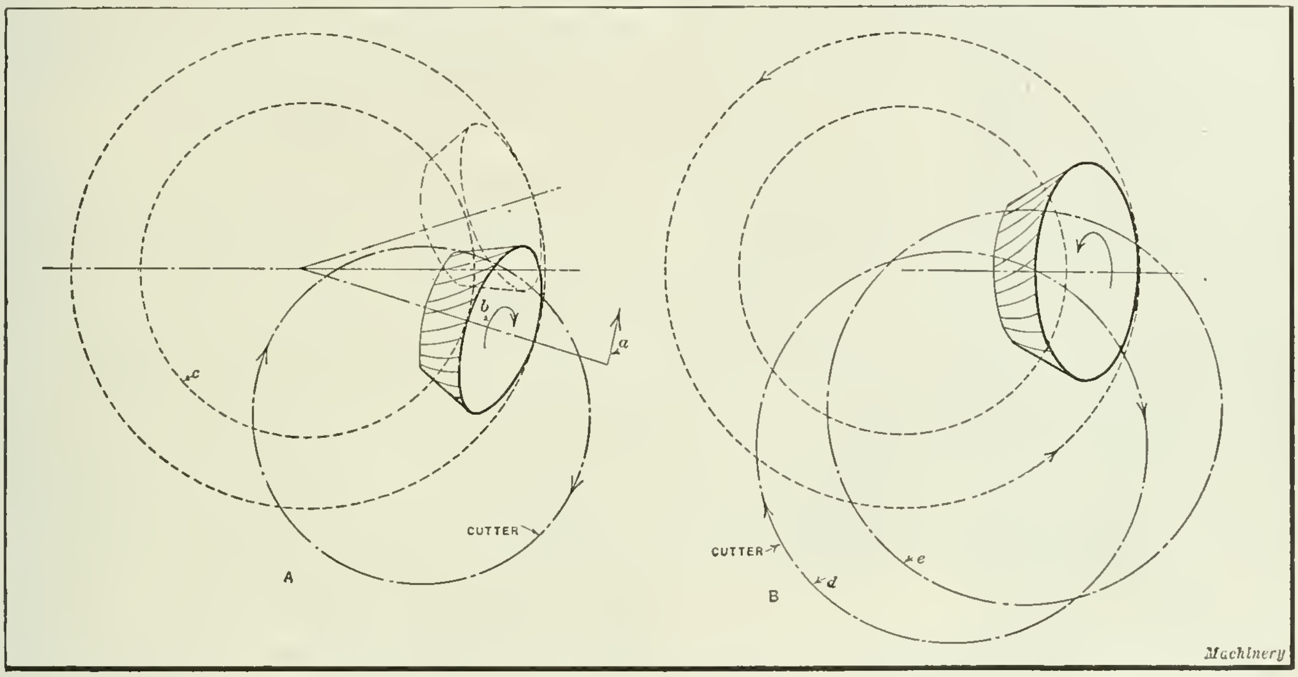


Fig. 8. (A) Movements when All the Generating Motion is applied to the Work; (B) Generating Motions applied to Both Gear and Cutter

Adjustment of Work- and Cutter-spindles

The work-spindle is mounted on a segment-shaped projection *B* (Fig. 7), which is integral with cradle *C*. This cradle receives an oscillating motion through a connecting link and crank mechanism located inside the frame of the machine. The work-spindle is adjusted relative to part *B* in accordance with the angle of the gear or pinion to be cut. The slide *D* (Fig. 6) carrying the cutter-spindle is also adjusted vertically, and the entire cutter-head is moved horizontally for locating the cutter in the proper position relative to the gear blank, as determined by the spiral angle of the teeth and the hand of the spiral. While the same cutter may be used for both gears and pinions, its vertical position relative to the center of the work must be reversed. For instance, if the center of the cutter is below the gear center, it must be above the center when cutting the mating pinion, because the teeth of the gear and pinion are of opposite hand.

The Operating Mechanism

Two motors are used to drive this machine. One motor *E* drives the cutter-spindle, and the other revolves the feed-cam for the cutter-spindle head and also the crank mechanism that oscillates the cradle *C* (Fig. 7) carrying the work-spindle. The axis of this cradle coincides with the axis of the crown gear segment *F*. Meshing with this crown gear segment is another master gear segment *G* (Fig. 6) connecting with the work-spindle sleeve; consequently, when cradle *C* is turned in its bearing, the master gear rolls on the crown gear and causes the work-spindle carrying the gear blank to turn about its axis as the gear itself moves to the position indicated by the full and dotted lines in diagram *A*, Fig. 8. This motion, relative to the cutter, is the same as when both gear blank and cutter receive the generating motions.

Cycle of Movements of Machine

When the machine is cutting a gear, the movements are as follows: The cutter is moved in to the cutting position by a cam, and it begins to cut as the work-spindle approaches the bottom of the rolling movement. A tooth space is finished on both sides as the gear rolls upward. Just before the upward movement is completed, the cutter begins to withdraw; then as the downward or backward motion takes place, and after the cutter is clear of the work, the latter indexes to bring the next successive tooth space around to the cutting position. The cutter is then gradually advanced into the gear blank during the remainder of the downward rolling movement, but it does not reach the full depth position until just after the beginning of the upward movement. This cycle of operations is controlled by what is known as a "completing cam."

The indexing movement is derived entirely from the generating motion by means of a mechanism located at the outer end of the work-spindle. The dividing plate *A* (Fig. 7) which forms part of this mechanism contains as many notches as there are teeth in the gear to be cut.

Cutting Both Gear and Pinion by Spread-blade Method

In view of the fact that both sides of a tooth space are generated at the same time when the spread-blade method is employed, it is apparent that the tooth does not have the same converging form that is obtained when one side is cut at a time, as is often done on the larger machines. With the former method, the tooth space has a uniform width at the bottom. Teeth generated in this way, however, operate satisfactorily, assuming that the pinion is cut to suit. The pinion, as well as the gear, may be cut by the spread-blade method, and this is done in the case of small spiral bevel gearing. When this duplex spread-blade method is employed, the cutter is sunk somewhat deeper at the large end or shallower at the small end on the gear or pinion, or on both, to obtain a space of the required width. In cutting gears by this method (cutting deep at the large end or shallow at the small end), it is customary to alter the face angles to suit the new root angles so as to maintain the standard amount of clearance. This method cannot be applied satisfactorily to gears for automobile drives, because either excessive under-cut or an excessive stub tooth form results from the modified depth. In the case of larger gearing, if both sides of a tooth space are finished simultaneously, it is common practice to take two cuts when cutting the mating pinions.

Rates of Production for Spiral Bevel Gears

Production rates on spiral bevel gear generators are decidedly affected by the method of cutting the teeth. For instance, when the spread-blade method is employed, the time is about one-half that required when finishing one side at a time and indexing around twice. Pinions also require more time per tooth than gears, because the generating motion necessary for a pinion tooth extends over a larger arc. When using a 4-inch generator, the time required for cutting cast-iron gears having 28 teeth of 18 diametral pitch, was 10 seconds per tooth; the floor to floor time was 5 minutes 10 seconds. The gears cut on this small machine are finished direct from the solid blank, as previously explained. The production rate on the 8-inch machine when cutting low-carbon nickel-steel gears with diametral pitches up to 4, varies from 10 to 25 seconds per tooth for the gear and is somewhat longer for the pinion. This applies to the spread-blade method. For example, the time when cutting 3½ per cent nickel-steel gears of 6 diametral pitch was 23 seconds per tooth by the spread-blade method, or 23 seconds per side when indexing around twice. When using the 15-inch generator for cutting nickel-steel gears of 4 diametral pitch and smaller, the time per tooth ordinarily varies from 20 to 30 seconds by the spread-blade method, and from 40 to 60 seconds when finishing the sides separately. The time for cutting pinions is about 50 to 70 seconds per tooth. The allowance for changing blanks, etc., varies from about 3 to 5 minutes per gear.

* * *

DEMAND FOR MACHINE TOOLS IN JAPAN

By S. NODA, President, Roku-Roku Shoten, Ltd., Tokyo, Japan

Manufacturers of machine tools in the United States will doubtless be interested in information relating to the kinds, types, and sizes of machine tools that are chiefly in demand in Japan. Of all classes, lathes sell in the greatest numbers. The majority are gap lathes of the English type, having swings from 10 to 20 inches, and beds from 4 to 8 feet long. The demand for American-type lathes without gap is only about 5 per cent that for gap lathes; such machines are built to some extent in Japan, but at rather high prices. Next in demand come larger gap lathes with swings from 24 to 40 inches and with beds from 12 to 20 feet long. Lathes of this type are mostly supplied by local builders. The prices average from 43 sen (21 cents) per pound for the smaller lathes, to 22 sen (11 cents) per pound for the larger sizes.

Next in demand come upright drilling machines of from 20- to 26-inch sizes, and smaller shapers of from 14- to 20-inch stroke. The shapers in greatest demand are the American type crank shaper with quick return. The domestic drilling machines average about 30 sen (15 cents) per pound and the shapers, 35 sen (17 cents). Large lathes, radial drilling machines, planers, and punching and shearing machines are also in demand, particularly among shipbuilders. Most of these machines are built by domestic manufacturers at average prices of from 25 to 35 sen (from 12 to 17 cents) per pound for the lathes and drilling machines, and from 22 to 28 sen (14 cents) per pound for the planers and punching and shearing machines.

Milling machines, gear-hobbing machines, and grinding machines are also in demand; these come chiefly from America. Plain milling machines and also some universal milling machines are built in Japan, but the domestic machines are higher in price than the American machine tools, and they are bought principally by the government. Twist drill grinders, cutter grinders, and other simple types of grinding machines are built in Japan at reasonable prices.

The state railways and other government shops and some of the big electrical works are the principal buyers of high-class machine tools, and most of their orders go to America. For plants of this type, heavy-duty tools, such as all-geared-head lathes, heavy-duty drilling machines, planer-type milling machines, car-wheel lathes, and gang and radial drilling machines are in demand.

Turret lathes and automatic screw machines are also coming into more general use. The chief buyers for these types of machines are manufacturers of bicycles, clocks, telephones, and electrical appliances. Most of these machines come from America. Recently, some German machines have been offered at extremely low prices, but the supply will not last very long. These classes of machines are not built in Japan to any appreciable extent.

The Machine Shops of Japan

Small shops scattered all over the country contribute greatly to the demand for machine tools. These shops employ only from five to ten men each, and have, perhaps, from three to five machine tools. The state railways, the army and navy, street railway shops, textile mills, machine shops in connection with mines, and contractors for harbor and road work come next on the list as important buyers. A considerable amount of equipment is required for the government aviation factories. The state railways and the other government and private shops of larger size are the chief buyers of American and European machine tools.

Aside from machine tools, Japan buys large quantities of mining machinery and railway and highway construction machinery, cranes, hauling engines and conveyors, sugar machinery, and steam and water turbines. The machinery for the chemical industry is chiefly bought from continental Europe. Textile machinery is imported chiefly from England. Steam and water turbines, and steam engines of the larger sizes, are chiefly imported, but are also made to quite some extent in Japan. This is also true of Diesel engines and other internal combustion engines.

The things that count in favor of imported machine tools and that the manufacturer in the United States must consider if he wishes to obtain and hold Japanese trade are accuracy and care in workmanship, making for precision; high-duty capacity; moderate price; good packing; and reasonable deliveries.

In the shipbuilding industry, where heavy machine tools are required, British tools have been bought to a large extent because of their rigidity. The British prices are also less on this class of machines than American. In some instances, certain types of British lathes are very much liked, but a study of the matter will show that some of these lathes are really built in accordance with American practice, and to some extent have been patterned after American designs. Generally speaking, both American and British machine tools find a market in Japan when they are of good quality and offered at a reasonable price.

* * *

Since the armistice the building of railroad equipment has gone on at a very rapid pace in Germany with the result that today the 150,000 freight cars and the 5000 locomotives delivered to France by Germany in the latter part of 1918 and the early part of 1919 have already been replaced by new equipment.

Selection and Use of Babbitt Metal

By L. D. ALLEN, General Manager, L. D. Allen Metal Works, Chicago, Ill.

In this article the author, who has specialized on bearing metals for many years, explains why there are such wide variations in different brands of bearing metals, and points out that there is more to the making of a good bearing metal than simply mixing or alloying certain percentages of constituent metals. He refers to the danger of selecting a bearing metal by analysis alone, and gives practical advice on the melting and pouring of babbitt metal for bearing liners. He also outlines the causes of shrinkage of babbitt metal when cast, and emphasizes the importance of pouring and casting the metal at low temperature.

As stated in the article on babbitt metal published in October Machinery, the selection of the materials and the method of combining them are important factors in producing the required degrees of hardness and toughness in babbitt metals. In addition, babbitt manufacturers who are anxious to produce a high quality of bearing metals should refine the constituent metals to a high degree of purity and take great care to alloy them by methods that have been scientifically determined to give the best results. Bearing metals so produced will run cooler and have a longer life as bearing liners than those produced without the necessary care or adequate technical knowledge of bearing requirements.

There is more to the making of a good bearing metal than simply mixing or alloying certain percentages of constituent metals. The constituents may be well mixed, but the quality and permanency of the mixture are determined by definite laws. An alloy that may be perfect at a high temperature partly segregates at low temperatures, while others remain perfect alloys at any temperature. It is at this point in the procedure of producing a good bearing metal that so-called "private" or secret methods are employed, certain fluxes being used in combining the ingredients. The use of these fluxes is not apparent in analyzing the resulting alloy, but the employment of these processes involves considerable extra cost and accounts for the higher price of the best bearing metals. Aluminum, bismuth, arsenic, zinc, iron, nickel, cadmium, sodium, barium, strontium, and calcium are among the elements that are used at this stage of the manufacturing process. These elements are employed more especially by manufacturers of special brands, catering to a special industrial demand, where the quantities required are not large; for that reason, industrial concerns having unusual requirements are more inclined to observe and appreciate the better working value of these special bearing metals, and are willing to pay the necessarily higher price to obtain them.

Manufacturers of machinery in general, because of price competition, are inclined to economize in their purchases at every point where the cheapness of the material used will not directly affect the reputation of the product. Special care is given by their engineers to the selection of the steel, iron, brass, and other metals that have to do directly with the strength and stability of the machine; but when it comes to such items as bearing metals, the machine builder seems to believe that if the bearing burns out, the buyer of the machine can easily obtain babbitt from a local hardware store, a mill supply house, or a babbitt manufacturer, and rebabbitt the bearing himself, without any appreciable influence on the merits of the machine. This point of view, however, is a mistaken one, because a machine is no better in uninterrupted production than the endurance and service quality of its bearing.

Manufacturers of machinery should realize that the best babbitt for their requirements that expert babbitt manufacturers can produce is the most economical, regardless of price. In some cases it may be a lead-based babbitt, in others a tin-based babbitt. The selection of the best babbitt requires a practical knowledge of bearing conditions and of the properties of bearing alloys.

The Use of Virgin Metal

Very often large babbitt users who order according to their own formulas or specifications request that "virgin" metal be used. Many metallurgists claim that it makes no difference whether virgin metal or older metal is used, so long as the metal is pure, that is, free from dissolved oxides or oxides in a mechanical mixture with the metal. It is the oxides and similar impurities that impair repeatedly overheated or remelted metals. Some authorities claim that the dross of tin, lead, and antimony products—when free from iron, aluminum, zinc, and arsenic—smelted in an adequate reducing furnace at about 2500 degrees F., will, with proper additions, produce alloys that are superior to the same alloys made from virgin metals, because the alloying is better than when virgin metal is used exclusively. The author's experience, however, leads him to believe that chemically pure well-balanced alloys made of virgin metal produce the best and strongest babbitt metals made, and that they also possess higher anti-frictional properties than babbitt metals produced in any other way.

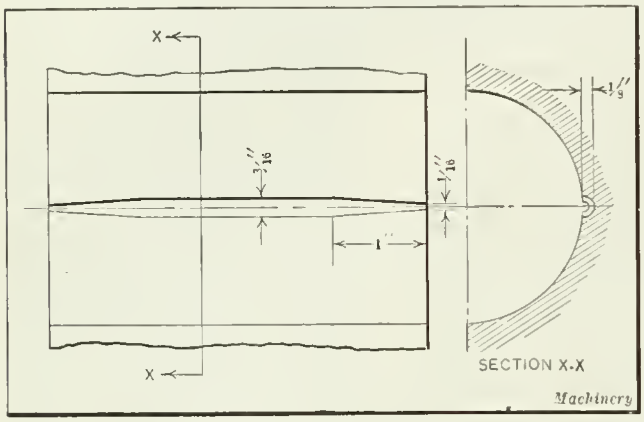
A babbitt should not be selected by analysis, as there are many points to be taken into account in the making of the metal that have to do with its physical properties, but that evade the chemist; nor should any one babbitt be selected for all bearing requirements. Metals high in lead have the best anti-frictional properties when properly produced; but metals high in tin and copper are desirable when toughness combined with hardness is required to meet unusually severe bearing conditions. Price and analysis are both dangerous factors to rely on in the selection of a babbitt. The size of the bearing, the thickness of the lining, and the speed and load conditions should influence the choice; and for that reason properly made lead-based babbitts will often, because of their better anti-frictional properties, give superior service to that obtained with the more expensive tin-based metals.

The safest course for the manufacturer who wishes to secure the best wearing qualities is to obtain his babbitt from a maker who is known to be thoroughly experienced in analyzing bearing requirements. His experience enables the maker of babbitt to specify just what metals or combinations of metals will possess the best endurance and anti-frictional properties in each case.

Melting Babbitt Metal for Bearing Liners

The first essential, after selecting the right metal, is to have a clean pot and ladle, so that some other metal which may have been previously used will not get mixed with and contaminate the babbitt about to be melted and applied. A high-grade lead-based anti-friction alloy should be heated to a point that will give a pine stick a very brown color. It should then be thoroughly stirred, the scum which forms on top removed, and the metal at once poured into the bearing. The liner or casting should be completed at one pouring. The bearing should be poured as near as is convenient to the pot containing the metal, because carrying metal a long distance in a ladle is likely to cause it to chill and pour sluggishly. Overheating a babbitt adds to its brittleness; pouring it too cold causes seams to form in the lining. It is always advisable to have a third more metal in the ladle than is required for pouring.

It is desirable to have the bearing warm or fairly hot, as pouring hot metal against a cold backing will cause the metal to shrink slightly away from the backing. The backing and mandrel against which the metal is poured should be clean and free from grease and moisture. Clay or asbestos wool dipped in heavy oil is used to close up the ends of the bearing so as to retain the metal while it hardens and seats. The metal should be poured slowly at first, the volume being gradually increased. This method usually expels the air from the bottom. The gate or pouring hole should be large enough so that the metal can be admitted in sufficient volume to be forced quickly to the farthest part of the bearing before it chills against the cold surface.



Groove cut in a Bearing to form a Grit Trap

The liner or newly poured bearing can be made denser and more durable by cooling quickly. This can be done by applying cold water to the outer shell or surface. Care must be taken, however, to see that no moisture or water gets into the molten metal, as if it does, a slight explosion or spatter of the metal will result.

Babbitt metal must not be allowed to stand long in the kettle or ladle before pouring, because of the specific gravity of the different ingredients; lead, being the heaviest, gradually works its way to the bottom, antimony comes next, and tin, being lighter, works to the top. This is why the metal should be stirred thoroughly before pouring so that it will not segregate or separate.

It is important that the mandrel or shaft be centered so that the liner will be of the same thickness all the way around, and also at each end. In that way a perfect allgnment is afforded the shaft when in operation. When the shaft is out of alignment, only certain parts of it are in contact with the bearing surface, and the result is the rapid destruction of the bearing. Smoking or chalking a mandrel produces a smooth surface. Liners should always contain oil-grooves so as to distribute the oil thoroughly over the bearing surface.

If a shaft is very badly cut or scored, a lead-based babbitt, being softer and more plastic than one high in tin and copper, will fill in these scored or cut parts, thus producing a smooth shaft surface. In using a lead-based babbitt, it is not always necessary to scrape or smooth the surface of the liner after it is poured, as it quickly wears to a smooth surface as soon as the shaft is put in motion. When a bearing heats a little on being started, it is usually because it is wearing to a smooth surface. In such cases if the machine is stopped for a few moments and then started again, the bearing will run cool because a smooth surface has been formed.

Grooves for Catching Grit and Dust

In plants where bearings wear rapidly because of the abrasive action of grit and dust, greater durability can be obtained by cutting a groove, where it is practical to do so, to serve as a grit trap. This groove should be cut lengthwise of the bearing, as shown in the illustration, and as close to the gravity center of the bottom half of the bearing as possible. By "gravity center" of the bearing is meant that part of the surface of the bearing liner on or against which the shaft pressure is the greatest. This pressure is governed by the pull and direction of the belt or gear drive. If the point where the load carried on a particular bearing coincides with the gravity center, that is, if the pull and direction of the belt or gear drive is directly downward, then the groove should be placed an inch or more back of the gravity center.

The groove should run nearly the entire length of the bearing, and should be cut to a depth of about 1/8 inch, depending somewhat upon the thickness of the liner. If too deep, it might cause the liner to crack. At each end, the groove is cut shallower, as shown in the illustration, from a point about one inch from the end of a liner, so that when the groove is filled with grit, the grit will be expelled through the aperture at the end of the groove by the shaft pressure. The edges of the groove should always be rounded off. Care should be taken to construct this groove so as to prevent waste of oil, as otherwise an excess of oil will pass out of the bearing. The outer opening of the groove should be very slight, say 1/16 inch. Grooves like this can, of course, be cut only in horizontal bearings.

Shrinkage of Bearings

Trouble frequently results from shrinkage and cracking of babbitt metals when cast. If a high-grade tin-based genuine babbitt metal is poured when overheated, or if it is poured against an overheated mandrel, or into a container that has been overheated, minute cracks will form in the liner, and these cracks, under shaft vibration and pressure, gradually increase in size, allowing the oil to seep through and work its way in between the liner and the backing. The result of this is frequently a loose bearing; and the heat conductivity of the oil, being practically nil, compared with that of the metal, prevents the friction heat from being conducted through the liner into the backing so that it may escape. Consequently, the bearing retains the heat to the point of fusion and destruction of the liner. If a moderate-priced lead-based metal is cast when overheated, the result will be that the metal itself will be made more brittle and coarser in grain, and by reason of this it will crack, break, and crumble more readily.

The difference in expansion and contraction between the babbitt metal and iron and steel causes an unequal strain on the solidifying metal when it contracts in cooling. This shrinkage is sometimes so great as to cause loose liners, which have only limited service and durability. In order to offset these common and cardinal bearing troubles, the principle of casting the metal at the lowest temperature at which it is fluid enough to "flow" the casting at one pouring, and not against a backing or mandrel or into a container which has been overheated, should be observed.

Value of Casting the Metal at a Low Temperature

All bearing metals are alike in that the hotter they are when cast, the more open and crystalline will be the grain that comprises the structure of the metal. The lower the temperature of the metal when cast, the more dense and solid will be its structure, and the longer wear will it give under equal conditions. For bearings subject to extreme pressure, it is desirable, where convenient to do so, to immerse the casting slowly in water from the bottom upward, immediately after the metal has solidified. This will further increase the density of the structure of the liner. The casting should not be dumped into the water, but taken with tongs and slowly immersed, beginning at the part of the casting or liner farthest from the point of the gate or opening into which the metal was poured.

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SAVING MATERIAL AT THE EXPENSE OF LABOR

By ROBERT GRIMSHAW

Sometimes materials can be saved by the expenditure of a small amount of labor. Again, labor can be saved at the expense of a small amount of material. Judgment and cost calculations are required to determine if a dollar's worth of material can be saved by the outlay of less than 100 cents worth of labor; and, conversely, whether 100 cents worth of labor might be saved by the use of less than a dollar's worth of material. In both instances, of course, it must be understood that the procedure must not cause costly delays, or deterioration in the quality of the product. The problem must be carefully figured; because snap judgment in a case of this kind is usually dangerous. It is not always so easy to figure whether it is cheaper to save material or to save labor, as it might seem to be. While most establishments have cost clerks who can tell quite accurately how much an article that has been made has cost for each of the three factors—material, labor, and overhead—few have men capable of determining beforehand with any degree of accuracy how much it will cost to do a certain job by any one of two or more methods.

Material can be saved at the expense of labor costs in two ways: (1) By using the same class of labor that would ordinarily be used, but allowing more time for the operation, the object being in this way to reduce the amount of waste material on the one hand, and spoiled pieces on the other; (2) by using a higher and more expensive grade of labor, thereby accomplishing the same ends. In either case, it is necessary to determine whether the saving in material and that due to the absence of spoiled pieces exceeds the additional labor cost.

A few examples may illustrate when and when not material should be saved at the expense of labor. One example may be seen in the foundry, when an effort is made to save materials at the expense of labor by offering a bonus for decreased percentages of defective castings. To a certain extent this may effect an actual saving; sometimes, however, it does not. The perfect pieces will cost more per unit for labor, but metal, fuel, and supplies are saved. The more complicated the castings, the lighter they are, and the more expensive the metal poured—reckoning its cost in the ladle, which is its true cost from the accounting point of view—the greater the opportunity for saving in this way. The simpler the casting and the cheaper the metal poured, the less likely it is that an actual saving will be accomplished by spending more for labor and trying to get all perfect castings.

In cutting patterns out of sheet metal, it may be possible, by taking a longer time in laying out the patterns, to use the metal more economically, but the cost of the saved metal may not equal that of the additional time spent in laying out this stock economically. Judgment and understanding of both labor and material costs are necessary to determine the best procedure.

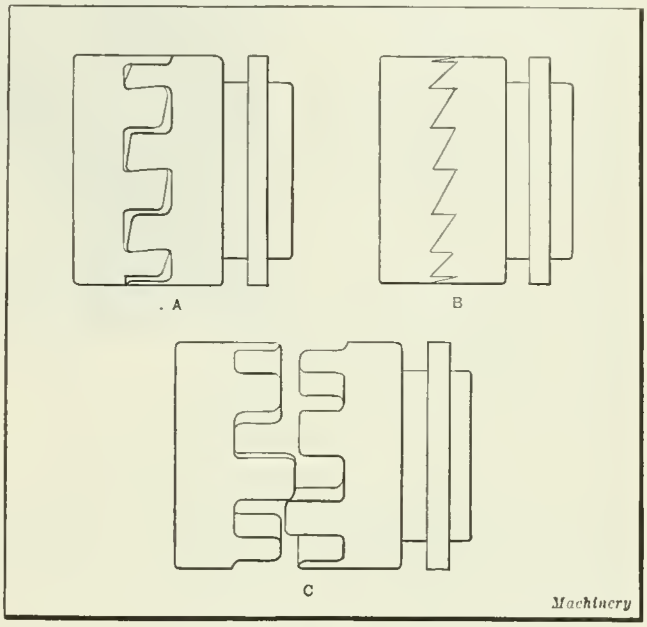
A story is told of a tool-room where a certain appliance that costs $2 on the market was repaired at various intervals, a first-class toolmaker spending some three hours in making the repairs. Labor was foolishly spent to save a device that could have been bought at a lower price than the cost of repairing.

TOOTHED-CLUTCH DESIGNS

By C. M. LINLEY

A good design of toothed clutch for drives in which the rotation is always in one direction is shown in the illustration at *A*. The engaging surface of the teeth on both members is under-cut slightly so as to facilitate full engagement after the teeth have partly entered. This construction also prevents them from being separated when the load is on. It is unwise to use clutches of the type illustrated at *B* in drives where there is any possibility of a reversal in the direction of rotation, as reversal would cause the members to be forced apart, and might strain the mechanism that controls the clutch.

Many toothed clutches are operated in both directions, and in such cases a slope on the ends of the teeth is undesirable; furthermore, under-cutting of the engaging faces to any marked degree weakens the roots of the teeth. But it is sometimes difficult to cause square-cut teeth to engage unless the driving member is brought almost to a standstill. This is due to the difficulty of having all the teeth enter at one time. The clutch shown at *C* was designed to overcome this difficulty. One of the teeth in both members is somewhat longer than the others. These long teeth will engage at a higher speed than is possible when the teeth are uniform in length, and, once engaged, the long teeth lead the others into place. Sometimes more than one long tooth is provided on each member.



(A) Toothed Clutch with Sloping Contact Faces; (B) Sawtoothed Clutch; (C) Clutch with One Long Tooth

* * *

VALUE OF MACHINE TOOLS AND METAL-WORKING MACHINERY EXPORTED TO BELGIUM, 1912-1921

Year*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal-working Machinery
1912	....	....	....	....	....	$646,541
1913	....	....	....	....	....	786,679
1914	....	....	....	....	....	552,531
1915	....	....	....	....	....	35,416
1916	....	....	....	....	....	....
1917	....	....	....	....	....	....
1918	....	....	....	....	....	....
1919	$1,222,885	$461,012	$226,254	$1,910,151	$1,972,012	3,882,163
1920	531,755	194,210	469,977	1,195,942	724,230	1,920,172
1921	236,996	37,652	125,003	399,651	262,476	662,127

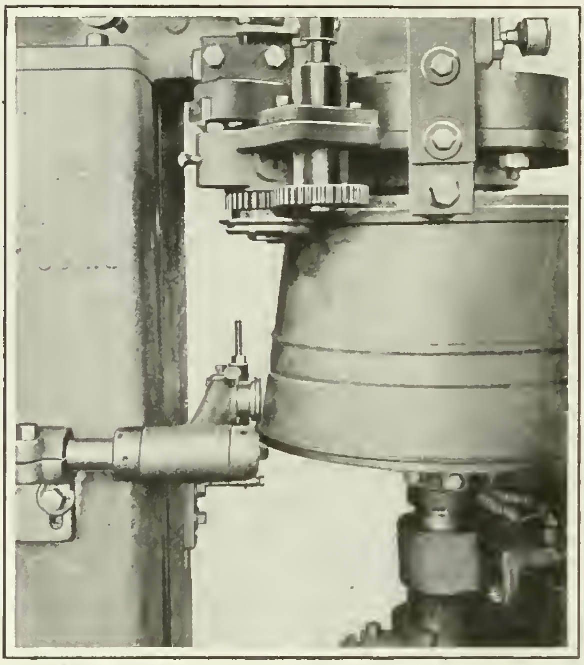
Machinery

*Amounts given are for fiscal years, up to and including 1918, and for calendar years thereafter. The Department of Commerce statistics did not give machine tool exports separately previous to 1918.

Manufacturing Pails and Tubs

Semi-automatic Machines Designed for Producing Large Sheet-metal Containers

By PAUL H. LANGE, Chief Engineer, The Max Ams Machine Co., Bridgeport, Conn.



SEVERAL operations are eliminated and labor is saved in the manufacture of large sheet-metal containers, such as pails and tubs, through the use of a number of machines that have been designed and built by the Max Ams Machine Co., Bridgeport, Conn., especially for work of this kind. The machines are intended for pails and tubs made from Nos. 28 to 26 gage galvanized or black sheet iron. The bodies are made in two or three sections and the bottoms are attached by a double seam. The tubs vary in diameter at the bottom from 14 to 21 inches, and at the top from 18 to 24 inches. Their height ranges from 9 to 11 inches. The pails vary in diameter at the bottom from 7½ to 10 inches, and at the top from 9 to 14 inches, the height ranging from 8½ to 11 inches.

Machine for Edging Both Ends of the Sheets

After the body sections are blanked in a punch press they are delivered to the duplex edging machine illustrated in Fig. 3, which simultaneously forms the ends of the body sections as shown at *A*, Fig. 6. The blanks are placed on the table of the machine and conveyed automatically to the edging station by means of feeding fingers *A*, Fig. 3, which are attached to a cross-bar. The latter is fastened to a slide reciprocated by power transmitted to it from crank disk *B* at the left-hand end of the machine, through connecting-rod *C*, rocker arms *D* and *E*, the shaft on which the rocker arms are mounted, and the link that connects arm *E* to the slide.

The positions of the edging heads *F* and *G* are adjustable by means of a screw actuated through handwheel *H*. This provision permits the handling of blanks of different widths. The heads can also be set at different angles to suit the taper of the blank ends, graduations being provided to facilitate this adjustment. The ends of the blank are bent back as the feeding fingers push the blank under plates attached to the front of the edging heads, and the work is automatically discharged at the completion of the operation. This machine edges, on an average, 30 blanks per minute. It weighs about 5000 pounds.

The next operations on the assembled tubs are wiring, beading and flanging as described in the following: The tub body sections are assembled in a horning press

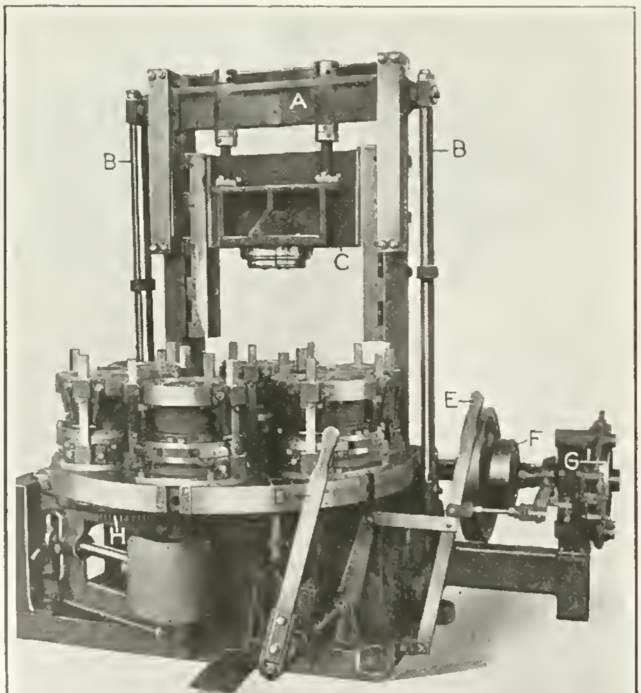


Fig. 1. Turret Press for Pail Manufacture, which is equipped with Six Dies and One Punch

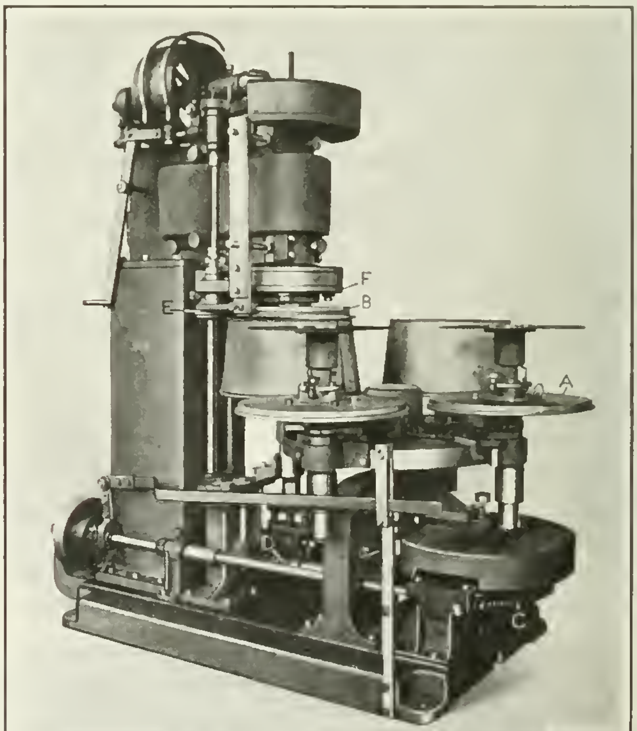


Fig. 2. Another Turret Machine, used for double-seaming the Bottom to the Body

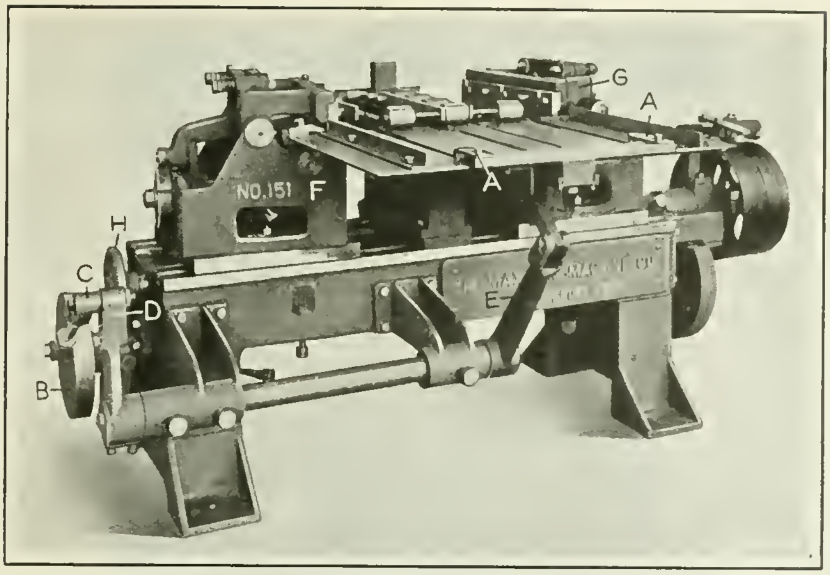


Fig. 3. Duplex Machine for edging the Ends of Tub Blanks as shown at A, Fig. 6

and then delivered to a turret press of the same general design as the machine shown in Fig. 1, except that it is larger and equipped with four dies instead of six. The machine is automatic except for the loading and unloading of the work. The four dies are mounted on a turret plate, which successively brings the dies into position beneath the punch. The appearance of the work after this operation is shown at *B*, in the illustration Fig. 6, the top edge being wired, the reinforcing beads formed, and the bottom flanged. A view of the punch and one of the dies used for this operation is shown in Fig. 7, this illustration being reproduced from a photograph taken of a machine equipped with only one die instead of with four dies, as described.

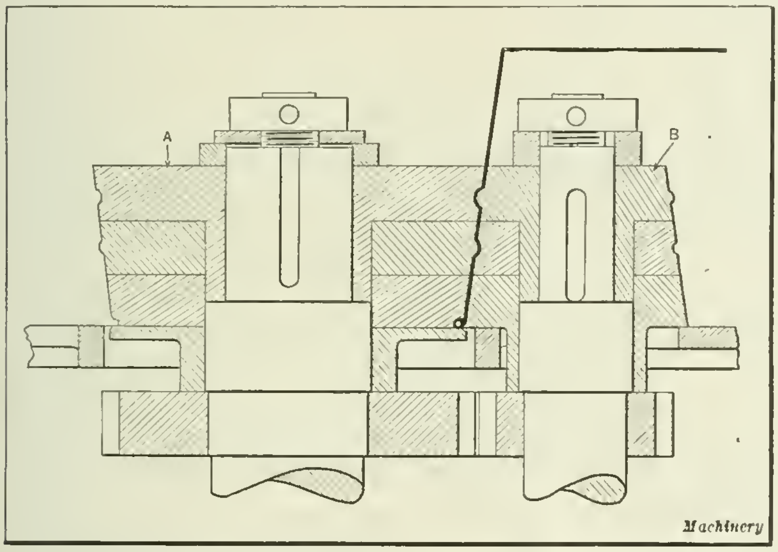


Fig. 4. Construction of Beading Rollers on the Rotary Beading Machine illustrated in Fig. 8

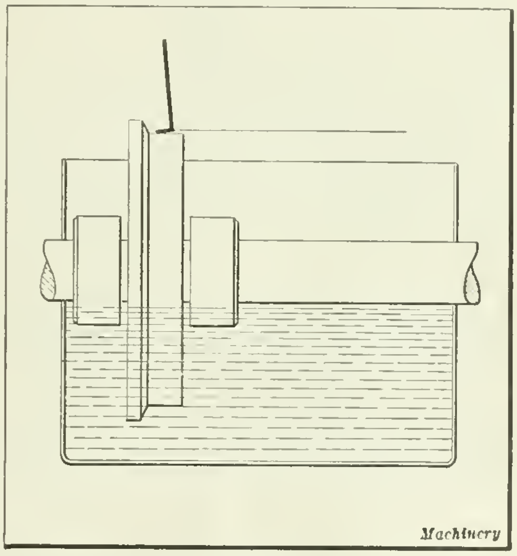


Fig. 5. Diagram of Compound Tanks on Machine shown in Fig. 9

The turret press has a built-up frame consisting of a bed, uprights, and an arch. The cross-head *A*, Fig. 1, is driven from the main driving shaft through the medium of twin crank gears and the upright connecting-rods *B*. Slide *C* is connected to the cross-head by two screws which permit the slide to be adjusted vertically to accommodate dies of different heights. The machine is double back-geared and driven through friction clutch *F*. The machine can be stopped and started at any point of the stroke by means of hand-levers *D* and *E*, which control the friction clutch and brake *G*. In addition, the foot-treadle may be employed to disengage the clutch if the operator is unable to finish placing the work in any of the dies by the time it advances to the punch.

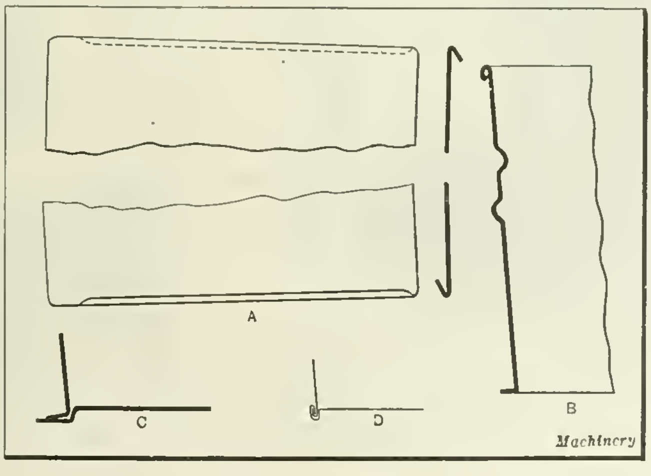


Fig. 6. Diagrams showing Different Stages in the Production of Pails and Tubs

The turret plate is driven by means of a swinging cam arm to which spur gear *H* is attached. A feed pawl on this arm successively comes into engagement with four equally spaced dogs on the inside of the turret plate rim. A pinion driven from the rear driving shaft through a train of bevel gears engages the cam gear and imparts a rotary movement to the turret plate. With this arrangement the dies are brought successively into the correct position beneath the punch. The pauses between the intermittent movements of the turret plate allow the operator sufficient time to remove a finished piece from the die and insert a new piece without stopping the machine. As the handling of the work is done while the dies are out of the path of the punch, the operator is not exposed to danger.

The turret spacing mechanism has a safety device which automatically disengages the clutch and stops the machine if, due to an accident, the punch and a die should not register correctly. The machine employed for this operation has an average production of ten tubs per minute. It weighs about 12½ tons. As previously mentioned, the machine in Fig. 1 is actually equipped for operations on pails, wiring them at the top and flanging them at the bottom, the outline being as shown at *B*, Fig. 6, with the exception of the reinforcing beads. This press produces fifteen pails per minute, and weighs about 7½ tons.

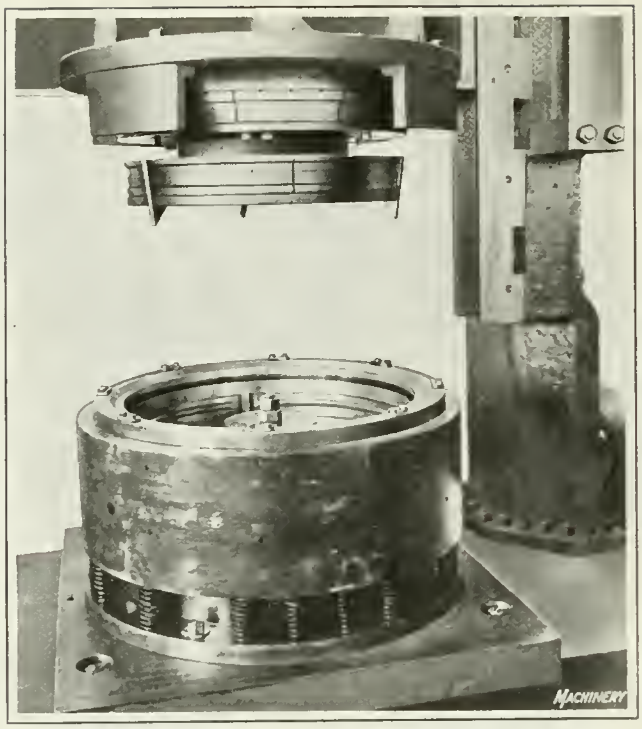


Fig. 7. Punch and One of the Dies employed for wiring, beading and flanging the Tub Body

Rotary Beading Machine

In cases where it is preferable to produce the reinforcing beads on a tub in a separate operation, the rotary beading machine shown in Fig. 8 is employed. This machine has one large central roller *A* and four smaller rollers *B*. The smaller rollers are mounted on a continuously revolving turret *C* and move in a circle about the central roller. The latter is driven by means of bevel gears and a double train of spur gears, the spur gears being located on the outside of the housing. The turret is driven through the large spur gear *D*, its pinion, and a pair of spiral gears, which connect to the main drive. Rollers *B* are also rotated about their own axes by being driven from the central roller shaft through spur gears as illustrated in Fig. 4.

The upper section of all the rollers is keyed to its shaft while the other two sections are idler members. Rollers *B* are slightly advanced toward and withdrawn from the central roller as the turret revolves, due to the action of toggles *E*, Fig. 8, which are controlled by cam *F*. The operator places the work over the small rollers when they have been withdrawn from the central roller, and removes it when the beading operation is completed. This machine produces ten tubs per minute. It weighs 7000 pounds.

Assembling the Bottom to the Body

Double-seaming the bottom to the body produces a watertight seam, but even better and more reliable results are obtained if the body flange is first covered with a cementing compound. A machine intended for coating the body flange with this compound is illustrated in Fig. 9. It has three containers for the compound, each container having a continuously revolving wheel upon which the work is supported. The wheels are partly submerged in the compound and as they rotate, they deposit it on the flange of the body. The wheels are driven from the horizontal driving shaft through bevel gearing. Fig. 5 illustrates diagrammatically a sectional view through a container. Each of these is heated either by gas or electricity to keep the compound fluid.

The bottom is next double seamed to the tub body on the machine shown in Fig. 2. The work is first prepared as shown at *C*, Fig. 6, and is then seamed as shown at *D*. The machine in Fig. 2 is automatic except for the loading and unloading of the work. It has a turret to which are attached four work-holding fixtures *A*. The intermittent rotation of the turret is obtained through a Geneva mechanism that brings the work-holders successively into alignment with chuck *B*. The chuck revolves continuously, being driven from the horizontal pulley shaft at the top of the machine through bevel gearing.

The Geneva mechanism is driven through worm-wheel *C* and a worm which is keyed to the horizontal shaft at the front of the machine. This shaft, in turn, is driven by a belt from the main driving shaft. The work-holders are raised at the seaming station by the action of cam *D*, and thus clamp the work between the holders and the chuck. When in this position the work-holder and the work are also revolved through the rotation of the chuck. As the

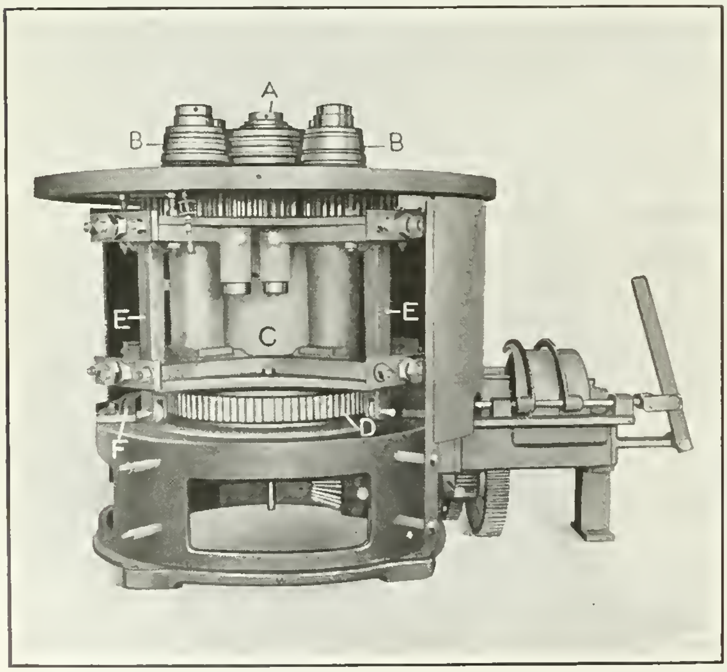


Fig. 8. Machine employed when it is Desirable to produce the Reinforcing Beads in a Separate Operation

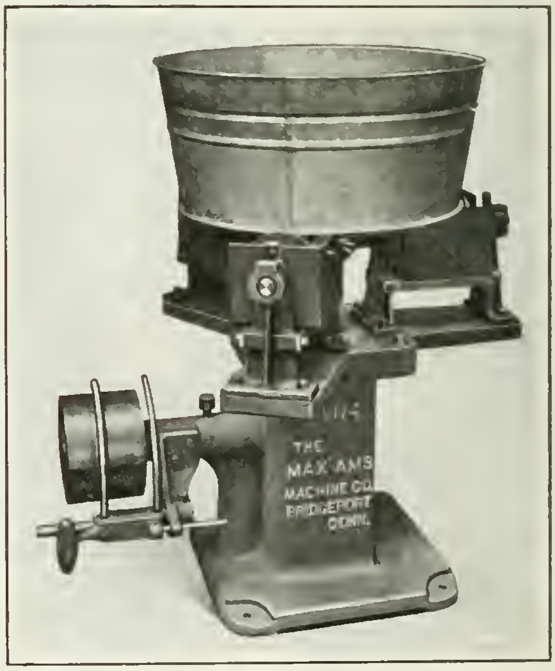


Fig. 9. Depositing the Cementing Compound on the Body Flange

turret carries the work-holder away from the seaming position it is lowered.

Two seaming rollers are required for the operation. The first roller *E* is driven through gears and a universal joint connected to the main drive, while the second roller, at the opposite side of the machine, is not driven positively, but revolved by coming in contact with the work. The two rollers are mounted on an oscillating member *F* which is operated through the medium of an eccentric to bring the rollers alternately in contact with the work. An electromagnetic clamping device holds the bottoms in place while they are being brought to the seaming station. The turret, work-holder, and roller mechanisms may be started and stopped readily by shifting the lever of a hand-operated friction clutch.

This machine can also be equipped with a smoothing roller attachment such as is shown in the heading illustration, the purpose of which is to finish the wired top edge of the tub simultaneously with the seaming operation. This attachment is fastened to the side of the machine column and its roller is in contact with the work as the work revolves about its own axis. The average production of this double-seamer is ten tubs per minute. It weighs approximately 6000 pounds. When it is used for seaming pails, the turret is equipped with eight work-holders in order to obtain a somewhat greater production. The machine then has an output of about fifteen pails per minute.

* * *

STARTING AN APPRENTICE SCHOOL

By WARREN ICHLER

Unfortunately, like most other developments that can demonstrate their value only indirectly and after a long period of trial and experiment, the apprentice school is regarded by too many executives as one of the "frills" of modern industrial development. This places both the apprentices and the instructors under the double handicap of poor surroundings and an unfavorable attitude on the part of shop executives. The writer, in various capacities of adviser and instructor, recently assisted in founding an apprentice school at a large mechanical plant in a city in the Middle West; the experience gained at this plant and through close observation and study of apprentice school work in various other plants has given him a good idea of the obstacles to be overcome and the mistakes most likely to be made in starting an apprentice school. Aside from the minor mistakes incident to all such ventures in their beginning, three major errors showed up prominently in the particular school mentioned. They are more general than local in their nature and scope, and hence are deserving of a short discussion so they may be avoided by those contemplating the founding of similar schools.

The first really serious obstacle to successful instruction work was found in the text-books selected. There is no doubt that the writers of these books honestly attempted to produce works that could be easily understood by the average boy of eighteen, but it was found that the subject matter of the various books had to be presented in much simpler language by means of informal lectures. This is not to be construed as a statement that all text-books are written in a style unfamiliar to the average apprentice. But many of them are difficult to understand, and for that reason great care should be taken in their selection.

An apprentice cannot readily bridge the gap between the concrete and the abstract, and in this respect is comparable to the average college student who demands practical demonstrations and a generous use of models to supplement the subject matter of his texts. This brings us logically to the matter of the selection and training of apprentice instructors as regards temperament, language, patience, etc., which, unfortunately, is the second point of criticism to be raised regarding the apprentice school in question. In an effort to secure the best instruction possible, certain young ambitious teachers from the high schools of a neighboring city were engaged to teach the purely theoretical work, practical instruction in the shop being cared for by mechanics assigned to that duty.

In theory, this plan would seem to be ideal, but in practice the results were far from satisfactory. However, no criticism attaches to the efforts of the teachers engaged from the city schools. It seemed impossible for them to effect an adjustment of their language and methods of instruction so that they would be entirely in sympathy with their classes. The work of these men as instructors in the city's high schools was remarkably good, and in an effort to find their trouble in dealing with apprentices, other instructors (toolmakers and machinists from the shop), were occasionally substituted for them in teaching theoretical work. Since these mechanics from the shop were uniformly successful in securing a better degree of cooperation from their classes and a better understanding of the matter discussed, than the teachers regularly engaged for this work, it is a fair inference that the methods of the high school teacher or even those of the grade school teacher, are not applicable in the apprentice school.

Unless high school teachers who have had the practical training that enables them to instruct from the shop man's viewpoint can be secured, it would be better to leave even the theoretical instruction in apprentice schools to mechanics from the shops, provided, of course, that men qualified for this work are available.

Possibly the failure of competent high school teachers to do really good work in apprentice schools can be traced to the facilities provided in the apprentice school. This is the third point criticised in the particular case cited. The rooms provided were such that all-year-round class work was impossible. Further than this, the accessories such as pencils, paper, drawing instruments, etc., had been provided on an "economy first" basis, which is obviously a mistake.

* * *

SMALL RACK-CUTTING MACHINE

Several interesting features are incorporated in a special rack-cutting machine employed in the plant of the Seneca Camera Mfg. Co., Rochester, N. Y. The machine is used to cut teeth of 0.0683 pitch in one side of brass rods, 1/8 inch square and 8 feet long. After the teeth are milled, the rods are cut off to lengths ranging from 4 to 6 inches as required. The most interesting feature of the machine is the high cutting speed employed, which is 1300 feet per minute. This may be considered more remarkable in view of the fact that the machine was developed and built about fourteen years ago when high speed steels had not been developed to their present-day state of efficiency.

The milling cutter is 1 1/4 inches in diameter and is driven by belt and 1 to 1 ratio gears at a speed of 4000 revolutions per minute. It is carried on a ram similar in design to that of a shaper, and the stock, which is supported in a tubular guide on each side of the machine, is ordinarily fed through the vise on each forward stroke and backward stroke of the ram. When the machine is set to cut both on the forward and backward strokes it requires about fifteen minutes to cut the teeth in an 8-foot rod. An electric bell located on the side of the machine indicates when a rod has been completed and more stock is required. If desired, the feed mechanism of the machine can be set so that on the return stroke the cutter will pass through the tooth space cut on the preceding stroke. When so arranged, the cutter will cut a tooth space only on the forward movement of the ram. Obviously a higher degree of accuracy is obtained when the machine is set to operate in this manner, as each tooth is cut under exactly the same conditions. As the chips fly with considerable force from the cutter, a hood is provided which deflects them downward into the box in front of the machine. E. C. S.

General Construction of Polishing Wheels Used for Metal Finishing—Characteristics of Polishing Abrasives

By BRADFORD H. DIVINE, President, Divine Bros., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THE principal materials from which polishing wheels are made are wood, leather, canvas, cotton cloth, felt, paper, walrus or sea-horse hide, sheep-skin, impregnated rubber and canvas composition, and wool. The leather-covered wood wheel is very popular with polishers, although its disadvantages are numerous. It frequently gets out of balance and the leather facing, if not treated with great care, becomes loose and dangerous to the operator. It is the most common form of polishing wheel, due principally to its being cheap and easy to make.

Leather-covered Wood Wheels

A leather-covered wood wheel that will retain its balance and shape should be made from a wood that is not likely to change shape easily due to climatic conditions. Poplar and basswood are not suitable, although they have been used to some extent, because they are generally easily influenced by changes in temperature and humidity, resulting in warpage, shrinkage, and general distortion. They are very porous, so that they readily absorb moisture. Polishing wheels are operated in hot factory rooms where artificial heat is supplied in winter, and where they come in contact with moisture when the glue and abrasive are being soaked off in water. Hence, they are subjected to every influence that would cause them to change shape.

The best woods from the standpoint of stability under such conditions are black walnut, mahogany, and cherry; but their use for polishing wheels is commercially impracticable on account of their cost. The most suitable wood for general use is air-dried or kiln-dried white pine. It does not change its shape readily through atmospheric conditions and gives general all-around satisfaction.

The old style of leather-covered wood wheel consisted of a solid or laminated wood block with the leather facing strap glued in place. The modern construction is as follows: The wood wheel is made up in layers of ½-inch stock with the grain of alternate layers at right angles. The layers are glued together and held under pressure while both the wood and glue are hot. This construction lessens the likelihood of the wheel's changing shape due to the influence of heat or moisture. The wheel may be covered with a good quality of oak-tanned back strip leather, or bullneck; or if desired, felt may be used. These materials are pegged and cemented securely to the wood.

Leather and canvas are the materials most commonly used in polishing wheel construction. Bullneck leather wheels are made of oak-tanned bullneck leather cut into disks of uniform thickness and cemented together. The thickness of bullneck leather varies; the thin pieces of leather produce a wheel of hard density for use on one class of work, while the thicker bullneck leather, which may be from ½ to ¾ inch in thickness, produces softer wheels used for a different class of work. "Extra hard" leather wheels are made from split leather.

Canvas wheels are made in a variety of ways; in some the disks are cemented together, while in others they are hand-sewed or "quilted." Wheels that are cemented are very hard and used for rough coarse work, while those that are sewed may be made of varying densities by sewing together a larger or smaller number of disks into sections and gluing them. A more flexible canvas wheel is the hand-sewed form, made by sewing all the disks together to obtain the required face width. The sewed wheels are a very old style, and are used for carrying the coarser abrasives when performing rough polishing operations. The main objection to the use of wheels of this kind is that the twine with which they are sewed sometimes breaks under the hard pressures to which wheels of this kind are subjected. Copper wire is used in place of twine where the wheel is to be used under severe conditions. The layers of canvas in wheels other than the "solid cemented" or hand-sewed may be glued from the center outward for varying distances, depending upon how much spread is desired for the face of the wheel. Wheels in which the disks are held together by sewing and which are not stiffened by the use of glue, usually require metal side plates to support the canvas disks.

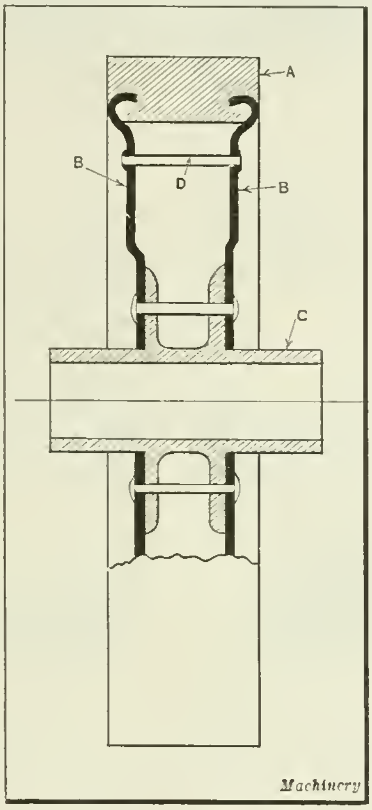
Muslin, Felt, Paper, Walrus Hide and Sheep-skin Wheels

Muslin wheels are made from sewed buffs glued together, the outer edges of the wheel often being left open or free from glue to give an open face to any desired depth. The sides of these wheels are supported by canvas disks. A polishing wheel of this type is softer than a hand-sewed canvas wheel.

Wool felt wheels are made from sheets of woven felt, ¼ inch thick, cemented together; this makes a flexible resilient wheel, the density of which may be varied by sewing two or more disks together and then cementing these to form a wheel. Solid wheels made of Spanish or Mexican felt are quite popular for fine finishing work, but have little value as general utility wheels.

Paper wheels are made from strawboard paper disks and are cemented together under pressure to form a very hard wheel for rough work. Softer wheels are similarly made from felt paper. For those who are partial to the use of leather-covered wheels, a leather face may be cemented to these paper wheels as a substitute for leather-covered wood wheels. They will run true and retain their balance and shape, if properly used, for a long time.

Walrus leather, or sea-horse hide, is a suitable material for polishing wheels because of its thickness and its tough open fibers, which make it desirable for fine finishing wheels. Its thickness makes it possible for wheels up to 1½ inches face to be made up without seams. One general criticism of polishing wheels made from leather disks of any kind is that the grain side is usually harder than the flesh side, so that a wheel constructed of cemented leather presents a face that is uneven in hardness and that wears in ridges. This reduces the efficiency of the wheel and requires frequent truing up. As a result the life of the wheel is greatly reduced.



Cross-sectional View of Compress Polishing Wheel

Sheep-skin polishing wheels may be made by cementing disks together, or by a loose construction in which the disks are sewed around the arbor hole only; or they may be hand-sewed. The cemented sheep-skin wheels are soft and pliable, and are used for fine finishing. The loose-disk sheep-skin wheels are suitable for even finer work and for buffing soft metals. The hand-sewed wheel is pliable and is used extensively in the jewelry trade; it is also suitable for buffing by the application of tripoli or other buffing compositions.

Vulcanite wheels, which are made from rubber and impregnated with abrasive, are sometimes used for polishing the flutes of reamers and the spiral grooves of drills and augers.

Materials for Buffs

As already mentioned, muslin polishing wheels are made from sewed buffs. In addition to their use for "cutting down" soft metals, buffs are regularly used for coloring various metals. They are made from all kinds of weaves and weights of cloth, and therefore vary greatly in their cutting or burnishing ability. There are two main classes of buffs, designated according to the method by which they are made—the "pieced-sewed" buffs, which are made from various weaves and weights of cloth, and the "full-disk" buffs, which are made from the best sheeting and shirting.

Bleached or unbleached cloth may be used according to the kind of surface for which the buff is intended. Bleached cloth is harder and stiffer than unbleached cloth, and is used for the faster cutting buffs the buff sections being made in plies of from eighteen to twenty thicknesses each. Coarsely woven unbleached cloth is recommended for highly colored work on soft metals, while the finer woven unbleached cloths are better adapted for the harder metals. The cloth used in buffs made for reliable service varies from 64 by 68 threads per square inch, to 92 by 96 threads. The material governs the ability of the buff to stand up in use, because the crocus, tripoli, rouge, and other cutting or coloring compositions should—for proper buffing—adhere to the ends of the threads instead of to the side of the cloth. Buffs may be sewed in any manner desired, but are usually sewed in spirals with the stitching ¼ or ⅜ inch apart.

A stiff buff, when working at the usual speed, is not suitable for "cutting down" soft metal or for use on light plated ware, but is used on the harder metals and for heavy nickel-plated articles. In the smaller sizes, a stiff buff may also be suitable for German silver, nickel, and white metal before it is plated. For buffing precious metals, wheels made of Canton flannel and wool are invariably used.

"Compress" Polishing Wheels

Many attempts have been made to produce a polishing wheel that could be made to suit various requirements of finish and that would not be affected by atmospheric changes. It is apparent that a wheel that runs true and that does not vibrate at high rotative speeds is desirable, and that such a wheel would do better polishing and increase production. The "compress" type of polishing wheel with the material placed crosswise of the face of the wheel, instead of disk-wise, was designed with the idea of producing a wheel that would be suitable for all classes of work when made of the proper materials.

The compress wheel, a sectional view of which is shown herewith, is made of rectangular pieces of leather, canvas, felt, paper, or other material, arranged radially and compressed to form a ring or cushion *A* of polishing material of one or more inches in depth. This cushion of polishing material may be varied in density to suit the requirements. The cushion is assembled with two side plates *B* which engage annular recesses in the material and which are riveted to a cast-iron hub *C*, thus tying the whole together in a flexible wheel. This construction permits the cushion to be shaped to conform to the curvature or contour of the piece to be polished and makes it possible to maintain this shape.

The wheels are turned on a lathe, so that when put in use they can be accurately balanced; with proper care they will mantain this balance. The side plates *B* carry several brass tubes *D* riveted to them as shown. These tubes receive pieces of lead wire for balancing the wheel after "setting-up" with abrasive and glue. The material in the cushion, being placed on edge, permits the glue to set well and to hold the abrasive securely. The glue has an opportunity to penetrate into the material, whereas on a strap-covered wood wheel, for example, the glue cannot penetrate, but rather lies on the surface, so that no great resistance to the strain produced in polishing is offered.

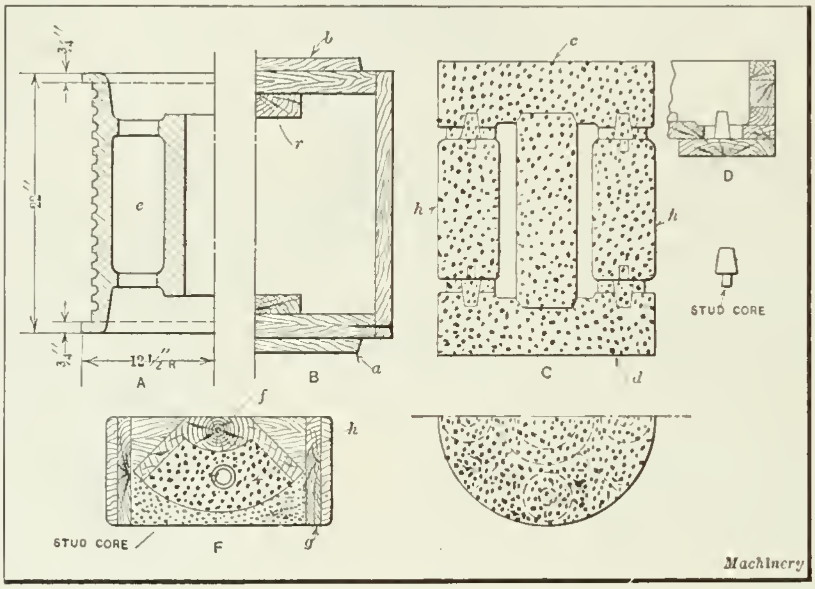
The difficulty encountered with a leather-covered wheel when the leather becomes loose, due to the use of water and rollers in removing old abrasive, is not met with in the compress wheel. The trouble often experienced with solid wheels made out of disks cemented or sewed together, when the disks separate at the face and cause the glue to crack and break off, cannot be encountered with a wheel of the compress type. These wheels are made in sizes of from 2½ to 24 inches in diameter and in practically any width of face. A detailed description of the manufacture of compress and other types of polishing wheels will be given in a subsequent article.

Abrasive Materials

The abrasives used in polishing and flexible grinding operations may be broadly classified as natural and artificial. The natural abrasive is corundum. This mineral in the granular form is known as emery, but this is not pure corundum, as it contains certain impurities. These impurities render emery more suitable for fine finishing operations than any artificial abrasive. The value of emery as an abrasive depends upon the percentage of alumina, or crystalline aluminum oxide, that it contains, as this is the only element in emery that is hard enough to cut metals effectively. The impurities that are present in emery are amorphous alumina, silica, iron oxide, and other metallic oxides.

Emery is known by the locality from which it is obtained. The percentages of the alumina contained in different kinds of emery used for polishing are: Naxos emery, 63 per cent; Turkish emery, 57 per cent; and Chester emery, 55 per cent. The natural mineral corundum may be crystallized in the electric furnace to produce an artificial abrasive of the same name, although, as generally known, corundum and emery are natural abrasives and are substantially the same mineral.

The artificial abrasives fall into two general classes—those composed of aluminum oxide in the crystalline form and those composed of silicon carbide. The aluminum oxide artificial abrasives are used for flexible grinding and polishing work, but the silicon carbide abrasives are used almost entirely in the form of solid grinding wheels. A special grade of artificial abrasive alundum, which is known as the TJ grade, has, according to the experience of Divine Bros. Co., given the best general satisfaction for all flexible grinding work with compress wheels. This grade of alundum is chemically treated in its manufacture so that the grains may be successfully held by glue.



Winding Drum Pattern and Cores made with Hand Woodworking Tools

For the finer finishing and coloring work, artificial abrasives are rarely used, and for this work natural emery finds general favor. One objection to the use of coarse numbers of artificial abrasives for polishing wheels has been the difficulty of holding the grains of the abrasives to the face of the wheels; but with care in the preparation of the wheels, and, particularly, in the correct use and treatment of a proper glue, artificial abrasives can be bonded to the polishing wheel securely enough to grind and polish the hardest metals. This phase of the polishing industry, relating to the preparation of the wheels for use, will be dealt with in a following article of this series.

Although it is sometimes claimed that artificial abrasives in the finer numbers are suitable for coloring purposes on such parts as surgical instruments, high-grade scissors, and hardware, the greater part of this work is done with natural emery. For fine finishing and coloring with artificial abrasives, or in fact, with any abrasive, it is well to remember that a higher degree of luster can be produced by using a slow speed and a more moderate cutting abrasive.

Other Materials Used in Polishing and Buffing

Pumice and rotten-stone may be regarded as abrasives, but their use is limited in the metal-finishing industries. Pumice is a hardened vulcanic product and rotten-stone is a substance obtained from limestone. Both these gritty materials are used for "cutting down" metals (such as white metal and German silver) that are subsequently to be plated. They are not bonded to the wheel but are applied to it by hand during the operation.

Tripoli is another abrasive used in finishing the surfaces of metal. It is easily pulverized, and is extensively used as a buffing material for "cutting down" soft metals that are to be plated. For coloring work with buffs, such materials as crocus, rouge, and Vienna lime are used. These are prepared in cake form with tallow, stearin, or petrolatum as a body. This composition adheres readily to the ends of the fabric used in the buffs. Crocus and rouge are metallic oxides and the lime is obtained by calcining limestone and certain kinds of shells.

* * *

MAKING PATTERNS FOR A WINDING DRUM BY HAND

By M. E. DUGGAN

Patterns that would ordinarily be turned up on a lathe are sometimes required to be made with hand tools. For example, the patterns for a winding drum such as shown in the half sectional view at *A*, were needed at a time when all the turning lathes were employed on important work. The patternmaker was therefore obliged to resort to the use of ordinary hand woodworking tools. The methods employed in constructing the pattern were rather unusual, although practical, and may be of interest to patternmakers handling similar work. The pattern was designed for molding on end, as this method gave a firm support for the necessarily heavy core. The result was a sound and true casting. Practically all the molding was done in the "drag flask," the cope being nothing more than a "flat back" except for the cope print impression.

The pattern for the drum is shown in the half sectional view at *B*. As but one casting was needed the drum was made with straight sides. This left considerable stock on the winding face of the casting which had to be removed in the machining operation, but the time thus saved in making the pattern and in molding more than compensated for the extra machine work. The pattern was constructed with top and bottom heads reinforced with cross-ribs, one of which is shown at *r* in the view at *B*. The cylindrical part of the pattern was made up of 1-inch square strips. The drag print indicated at *a* was securely fastened to the bottom head of the pattern, while the cope print *b* was pinned loosely to the top.

At *D* is shown a broken section of the core-box used to form the upper section *c* and the lower section *d* of the core shown in view *C*. The core that formed the "ring chamber" *e*, view *A*, was made in four sections. The core of one of these sections with its stud core in place is shown in the view at *F*. The core-box *f* and the black sand box *g* are shown in an inverted position with one of the four core sections *h* resting on the black sand bed. The core-box and the black sand box are lifted off before placing the core in the baking oven. The sectional view at *C* shows how the completed core was assembled in the mold.

The construction of this pattern is of particular interest in view of the fact that all the work was done with hand woodworking tools and a bandsaw.

Letters on Practical Subjects

JIGS FOR MOTORCYCLE CYLINDERS

The accompanying illustrations show two drill jigs used in machining cylinders for the Reading-Standard motorcycle. These cylinders are made of high-grade cast iron, and have a bore of 3⅜ inches and a piston stroke of 4 inches. The castings are bored and reamed to 3⅜ inches diameter (minus a grinding allowance of 0.012 inch), both sides of the flange are faced, and a "register" or sleeve is turned on the outer face of the flange. The valve, plug, and flange holes are then drilled, during which operation the work is located by means of the previously turned register and two wedges driven lightly between the jig and the sides of the flange.

After these holes have been drilled the jig illustrated is used for machining the nipples on the cylinders. In Fig. 1 the jig for the forward cylinder is shown. The casting is located by the flange register fitting into a recess in wall *A* and by a dowel-pin which enters one of the previously drilled holes. A hole is then drilled at *B* to suit a 1-inch S. A. E. standard thread. This is the intake manifold hole. The jig is next turned 90 degrees so that it is supported by leg *C* in such a position that the exhaust manifold hole *D* is in a vertical position. This hole is then machined with a hollow-mill to suit a 1⅞–24 threads per inch thread.

When performing similar machining operations on the rear cylinder casting, the work is located in a jig of the same type as that shown in Fig. 1. In this case also the casting is located in the jig by means of a turned register and a dowel-pin. The exhaust nipple, as shown in Fig. 2, is so located that it is necessary to cut away a section of the upper wall in order to admit the passage of the hollow-mill used in machining the hole. The sizes of both exhaust and intake manifold holes are the same as for the rear cylinder. This jig is also turned on its side when machining the intake nipple.

Providence R. I. ROBERT MAWSON

SAFETY CLUTCH FOR DRIVING PULLEY

Shear pins are used extensively as a means of preventing certain machines from being operated under excess loads. When a machine so equipped is overloaded, the pin is sheared and as a result the driving pulley is permitted to revolve on its shaft without operating the machine. Breakage of the machine itself is thus avoided. However, the necessity of replacing the shear pin before the machine can be again put in operation is an inconvenience that delays production. The safety clutch shown in the illustration is designed to overcome this undesirable feature. When disengaged, as a result of an overload being applied to the machine, this clutch can be quickly reset to the operating position.

The clutch and driving pulley complete are shown in the central view, while the views at the right and left show, respectively, the front and back of the clutch yoke. The pulley and driving yoke are omitted from the two latter

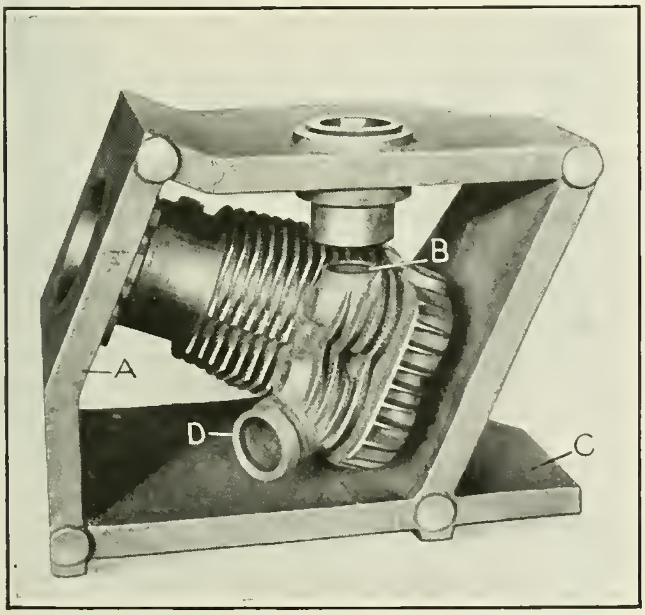


Fig. 1. Jig located for boring Intake Manifold Hole in Front Cylinder

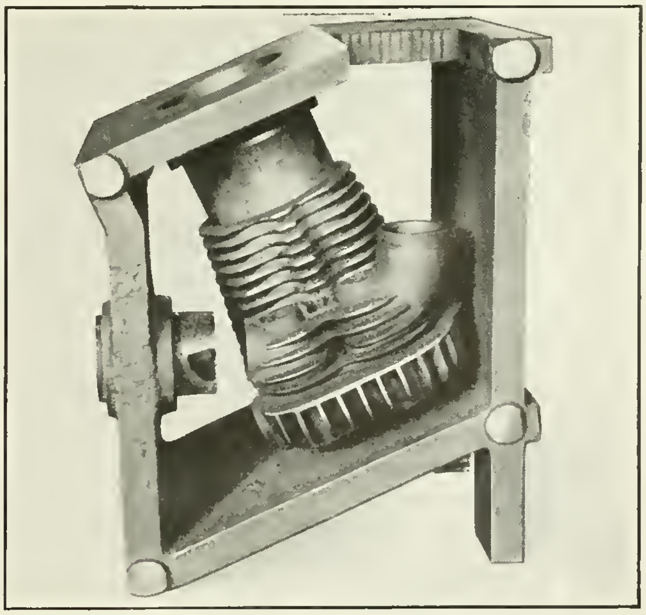
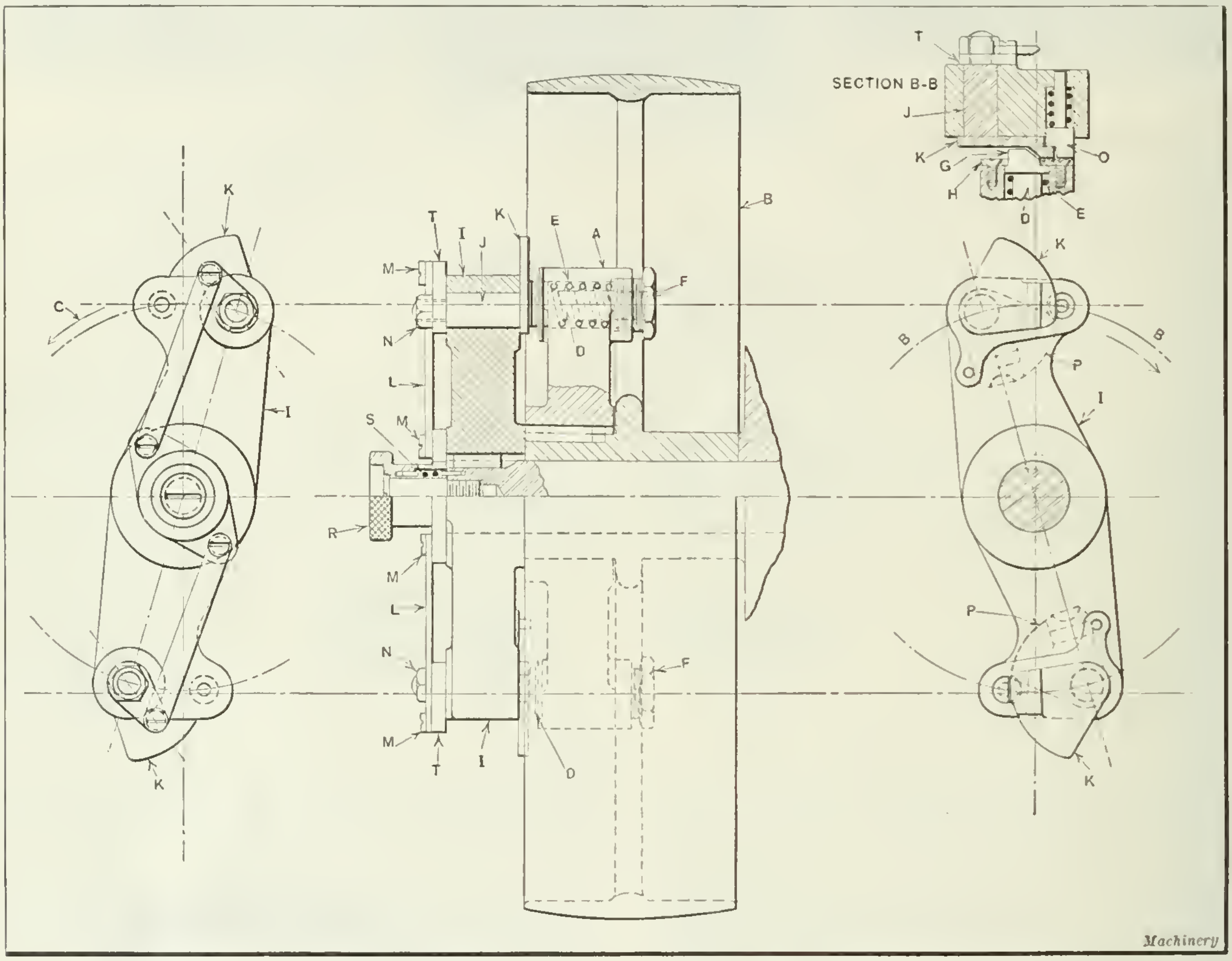


Fig. 2. Jig used for machining Exhaust Nipple on Rear Cylinder

views. The driving yoke *A*, being keyed to the pulley *B*, rotates with the latter member in the direction indicated by arrow *C*. In yoke *A* are two plungers *D* which have angular surfaces on their protruding ends, as shown in the sectional view in the upper right-hand corner of the illustration. These plungers are placed under a heavy tension by springs *E* which are held in place and adjusted by the nuts *F*. On the ends of the plungers at *G* are flats which fit into corresponding openings in the collar *H*. This construction prevents the plungers from turning or getting out of alignment. On the driven yoke *I* are two studs *J* located the same distance from the center of the driving shaft as the spring plungers *D*. On studs *J* are lugs or segments *K*, which are shown in the sectional view previously referred to. It will be noted that one side of each lug is cut at an angle to correspond with the angle on the driving plungers *D*.

With the ordinary load, all parts remain in the position shown, but when the machine is subjected to an excessive overload, or some part of the machine fails to function, so that a greater driving force is required to operate the machine, the excessive pressure causes driving plungers *D* to be forced inward. This allows the plungers to ride over the driven lugs *K*. On passing over these lugs, plungers *D* force the small plungers *O* inward, thus releasing studs *J* from their position so that segments *K* are turned, by the pressure of spring *S*, to the positions shown by the dotted lines at *P* in the view at the right-hand side of the illustration. When in this position, segments *K* allow the driving plungers *D* to rotate with the pulley without making contact with their driving faces. To again engage the clutch, the knob *R* is given a slight turn in a clockwise direction. Knob *R* is connected by screws *M* and levers *L* to the arms *T*, which are clamped to the studs *J* by means of nuts *N*. It will be evident from the construction that by turning knob *R* segments *K* will be brought into the driving position.



Safety Clutch for Driving Pulleys, which is so designed that it can be quickly reset to the Operating Position after being disengaged

Fitchburg, Mass. E. E. Lakso

TRUING UP A LATHE

In the following the writer will try to explain the reason for the inaccuracies observed in the test described in the article "Truing Up a Lathe Center," which appeared in August Machinery on page 991. Briefly, end play in the lathe spindle evidently caused the carefully ground centers to run out of true from 0.00025 to 0.0005 inch. In performing the grinding operation, the grinding wheel cuts "free," there being no end thrust on the center which is being trued up. Also the wheel runs at a uniform rate of speed. If the grinding wheel is applied too suddenly at the beginning of the cut, it will cause the lathe spindle to oscillate endwise. This oscillation will continue as long as the wheel cuts freely and is fed at a uniform rate of speed; thus as a result of these oscillations there will be a high side on the center being trued.

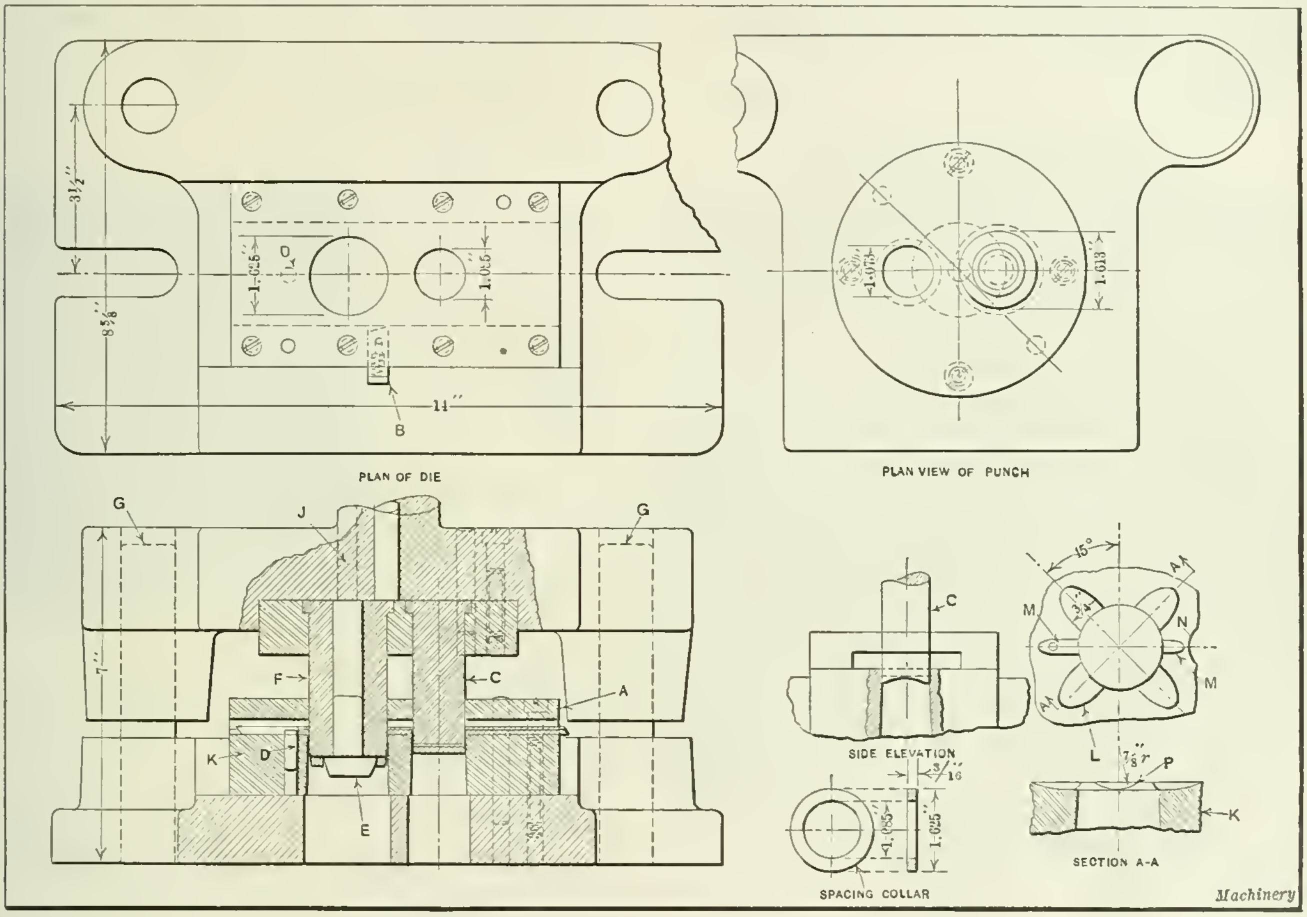
To overcome this, the writer would suggest that just sufficient pressure be applied to the faceplate (near the center) to take up the end play. Proof of the explanation here given is found in the fact that the inaccuracies were corrected by applying a cast-iron lap to the center. The lap required pressure to do its work, and this pressure naturally took up the end play in the spindle. The remedy suggested will eliminate the cost of lapping and will give a true center.

Cleveland, Ohio Walter H. Stickler

PIERCING AND BLANKING DIE FOR SPACING COLLAR

The progressive type of piercing and blanking die shown in the accompanying illustration is designed to produce spacing collars used in automobile construction. The material from which the washers are blanked is designated as "half hard" cold-rolled steel. It is 3/16 inch thick and is obtained in strips 2 inches wide by 36 inches long. The operations are piercing the 1.085-inch hole and blanking the 1.625-inch diameter indicated in the detailed view.

The strip stock is fed under the stripper plate *A* until its edge strikes finger-stop *B*, which is previously pushed in by the left hand of the operator. The press is then tripped, allowing punch *C* to pierce the 1.085-inch hole, after which the stock is again pushed forward until it strikes pin *D*. On the second stroke, pilot *E* enters the 1.085-inch hole, thus centering the stock while punch *F* blanks the 1.625-inch diameter.



Punch and Die used for piercing and blanking Spacing Collars

The punch and die are aligned by means of pins *G*, which are driven into the die bed and made a good sliding fit in holes machined in the cast bosses of the punch-holder. Hole *J* in the punch-holder is provided to permit the pilot *E* to be pushed out, when the face of punch *F* is to be ground. Referring to the side elevation in the lower right-hand corner of the illustration, it will be noted that the cutting end of piercing-punch *C* is given shear. The amount of shear is about two-thirds the thickness of the strip stock. Blanking punch *F* is also given shear by making it longer than the piercing punch.

After the die had been in operation a short time, it was noticed that the blanking punch did not stand up well. In order to remedy this fault die *K* was also given shear as shown at *L* in the lower right-hand corner. As will be noted, the shear on the die consists of four grooves spaced 45 degrees apart and about ⅛ inch deep. These grooves were ground into the die on a surface grinder with a wheel dressed to a radius of ⅞ inch. The two grooves at *M* were made less deep than the others to avoid grinding into the piercing hole *N* of the die. The sharp corners at *P* were rounded by stoning the edges so as to prevent the die from tearing the metal.

Brooklyn, N. Y. J. A. Honegger

REDESIGNING TRUNNION BEARING TO FACILITATE PRODUCTION

A few simple changes in the design of a trunnion bearing not only simplified the work of making the patterns, but also greatly facilitated the molding, casting, and machining operations. With the original design only a half bearing was cast at one time. The single half bearings were machined on a boring mill, and as no special holding fixture was provided, this operation proved a very trying one for the boring mill operator. The form of the single half bearing, as originally designed, is shown by the two full-line views in the upper half of the accompanying illustration (see next page).

At the suggestion of the boring mill operator, a change was made in the method of making the bearing. Instead of casting only a half bearing at a time, a full pattern was made with tie-pieces *A* and *B* connecting the two halves. This pattern was then split on the line *X–X*. The spaces between the two halves of the pattern at *C* and *D* were produced by dry sand cores. It will be noted that the 6¾-inch radius in the original design was struck from a center somewhat above the center of the bore. By referring to the full-line view at the left, it will be evident that practically all the outer pattern surface must be finished by hand.

By simply changing the design as indicated by the dotted lines in the lower half of the illustration, it was possible to eliminate much of the hand work required on the original pattern. Thus the surfaces finished to the 5¼-, 6½-, and

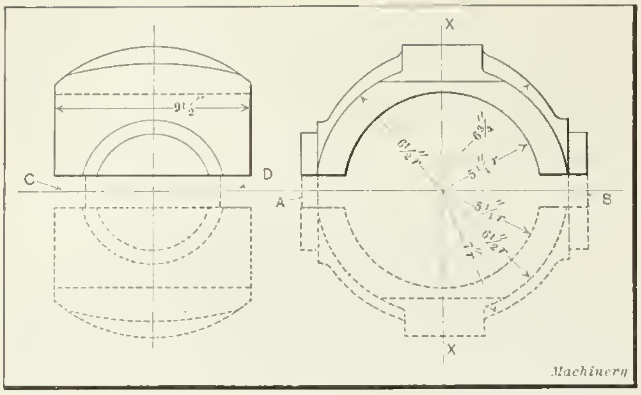


Illustration showing Change made in Trunnion Bearing Design

7-inch radii could be finished to size in the lathe. The addition or building on of the trunnions and saddle is a comparatively simple matter and is well understood by the patternmaker.

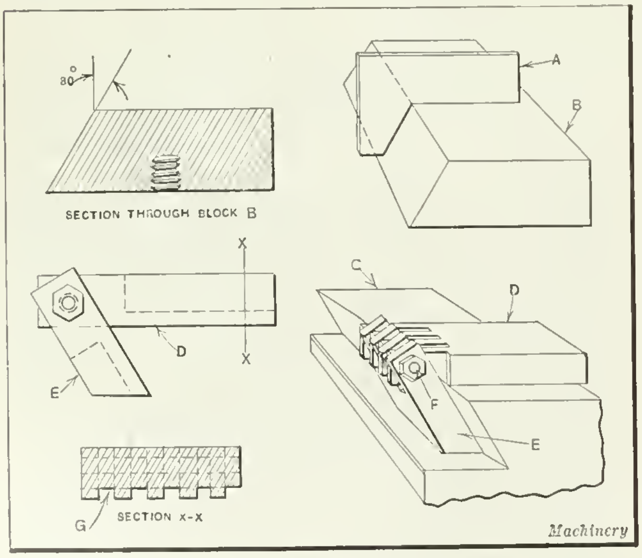
Kenosha, Wis. M. E. Duggan

LAPS FOR ANGLE-GAGES

In lapping angle-gages, difficulty is often experienced in making the two gaging surfaces come to a true or sharp edge. If the individual surfaces are lapped separately, this difficulty is increased. The writer believes that the best method of lapping an angle-gage, such as shown at *A* in the illustration, is to use a lapping block *B*, made of close-grained cast iron. The faces of this block should be tested on an accurate surface plate and the angle checked with a sine bar. The gage should be worked down to as nearly the required size as possible before it is finished on the lap.

The angle gage for work such as shown at *C* is much more difficult to machine and should be made of two hinged pieces *D* and *E*. The two separate parts of the lap are dovetailed and fastened together as shown. The bolt *F* clamps the pieces together when they are set to the correct angle. Grooves, such as indicated at *G* in the cross-sectional view *X-X*, are planed in the working faces of the lap. These grooves have the same spacing as the slots at the ends of pieces *D* and *E*, so that the amount of bearing surface in contact with the work will be uniform at all points. The two-piece adjustable lap can be trued up easily by grinding the lapping surfaces. The edge formed by the intersection of two surfaces can be lapped to a knife-edge with this type of lap. The widths of pieces *D* and *E* should be the same, but their lengths may be different.

Allentown, Pa. Joe V. Romig

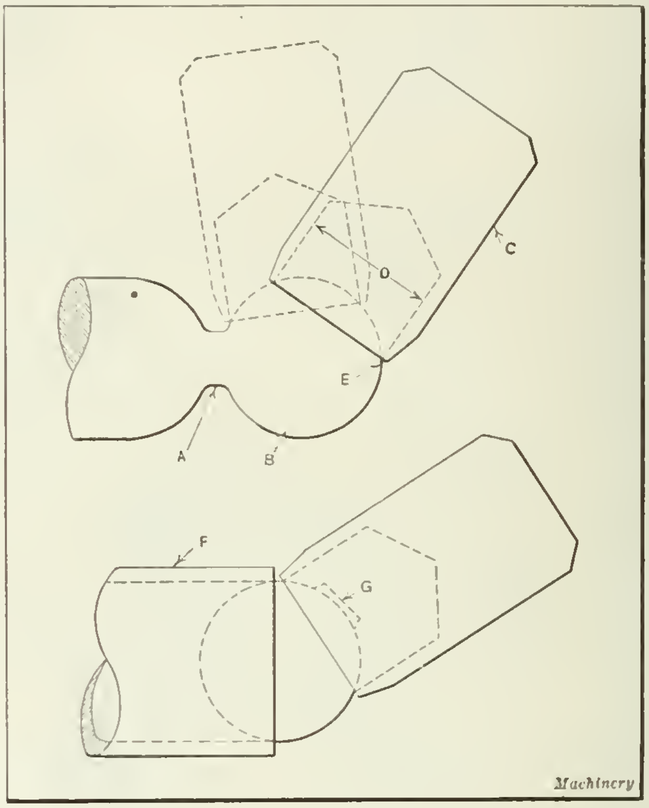


Laps for Angle-gages

TURNING A BALL IN THE LATHE

The turning of a ball or spherical surface in the lathe is rather difficult unless a special ball-turning device is employed. Even with a special device considerable skill is necessary to produce an accurate ball. Quite good results may be obtained, however, by the method here illustrated. First, turn the stock down to form a ball *B* of nearly the desired size, leaving a neck *A* as indicated in the upper view of the illustration. Calipers are employed, of course, to test the partly turned ball *B*, so that it will be made as nearly round as possible.

The next step is to smooth up the turned surface with the ball-forming tool shown at *C*. If the ball is to be 1½ inches in diameter the inside diameter *D* of the tool *C* should be about 1¼ inches. The ball-forming tool should be made of a good quality of tool steel, and hardened. The end *E* of the tool should be ground so that it is at right angles to the axis. The tool may be made any length that can be conveniently held in the hand. The sharp edge of the tool, which is brought in contact with the work as indicated, produces a smooth surface.



Method of forming a Ball in a Lathe

After the ball is partly finished, it is cut off and driven into a tube held in the lathe chuck. The tube into which the ball is driven is shown at *F* in the lower view of the illustration. Before driving the ball into place, the tube is bored out to a diameter a little less than that of the ball and given a slight taper. The projecting neck *G* should be located at an angle of about 45 degrees with the axis of the tube. This projection can be removed by taking very light cuts, using the finished surface as a guide in feeding the tool. The tool *C* is then used to smooth up the work. A very accurate ball can be made by repeatedly relocating the ball in the tube *F*, if the smoothing tool *C* is carefully used each time the ball is relocated. If the ball is to be hardened and ground, a tool similar to the one shown at *C*, but of soft steel or brass, can be used for grinding. This tool should be chamfered on the working edge so that it can be effectively used with an abrasive.

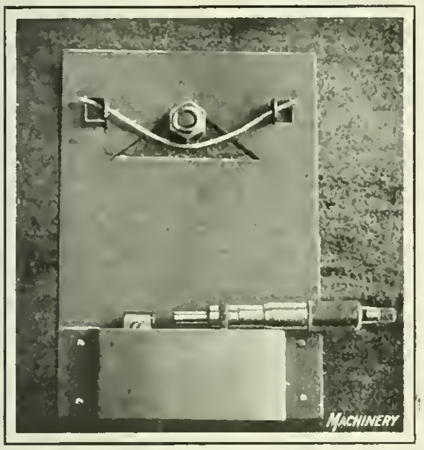
Butte, Mont. E. W. Cable

Shop and Drafting-room Kinks

HOLDER FOR MICROMETER

It is often convenient to have some other place for holding a micrometer when not in use than in the pocket of an apron, overalls, or shop coat. Although many mechanics are careful in handling instruments of precision, such as micrometers, nevertheless they are often found lying around on machines. Some mechanics do not like to carry instruments in a pocket of their shop clothing because they are likely to fall out when the men stoop or lean over their work. The accompanying illustration shows a convenient method of holding a micrometer, so that it need not be left around where it can become mislaid or damaged.

This holder is made of sheet metal, the pocket at the bottom being wide enough to admit the frame of the micrometer with the barrel resting as shown. This prevents the instrument from falling through, which it otherwise might do, as the pocket has no bottom. With this construction, any stray chips are free to drop through so that there can be no accumulation of dirt in the pocket. The section forming the pocket is attached by four pins which are riveted over. Near the top of the holder there is a triangular section cut away, and on each side of this hole a square hole is cut, the metal being bent out at right angles. A hole is drilled through each of these bent projections to accommodate a piece of spring wire, the ends of which, after being passed through the holes, are flattened to keep them in place.



A Convenient Micrometer-holder

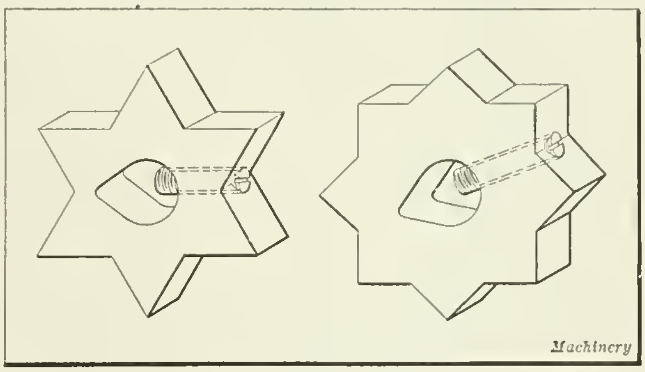
In the shop where this holder is used, it is taken around from machine to machine as desired and the spring snapped over a nut, bolt-head or pin, whichever is most convenient. The tension of the spring is great enough to furnish a firm contact with the nut, bolt-head or pin, which effectively prevents it from being displaced by vibration of the machine.

Montreal, Canada HARRY MOORE

INDEXING IN THE VISE

In the average tool-room and in small job shops, it is often desired to mill flats on opposite sides of a round piece, or square the end, or perhaps cut three or four flutes in a reamer. For such work, more time is generally spent in setting up the dividing head and tail-center than in performing the actual machining operations. The accompanying illustration shows a pair of blocks which will enable indexing of plain work to be done in the ordinary vise.

With these blocks, two, three, four, six, and eight divisions (which are the ones usually required) can be made with a fair degree of accuracy. One of these blocks, when in use is clamped on the end of the shaft or piece to be machined, and one set of faces leveled with an indicator surface gage placed on the table. After the first cut, the vise is loosened and the work turned until the next face to be used is level.



Blocks for indexing Work held in Vise

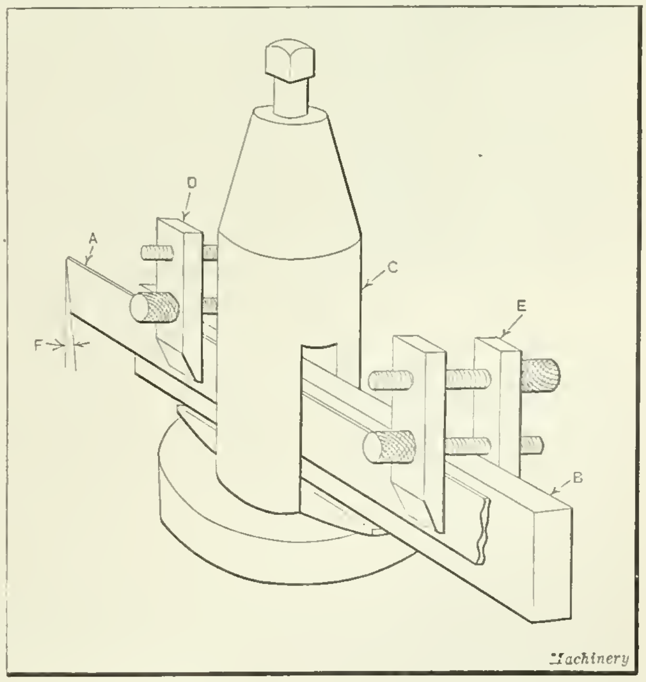
This procedure is repeated until the required number of cuts has been taken. Irregular spacing such as is often required in milling flutes in reamers can also be readily obtained with indexing blocks of the type shown.

Rochester, N. Y. GEORGE C. HANNEMAN

CUTTING-OFF TOOL FOR NARROW CUTS

The accompanying illustration shows a cutting-off tool made from a piece of a power hacksaw blade. For fine work a regular hand hacksaw blade could be used. Blade *A* is ground at one end to give the required clearance angle *F*, and is clamped to a piece of bar stock *B* or to a regular tool-holder which is narrow enough to permit both the blade and the holder to be slipped through the slot in the toolpost *C*. Clamp *D* is placed in front of the toolpost, and another clamp *E* at the rear, as shown. The clamp *D* is located near the cutting end of the blade to prevent the blade from being unduly deflected. Such a tool is convenient for cutting brass tubing, nuts, and other pieces from bar stock when it is desired to keep the amount of waste as low as possible.

Oakland, Cal. H. H. PARKER



Improvised Cutting-off Tool made from Hacksaw Blade

TABLE 1. GLEASON WORKS SYSTEM FOR GENERATED SPIRAL BEVEL GEARS

For Spiral Bevel Gears Operating at Right Angles, where the Pinion is the Driver and has Less than Ten Teeth

The proportions given have been based on the assumption that the spiral angle used is 30 degrees. In order to obtain the desired tooth action it is recommended that the spiral angle selected should not be less than 27 degrees.

WORKING DEPTH, WHOLE DEPTH, PRESSURE ANGLE

For Combinations having	Working Depth, Inches	Whole Depth, Inches	Pressure Angle, Degrees
9 teeth in pinion	$\frac{1.700}{\text{D.P.}}$	$\frac{1.888}{\text{D.P.}}$	17½
8 teeth in pinion	$\frac{1.600}{\text{D.P.}}$	$\frac{1.788}{\text{D.P.}}$	17½
7 teeth in pinion	$\frac{1.600}{\text{D.P.}}$	$\frac{1.757}{\text{D.P.}}$	20
6 teeth in pinion	$\frac{1.500}{\text{D.P.}}$	$\frac{1.657}{\text{D.P.}}$	20
5 teeth in pinion	$\frac{1.400}{\text{D.P.}}$	$\frac{1.557}{\text{D.P.}}$	20

ADDENDUM AND DEDENDUM

For 9 teeth in pinion, addendum of gear = Addendum for 1 D.P. (Table 2) ÷ D.P.

For 8 teeth in pinion, addendum of gear = (Addendum for 1 D.P. ÷ D.P.) × (80 ÷ 85)

For 7 teeth in pinion, addendum of gear = (Addendum for 1 D.P. ÷ D.P.) × (80 ÷ 85)

For 6 teeth in pinion, addendum of gear = (Addendum for 1 D.P. ÷ D.P.) × (75 ÷ 85)

For 5 teeth in pinion, addendum of gear = (Addendum for 1 D.P. ÷ D.P.) × (70 ÷ 85)

For all combinations, addendum of pinion = working depth — addendum of gear.

For all combinations, dedendum of gear = whole depth — addendum of gear.

For all combinations, dedendum of pinion = whole depth — addendum of pinion.

CIRCULAR THICKNESS

For 9 teeth in pinion, circular thickness of gear =

$$\frac{0.976''}{\text{D.P.}} + (0.7 \times \text{addendum of gear}) - \frac{\text{K (Table 2)}}{\text{D.P.}}$$

For 8 teeth in pinion, circular thickness of gear =

$$\frac{1.011''}{\text{D.P.}} + (0.7 \times \text{addendum of gear}) - \frac{\text{K}}{\text{D.P.}}$$

For 7 teeth in pinion, circular thickness of gear =

$$\frac{0.931''}{\text{D.P.}} + (0.8 \times \text{addendum of gear}) - \frac{\text{K}}{\text{D.P.}}$$

For 6 teeth in pinion, circular thickness of gear =

$$\frac{0.971''}{\text{D.P.}} + (0.8 \times \text{addendum of gear}) - \frac{\text{K}}{\text{D.P.}}$$

For 5 teeth in pinion, circular thickness of gear =

$$\frac{1.011''}{\text{D.P.}} + (0.8 \times \text{addendum of gear}) - \frac{\text{K}}{\text{D.P.}}$$

For all combinations, circular thickness of pinion = 3.142 — circular thickness of gear

Machinery

TABLE 2. GLEASON WORKS SYSTEM FOR GENERATED SPIRAL BEVEL GEARS

ADDENDUM FOR 1 DIAMETRAL PITCH

To obtain addendum select from table value corresponding to ratio given by the following formula:

$$\text{Ratio} = \frac{\text{Number of teeth in gear}}{\text{Number of teeth in pinion}}$$

Ratios		Addendum, Inch	Ratios		Addendum, Inch	Ratios		Addendum, Inch	Ratios		Addendum, Inch
From	To		From	To		From	To		From	To	
1.00	1.00	0.850	1.15	1.17	0.750	1.41	1.44	0.650	1.99	2.10	0.550
1.00	1.02	0.840	1.17	1.19	0.740	1.44	1.48	0.640	2.10	2.23	0.540
1.02	1.03	0.830	1.19	1.21	0.730	1.48	1.52	0.630	2.23	2.38	0.530
1.03	1.05	0.820	1.21	1.23	0.720	1.52	1.57	0.620	2.38	2.58	0.520
1.05	1.06	0.810	1.23	1.26	0.710	1.57	1.63	0.610	2.58	2.82	0.510
1.06	1.08	0.800	1.26	1.28	0.700	1.63	1.68	0.600	2.82	3.17	0.500
1.08	1.09	0.790	1.28	1.31	0.690	1.68	1.75	0.590	3.17	3.67	0.490
1.09	1.11	0.780	1.31	1.34	0.680	1.75	1.82	0.580	3.67	4.56	0.480
1.11	1.13	0.770	1.34	1.37	0.670	1.82	1.90	0.570	4.56	7.00	0.470
1.13	1.15	0.760	1.37	1.41	0.660	1.90	1.99	0.560	7.00	∞	0.460

VALUES OF K FOR CIRCULAR THICKNESS FORMULA

Select value corresponding to number of teeth in pinion and ratio given by formula.

Number of Teeth in Pinion	Ratios														
	1.00 to 1.25	1.25 to 1.50	1.50 to 1.75	1.75 to 2.00	2.00 to 2.25	2.25 to 2.50	2.50 to 2.75	2.75 to 3.00	3.00 to 3.25	3.25 to 3.50	3.50 to 3.75	3.75 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 and higher
	Values of K (in inches) for Different Ratios														
9	0.000	0.010	0.025	0.040	0.055	0.070	0.085	0.095	0.105	0.115	0.125	0.135	0.150	0.165	0.185
8	0.000	0.010	0.030	0.045	0.065	0.080	0.095	0.110	0.125	0.135	0.145	0.155	0.170	0.180	0.195
7	0.000	0.025	0.050	0.075	0.095	0.115	0.135	0.155	0.170	0.185	0.195	0.205	0.220	0.235	0.250
6	0.010	0.035	0.060	0.085	0.105	0.130	0.150	0.165	0.180	0.195	0.210	0.220	0.235	0.250	0.265
5	0.020	0.040	0.075	0.110	0.135	0.155	0.170	0.185	0.200	0.215	0.230	0.240	0.255	0.270	0 285

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The Gleason Works System of Bevel Gears*

By F. E. McMULLEN and T. M. DURKAN, of the Gleason Works, Rochester, N. Y.

THE Gleason Works system of bevel gears was designed with the idea of securing the quietest form of tooth consistent with strength and wearing qualities, as explained previously in an article descriptive of this system, which appeared in June, 1922, MACHINERY, beginning on page 788. When this system was first introduced, the tables of formulas and data for determining the tooth proportions applied to driving pinions having ten teeth or more.

The accompanying tables represent an addition to this system in that they give the tooth proportions for smaller numbers of teeth in spiral bevel pinions than were included in the tables previously published. In addition, the Gleason Works have prepared a table of outline factors for both spiral and straight bevel gears. These factors are used in connection with the well-known Lewis formula for calculating the strength of bevel gears, and were obtained by considering the load applied at the outer end of a tooth proportioned according to the Gleason Works system.

As previously explained, the point of application of the load, according to the Gleason Works system, should be determined for each combination, since it is a function of the number of teeth in contact. The calculated strength of gears, based upon this method of load application, is greater than that obtained by the Lewis method, the increase in some cases being as much as 100 per cent. However, in view of the fact that the Lewis formula is universally known, it was considered desirable to present, at this time, values determined by the Lewis method.

It is recommended that this subject be thoroughly investigated to determine the exact influence of the number of teeth in contact, on the strength of bevel gears, especially in view of the recognized fact that the Lewis method gives ultimate loads that are less than the breaking loads found in actual practice.

TABLE 3. OUTLINE FACTORS Y FOR GLEASON WORKS SYSTEM

For use in the Lewis Formula as given on page 640 of MACHINERY'S HANDBOOK, these values are for either gear or pinion.

STRAIGHT BEVEL GEARS

Number of Teeth in Pinion	Ratios														
	1.00 to 1.25	1.25 to 1.50	1.50 to 1.75	1.75 to 2.00	2.00 to 2.25	2.25 to 2.50	2.50 to 2.75	2.75 to 3.00	3.00 to 3.25	3.25 to 3.50	3.50 to 3.75	3.75 to 4.00	4.00 to 4 50	4.50 to 5.00	5.00 to ∞
	Values of Y for Lewis Formula														
10	0.231	0.260	0.280	0.294	0.305	0.315	0.324	0.332	0.340	0.347	0.353	0.358	0.365	0.371	0.377
11	0.268	0.264	0.273	0.286	0.296	0.303	0.309	0.315	0.320	0.324	0.328	0.332	0.336	0.340	0.342
12	0.248	0.265	0.281	0.295	0.308	0.318	0.328	0.335	0.341	0.345	0.348	0.351	0.353	0.355	0.356
13	0.264	0.278	0.291	0.280	0.278	0.286	0.291	0.295	0.298	0.299	0.301	0.303	0.305	0.307	0.310
14	0.242	0.254	0.263	0.272	0.281	0.288	0.294	0.299	0.304	0.307	0.310	0.313	0.316	0.318	0.319
15	0.248	0.258	0.266	0.274	0.283	0.290	0.296	0.301	0.305	0.308	0.312	0.315	0.318	0.319	0.320
16	0.252	0.261	0.269	0.277	0.285	0.292	0.298	0.304	0.308	0.312	0.314	0.317	0.319	0.321	0.323
17 to 18	0.257	0.265	0.273	0.281	0.288	0.295	0.302	0.307	0.311	0.315	0.318	0.320	0.322	0.325	0.326
19 to 21	0.265	0.272	0.279	0.286	0.294	0.300	0.307	0.312	0.317	0.320	0.324	0.326	0.328	0.330	0.332
22 to 25	0.274	0.281	0.288	0.295	0.301	0.307	0.314	0.319	0.324	0.327	0.331	0.332	0.335	0.337	0.338
26 to 30	0.284	0.291	0.297	0.304	0.310	0.317	0.322	0.327	0.332	0.336	0.339	0.342	0.344	0.346	0.347

SPIRAL BEVEL GEARS

Number of Teeth in Pinion	Ratios														
	1.00 to 1.25	1.25 to 1.50	1.50 to 1.75	1.75 to 2.00	2.00 to 2.25	2.25 to 2.50	2.50 to 2.75	2.75 to 3.00	3.00 to 3.25	3.25 to 3.50	3.50 to 3.75	3.75 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 to ∞
	Values of Y for Lewis Formula														
5	0.297	0.322	0.343	0.361	0.376	0.388	0.398	0.406	0.411	0.416	0.420	0.424	0.431	0.438	0.450
6	0.310	0.332	0.353	0.372	0.386	0.398	0.406	0.414	0.419	0.424	0.428	0.431	0.436	0.443	0.452
7	0.318	0.333	0.347	0.360	0.373	0.384	0.392	0.398	0.405	0.410	0.415	0.419	0.426	0.432	0.439
8	0.298	0.320	0.336	0.348	0.357	0.366	0.373	0.379	0.384	0.388	0.392	0.394	0.397	0.400	0.405
9	0.292	0.313	0.327	0.338	0.346	0.352	0.357	0.363	0.367	0.370	0.373	0.376	0.380	0.384	0.388
10	0.315	0.338	0.353	0.363	0.371	0.345	0.326	0.342	0.351	0.357	0.363	0.367	0.371	0.374	0.377
11	0.316	0.335	0.343	0.325	0.327	0.333	0.338	0.344	0.350	0.356	0.361	0.367	0.375	0.384	0.390
12	0.298	0.318	0.333	0.343	0.351	0.357	0.363	0.368	0.372	0.377	0.379	0.381	0.384	0.386	0.388
13	0.302	0.320	0.334	0.343	0.351	0.358	0.365	0.371	0.376	0.381	0.384	0.386	0.388	0.391	0.393
14	0.306	0.322	0.334	0.345	0.354	0.362	0.369	0.374	0.378	0.382	0.386	0.389	0.391	0.393	0.395
15	0.314	0.330	0.342	0.352	0.360	0.368	0.374	0.380	0.385	0.389	0.392	0.394	0.397	0.399	0.402
16	0.322	0.335	0.347	0.358	0.367	0.374	0.381	0.386	0.390	0.394	0.397	0.400	0.402	0.404	0.406
17 to 18	0.329	0.343	0.354	0.364	0.373	0.382	0.389	0.394	0.398	0.400	0.403	0.406	0.407	0.409	0.410
19 to 21	0.339	0.351	0.362	0.373	0.382	0.389	0.396	0.401	0.405	0.407	0.410	0.411	0.412	0.414	0.415
22 to 25	0.351	0.363	0.373	0.382	0.391	0.398	0.403	0.407	0.410	0.412	0.413	0.414	0.415	0.417	0.418
26 to 30	0.364	0.374	0.384	0.393	0.399	0.404	0.407	0.410	0.412	0.414	0.415	0.416	0.417	0.418	0.419

Machinery

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*Addition to the Gleason Works system of bevel gears, presented at the convention of the American Gear Manufacturers' Association held in Chicago, October 9 to 11.

The Machine Tool Industry

THE steady, although slow, improvement in the machine tool industry noted in this review from month to month during the last six months continues. Prices have advanced in practically all lines of shop equipment, the advances averaging from 10 to 15 per cent over the prices prevailing in the latter part of 1921. These advances have stimulated buying, especially by the railroads. Several lists of railroad shop equipment held up for a year or more, partly because purchasing agents expected still lower machine tool prices, have been released. In the Middle West, particularly, substantial railroad business has been placed.

Present indications are that there will be further price advances, because costs of materials have risen considerably, and the class of labor required in machine tool shops is scarce. Hence, there can be no reduction in costs, but it is more likely that costs will go up, for the machine tool builder must compete with his customers for labor and must pay at least as high rates as are paid in machine shops engaged in building automobiles, locomotives, washing machines, and hundreds of other plants using machine tools. He must also compete for his labor with other industries that in the past paid a lower wage than that paid to a good machinist—like textile mills and shoe factories—but that now in many instances pay wages higher than the machine tool builder can afford to pay, unless there is a further advance in prices. Anyone wishing to prove these facts for himself should simply compare the price per pound paid for machinery outside of the machine tool field with the price of machine tools. It is surprising how many lines of machinery there are requiring only the simplest kind of construction and workmanship which sell at prices per pound net weight that are double or more than double those of machine tools.

Conditions in the Industry

One of the favorable conditions in the machine tool industry—and one that will soon have a marked effect on the activity of the shops in this field—is that the large stocks of equipment accumulated in the earlier part of the business depression have been gradually worked off, and many manufacturers now find it necessary to resume the building of new lots of machines for stock. There is some hesitancy as to the desirability of again accumulating stock; but it is practically a necessity, because buyers expect prompt deliveries, and instances are on record where orders have been lost because the manufacturer was not in a position to quote early delivery. Furthermore, there is less danger in building for stock at present wages and material costs than when these were at their peak; and stocks built now are likely to be produced as cheap as, if not cheaper than, later on. The labor market is becoming more and more difficult, and the machine tool builder who can begin now to build up an organization, by gradual steps, is likely to be in a better position than the manufacturer who is forced suddenly to put a large force together when business is pressing him.

The second-hand market is practically normal now, and only in certain centers is there what might be termed a surplus of used machinery. In Dayton and Columbus, for example, where many of the tool shops that started during the war have gone out of business, there are many good used machines to be had; but in most places used machines of good quality and in good condition have been absorbed. The Government has practically nothing more to offer, except some special machinery and some of the shipyard equipment, which is not of general application.

In new equipment, the automotive industries are still the consumers of the greatest volume; but the railroads, and the locomotive shops, have also placed some fair-sized orders.

The Automobile Shop Demand

The automobile industry shows no sign of slackening its pace, although the business done is chiefly in the hands of a few large well-known companies. The weeding out process is still at work, and it is a case of the survival of the fittest. Builders of the best and most reliable cars who sell them at reasonable prices are doing a very good business, while the speculators and mere money-makers who rode in on the high tide of prosperity are being crowded out. This is a normal development of the industry. There are no advantages to be gained in having a great variety of makes of automobiles. It would be futile to attempt to predict how many makers of cars will ultimately dominate the market, but it is a fact that even now a dozen companies make practically all the cars in the country. The remainder, even though some make excellent automobiles, produce a comparatively small number. These leaders are constantly expanding, or securing new and up-to-date equipment; and several machine tool builders depend almost solely on this industry, at least two plants running at capacity on equipment of this kind.

Combating Trade Abuses

During periods of depression, the buyer always has an advantage over the seller. This has been especially true in the machine tool industry during the past year. Purchasing agents have pitted sellers against each other, not always by fair means or scrupulously truthful statements. In many cases they have told of concessions offered by a competitor of the seller that had no foundation in fact. Manufacturers and salesmen would do well to investigate statements of this kind before acting upon them. If it is illegal, as it should be, to combine to maintain prices, it certainly is unfair practice to force prices down by untruthful statements. Buyers as well as sellers should be legally responsible for trade abuses that interfere with open and free competition.

Some buyers, taking undue advantage of the manufacturer competing for orders in a hard market, have tried to impose the condition that new and improved equipment developed later must not be sold to a competitor. Such conditions have generally been rejected by the manufacturer. He cannot afford to place upon his inventive ability and experience what amounts to a mortgage. He cannot afford and should resolutely refuse to limit the equipment he develops to a single customer.

Another difficulty frequently met with is the excessive demand for free service. Those who manufacture a line of machines where competition is not too keen may be able to recover the cost of this free service in the selling price of the machine. But in many lines the price of the machine covers nothing but actual manufacturing costs; in such instances, free service becomes a serious problem. There is also the matter of the engineering lay-outs that are submitted before an order is placed; these, in many cases, take on the character of consulting engineering service, and it is an open question whether manufacturers are not justified in making such service contingent upon a subsequent order—that is, if an order for the equipment is placed, the service in planning methods of production is free; but if the prospective customer does not place an order, this service should be charged for the same as any other consulting engineering service.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

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Sundstrand Stub Lathe. Rockford Tool Co., 2400 Eleventh St., Rockford, Ill. 231
Giddings & Lewis Internal Grinding Machine. Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. 232
Campbell Nibbling Machine. A. C. Campbell, Inc., Waterbury, Conn. 233
Brown & Sharpe Ground-form Gear-cutters. Brown & Sharpe Mfg. Co., Providence, R. I. 233
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Garrett Lathe Milling Attachment. Production Machine Tool Co., 629 East Pearl St., Cincinnati, Ohio 244
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Pratt & Whitney Centering Machines

CENTERING the ends of small-diameter quantity-production work may be performed at high production rates by means of an automatic centering machine lately developed by the Pratt & Whitney Co., Hartford, Conn. This machine is equipped with two drill heads for simultaneously drilling both ends of the work. It has been designed primarily for use in conjunction with the automatic lathe manufactured by this company, which was described in December, 1921, MACHINERY, but it may also be used as auxiliary equipment to other machine tools. The work is fed from a magazine into alignment with the centering spindles by means of a transfer mechanism, the movements of which are correlated with the feeding and withdrawing movements of the drill spindles. The work is clamped automatically, the only requirement of the operator being to keep the magazine loaded and remove the finished parts

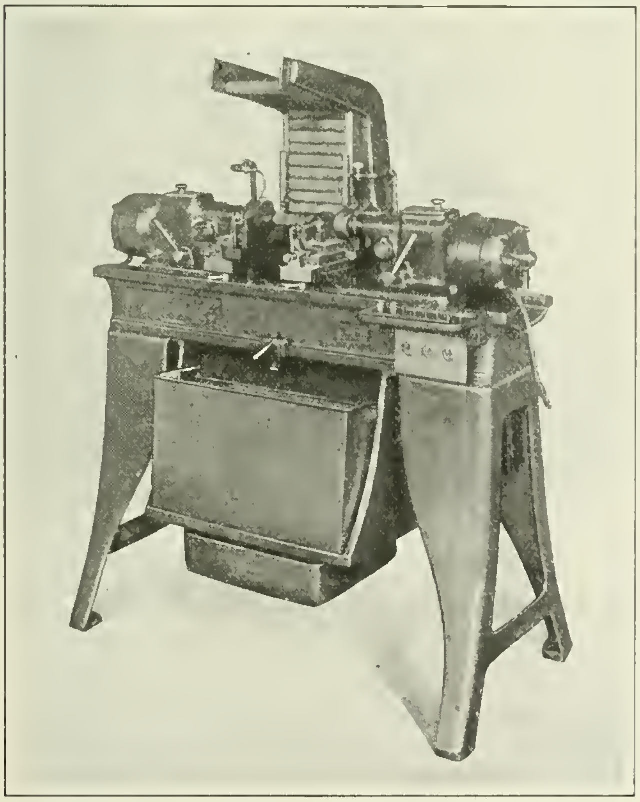


Fig. 1. Pratt & Whitney Automatic Centering Machine which simultaneously drills Both Ends of Work

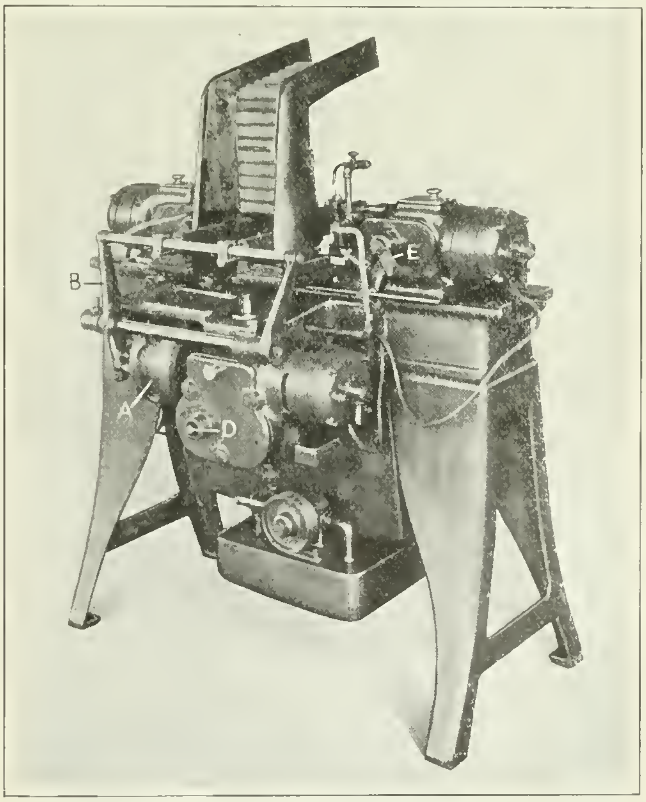


Fig. 2. Rear View of Machine, showing Mechanism for transferring Work and feeding Drill Spindles

as the work-box becomes full. The Pratt & Whitney Co. is at this time also introducing to the trade a new model hand-centering machine (similar to the automatic type), a description of which will be included in the present article.

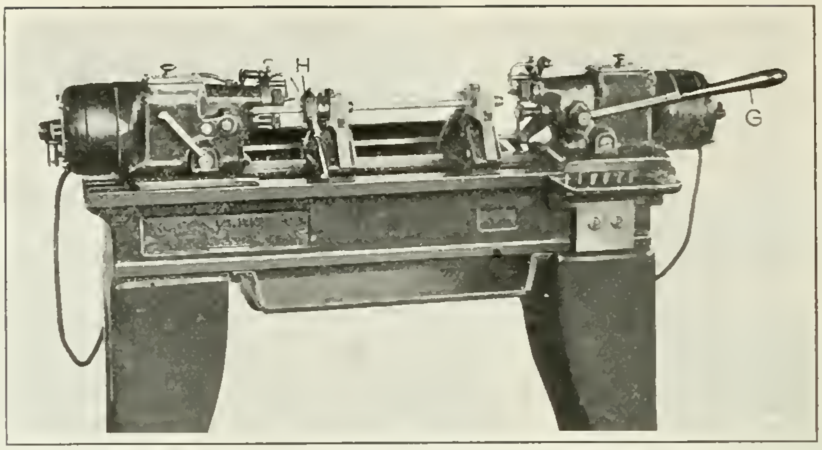


Fig. 4. Front View of the Hand-operated Machine equipped with Quick-acting Self-centering Vises

Automatic Centering Machine

From Figs. 1 and 2 it will be seen that the two drill heads mounted on opposite sides of the bed are individually driven by a motor integral with each head. These motors are geared to the drill spindles in such a way that spindle speeds of either 1200 or 1800 revolutions per minute may be secured. The selection of these speeds and locking of the spindle during the replacement of drills is accomplished by means of a knob on top of each drill head. The magazine and work supports are attached to the head castings, and so in setting the machine to accommodate different lengths of work, it is only necessary to move the heads to the proper positions along the bed. The sides of the magazine are readily adjustable to suit work of different diameters, from ¼ to 1½ inches.

The automatic feeding of the drills is accomplished by means of cam *A*, Fig. 2, which is driven by the small motor at the rear of the machine. This cam, through lever *B* and several rods, also actuates two transfer plates, one of which may be seen at *C*, Fig. 3. These plates bring the work forward into alignment with the drill spindles. A set of change-gears provides a means of regulating the drilling time to suit the work. The drills are automatically withdrawn twice while drilling so as to clear the holes of chips and permit oil to enter. The feeding movement of each spindle may be varied from 7/16 to ⅞ inch by setting the regulator lever *E*, Fig. 2, to suit. After the machine has been set up, its cycle of operations may be checked by turning by hand a crank handle placed on the square end of shaft *D* which projects from the change-gear box.

Depth Stops and Self-adjusting Vise

Adjustable stops on the drill heads bear against the ends of the work to limit the forward movement of the spindles so as to provide for drilling to any desired depth. In certain cases it is necessary to have the center holes the same distance apart, regardless of variations in the length of the work. For this purpose the adjustable stops are arranged to engage lugs on the drill heads which hold the spindles to the predetermined forward movement.

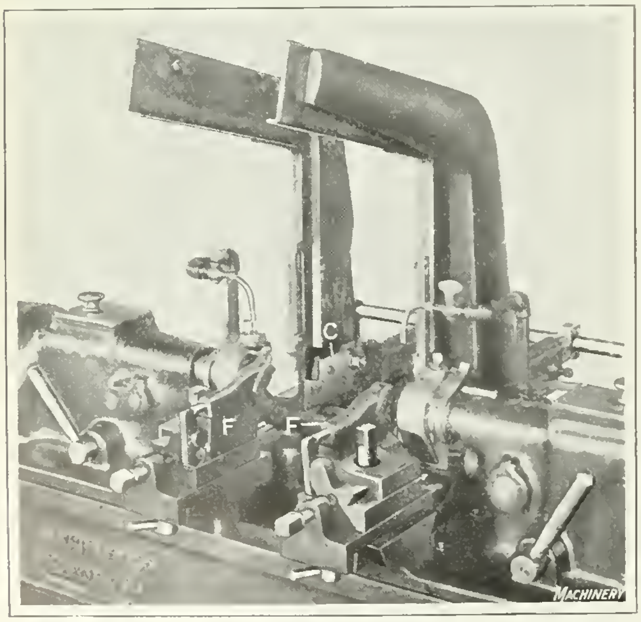


Fig. 3. Close-up View of One Transfer Plate and the Work Supports

During the centering operation, the work is supported by V-jaws *F*, Fig. 3, which have adjusting screws by means of which they may be set for work of different diameters. The jaws have an automatic arrangement which compensates for minor variations in diameter. The work is clamped in the jaws by the transfer slide plates *C*, Fig. 3, which remain in contact with the work during the drilling. Simple adjustments of the V-jaws make it possible to drill the hole out of center on one or both ends, when holes must be drilled in this way to receive driving pins for grinding operations, or when they are to serve as oil-holes. Facing or chamfering tools may be used on the machine in place of the drills. Different transfer plates for accommodating various diameters of work are easily mounted in place. Four sets of these plates cover the range of the machine.

Oil is supplied to the drills from a geared pump at the rear of the machine which runs at a constant speed. The tank is located under the bed, and the oil drains into it from all parts of the machine, including the work-box. The work-box is taken off for cleaning and for removing the finished parts. These are ejected from the V-jaws directly into the box, but when the latter is removed, a deflector hinged on the bed is latched in position to catch the work. The three motors are of ¼ horsepower, operate on 110- or 220-volt alternating or direct current, and run at a speed of 1700 revolutions per minute. A switch is supplied for controlling the starting and stopping of the motors. This machine receives work from 2½ to 18 inches in length and from ¼ to 1½ inches in diameter, as previously mentioned. It weighs about 1020 pounds.

The Hand-operated Machine

The hand-operated centering machine is also provided with two drill heads having individual motor drives, the spindles of which are simultaneously fed toward the work. However, the machine may be equipped with only one head in instances where the work is longer than can be handled with the duplex head. This machine can be quickly adjusted to suit work of all lengths and diameters within its capacity, and thus covers the requirements of a shop having a variety of work of the kind for which the machine is intended. The right-hand drill head is permanently attached to the bed, while the left-hand head can be moved along the bed to suit different lengths of work, and may be removed entirely for handling long work.

The drill spindles of the two heads are normally operated together by manipulating lever *G*, Fig. 4, on the right-hand head, the movement being transmitted to the left-hand head through the levers and a rod seen in Fig. 5. The drills are advanced by means of lever *G* until they contact with the ends of the work, which has been placed loosely between the jaws of the vise shown in Fig. 4, so that it may shift

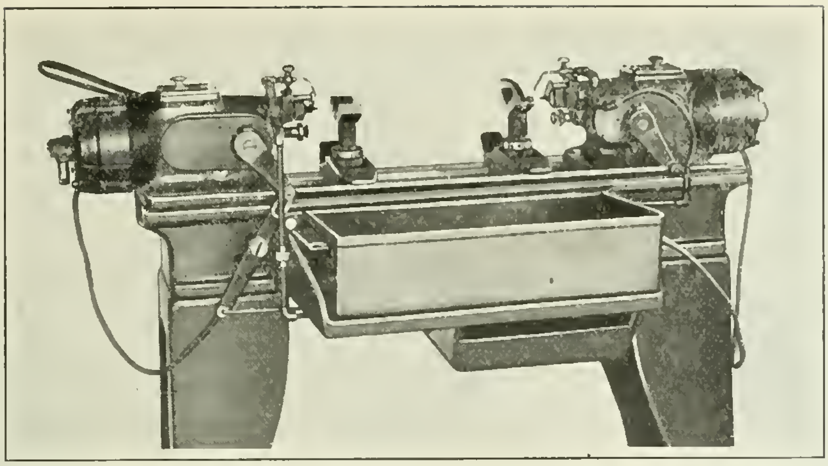


Fig. 5. Rear View of the Hand-operated Machine equipped with Adjustable V-supports

endwise during this step. When contact has been obtained both jaws are tightened at the same time by operating lever *H*, after which the work is ready for centering. The drill spindles are mounted in sliding bronze sleeves and are provided with ball thrust bearings. The spindles can also be driven at speeds of either 1200 or 1800 revolutions per minute, the same as on the automatic machine. These two speeds and locking of the spindles for the removal of drills are accomplished by means of a knob on the top of each drill head.

Other Details of Construction

As in the automatic centering machine, adjustable stops are provided on the heads to bear against the ends of the work so as to limit the forward movement of the spindles and hold the depth of drilling to the desired dimension. The center holes may be held the same distance apart by having the stops positioned to engage lugs on the drill heads. In Fig. 4 the machine is equipped with two quick-acting self-centering vises which take work of any diameter up to and including 2 inches. The vises are adjustable along the bed to accommodate work from 3 to 18 inches in length, and are operated simultaneously through lever *H*, as previously mentioned. However, for heavy work up to and including 4 inches in diameter, the adjustable V-supports shown mounted on the machine in Fig. 5 are used. Locking screws maintain the adjustment of these supports, and one of the supports has a clamping lever for holding the work in place.

After being centered, the work is deposited in a removable metal tote box at the rear of the machine. Oil is conveyed to the drills by means of a plunger pump, which is connected to hand-lever *G* and works in conjunction with it. By this arrangement, oil is supplied to the drills only while they are cutting, and this is accomplished without requiring attention on the part of the operator. Oil running from the work in the tote box is drained back into the supply tank. The drill-head motors on this machine are of the same type as those with which the automatic machine is equipped. An outboard support can be furnished for use in handling work over 5 feet long. The weight of this machine is approximately 600 pounds.

SUNDSTRAND STUB LATHE

The striking feature of the Sundstrand stub lathe is its unique construction. As will be seen from the illustrations, this machine is of an entirely different design from the ordinary lathe. Maximum rigidity has been obtained by making the headstock integral with the housing, which contains all the driving mechanism, exclusive of the motor, and on which the carriage ways are machined. It will be noticed that the tailstock is supported both by an over-arm and by a stud which extends from the bed. This machine has been primarily developed for turning automobile pistons, but it is also suitable for turning a large variety of parts, such as gears, pulleys, bushings, and automobile hubs and steering knuckles. It is built by the Rockford Tool Co., 2400 Eleventh St., Rockford, Ill.

The machine is driven by a 5-horsepower motor, which is fastened on a pivoted frame or plate in the bed, where it is entirely out of the way of the operator. The tension on the driving belt may be regulated through adjustment. The motor pulley is connected by belt to a friction-clutch pulley at the rear of the machine, as shown in Fig. 2. The upper pulley is mounted on roller bearings and the clutch is operated by means of the handle which projects from the front of the machine.

Details of the Spindle and the Feeding Mechanism

The spindle is driven through a worm and a heavy bronze worm-wheel, the reduction of which is in the ratio of 3 to 1. The worm is provided with ball bearings to eliminate friction. Through gearing, six spindle speeds ranging from 40 to 145 revolutions per minute are obtainable. The spindle is of generous proportions, and runs in phospher-bronze taper bearings which are lubricated by a wick feed from an oil reservoir provided with sight-feed oil-cups. Both bearings are adjustable by means of a nut at the rear of the spindle. Provision is made for mounting an air cylinder and a quick-acting draw-back chuck on the spindle.

The feeding mechanism is driven from the spindle through a chain and pick-off gears located at the headstock end of the machine. The standard gears furnished provide for six feeds ranging from 0.020 to 0.090 inch per spindle revolution. The carriage and rear tool are fed through worm-gearing, the worm being submerged in oil. To start feeding, the worm is lifted into engagement with the worm-wheel by means of a handle located at the front of the machine. The worm-wheel is keyed on a pinion shaft which drives the carriage, and because of this construction no gearing is required in the apron. The large handwheel seen at the front of the machine is mounted on the worm-wheel and pinion shaft.

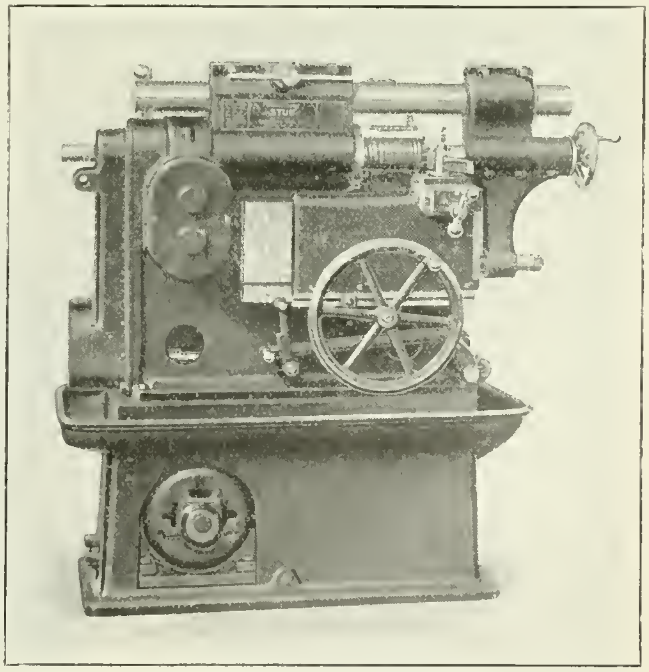


Fig. 1. Sundstrand Lathe of Unique Construction which was designed especially for turning Automobile Pistons

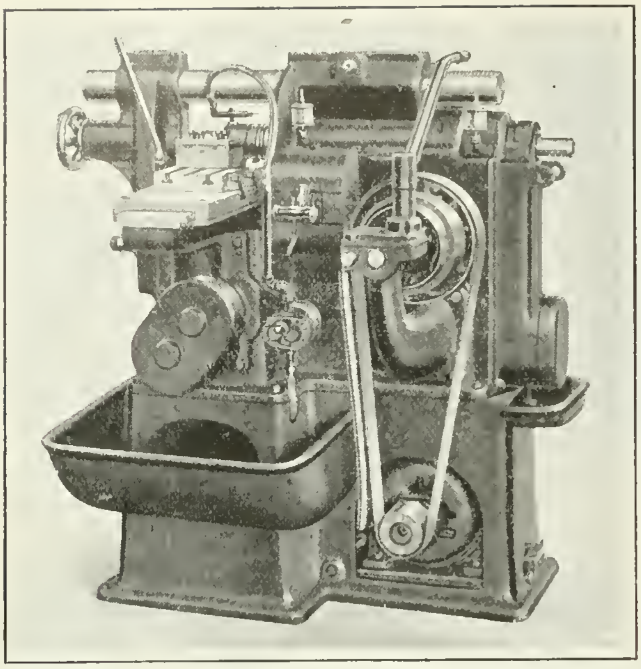


Fig. 2. Rear View of the Stub Lathe, showing the Driving Arrangement and the Rear Tool

The Carriage Construction

The carriage has a full-length bearing on an eight-inch face at the front of the housing and on a four-inch angular surface at the top. An angular gib is provided at the bottom of the carriage to take up wear. The front tool-slide has stop-screws underneath for tool adjustment, and the slide is of sufficient width so that several tools can be clamped on it at one time. The rear tool has a four-inch in and out travel and ample sidewise adjustment. The carriage feed can be ended at any desired point by setting a dog to trip the feed-lever and thus automatically disengage the worm of the feeding mechanism from its mating worm-wheel. This arrangement is said to be especially satisfactory when facing to close diameters or turning shoulders.

Method of Supporting the Tailstock

The tailstock is clamped to a large overhanging arm which extends from the headstock, and is also supported by means of a stud that projects from the main housing. This method of supporting and locking the tailstock is said to insure the elimination of vibration. The screw of the tailstock is of large diameter and has a lead of 1½ inches. The tailstock spindle is of sufficient diameter to withstand tendency to spring. The bearing for this spindle is split the full length and held in position with screws which may be adjusted to compensate for wear. This feature does away with any chance of the spindle becoming loose and causing chatter.

The overhanging arm is so arranged that tools can be clamped on it for several operations such as facing and boring the open end of pistons and center-drilling. Adjustment of the arm is easily effected by means of a rack and pinion, the rack being cut on the top of the overhanging arm. The bed is well ribbed throughout and so designed that the chips fall from the carriage into a pan at the back of the machine which may be readily cleaned out. Oil is supplied to the work by means of a pump driven directly from the main-drive friction pulley. A tank is located in the bed below the chip pan for the coolant.

Some of the principal specifications of this machine are as follows: Swing over carriage, 8 inches; maximum distance between centers, 12 inches; diameter of hole through headstock spindle, 1 13/32 inches; longitudinal adjustment of tailstock spindle, 5 inches; length of carriage, 18 inches; travel of carriage, 8 inches; distance from floor to center of spindles, 45 inches; and approximate weight of machine with motor, 3000 pounds.

GIDDINGS & LEWIS INTERNAL GRINDING MACHINE

An automatic gaging mechanism, which entirely eliminates gaging of the work by hand, has been incorporated in the design of an automatic internal grinding machine, lately brought out by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. This machine is illustrated in Figs. 1 and 2. After the operator has chucked the work and started the feed, the machine will automatically grind the work to the finished size, trip the carriage at the end of the operation, and then return it to the starting position. This mechanism is of a construction that compensates for wear of the grinding wheel. Two gages are employed, one for the roughing and the other for the finishing feed.

When the roughing gage enters the work, the roughing feed is automatically ended, and the finishing feed is automatically engaged until the finishing gage enters the work, at which time the carriage is tripped as already mentioned. The two gages revolve at the work speed, and the finishing gage enters the work but once these provisions prolonging the life of the gages. The chief aims of the builders in designing this machine were to provide an equipment that would practically eliminate the requirement of skill on the part of the operator and that would automatically grind a hole to the desired size without resulting in the scrapping of parts.

The machine is motor-driven and is operated through a push-button control. The work-spindle is of large diameter, and runs in bronze bearings which are adjustable. There are six work-spindle speeds, which are selected by turning the handwheel on top of the work-head to any of six indicated positions. Ball bearings are supplied for the members that transmit power to the work-spindle. The work-head is mounted in a circular bearing on the cross-slide, and may be swiveled to permit the grinding of tapers having an included angle up to 30 degrees. The work-head can be indexed quickly and accurately to the required positions. A special three-jaw scroll chuck built by the Cushman

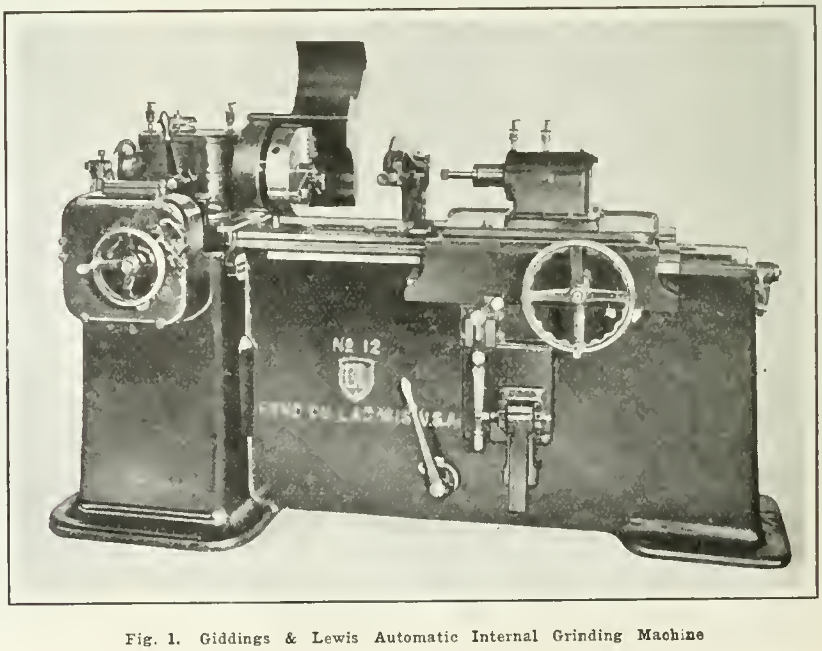


Fig. 1. Giddings & Lewis Automatic Internal Grinding Machine

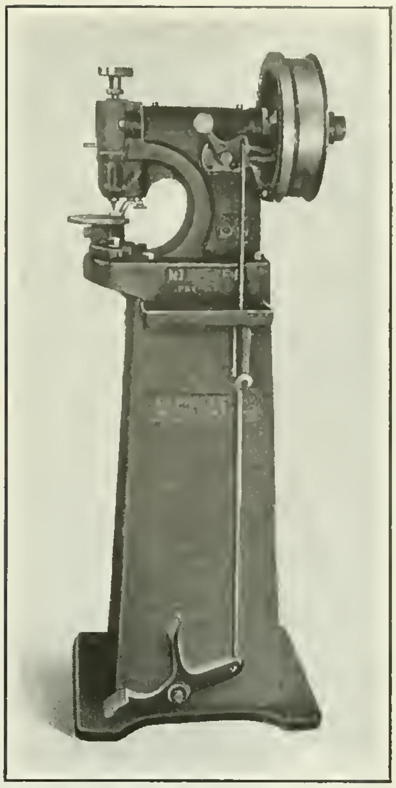
Chuck Co., and having a capacity for work from ¼ to 10¾ inches in diameter is furnished as standard equipment. This chuck is water-tight; all operating parts are protected against grit and the body is filled with grease. The body is made of steel and all working parts are hardened. A draw-bar is provided for opening and closing collet chucks, which is operated by the handwheel at the rear of the work-head.

The wheel carriage is heavily constructed and has large bearing surfaces on the vees of the bed. It is reciprocated hydraulically and, as the motor for driving the wheel-spindle is mounted directly beneath the carriage it reciprocates with it. The wheel-spindle is mounted on ball bearings in the head, the latter being tapered on the outside to suit the head housing, in which it is fastened by means of a lock-nut. This method of mounting the spindle permits of easy attachment and removal. A separate steel pulley is furnished with each wheel-spindle to provide for correct wheel speeds on all jobs. The work is fed against the wheel at each end of the stroke. Two separate series of feeds have been provided—ten roughing and five finishing feeds—which are controlled by the gaging mechanism, as previously outlined.

The bed of the machine is of substantial construction, being well ribbed to provide strength and rigidity. All bearing surfaces are amply protected from abrasive material. Water is supplied by a direct-driven centrifugal pump mounted within the machine, which forces the water through the center of the work-spindle to the work. Means have been provided for automatically shutting off the water when the wheel leaves the work, and for turning it on when the wheel enters the work. Some of the important specifications of the machine are as follows: Total swing over ways, 13 inches; range of hole diameter which may be ground, ¾ to 10 inches; maximum depth to which holes can be ground, 9 inches; maximum travel of wheel carriage, 20 inches; height of spindle from floor, 44 inches; and approximate weight of machine, 4400 pounds.

CAMPBELL NIBBLING MACHINE

Sheet metal up to and including 3/16 inch in thickness can be quickly cut to any desired outline by means of the patented nibbling machine here illustrated. This machine has a rapidly reciprocating punch of small size which enters a die held in the bedplate. The work is fed by hand against a stop-pin, so located as to allow a small part of stock to be removed by the punch on each stroke. This machine was exhibited by A. C. Campbell, Inc., Waterbury, Conn., at the recent machine tool exhibition held at Yale University.



Campbell Nibbling Machine for cutting out Sheet Metal

The design of the machine is such that sheet steel can be fed in any direction, and it can be cut out to the contour of superimposed templets in cases where the quantity of work is not sufficient to warrant making a blanking punch and die for use on a power press. The twelve punches furnished with the machine are easily inserted and removed from the holder. They are made from alloy steel, tempered and ground to size. Each punch is double-ended so that it can be reversed in the holder when one end becomes too worn for further use. An attachment enables circles to be cut conveniently up to 28 inches in diameter. This machine is especially adapted for cutting out stripper plates and gages for steel, malleable-iron, brass, or aluminum castings and steel forgings. Stock can be fed past the punch at an average rate of 18 inches per minute.

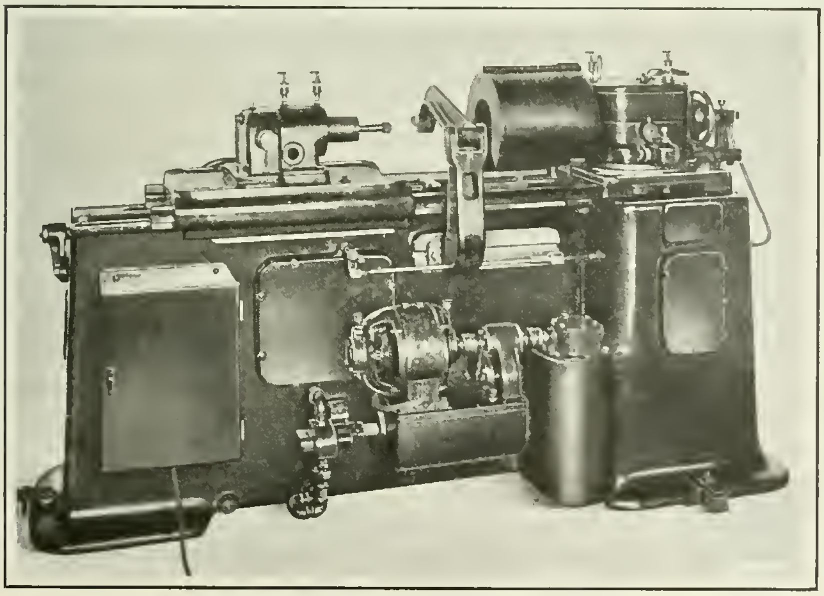


Fig. 2. Rear View of the Automatic Internal Grinding Machine showing the Arrangement of the Motor Drive

BROWN & SHARPE GROUND FORM GEAR-CUTTERS

Gear-cutters ground on the tooth form to correct hardening distortions and to align all teeth with the hole, have recently been placed on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. The tooth form of these cutters is accurate within very close limits, and so the tooth spaces of the gears produced by using the cutters will be correspondingly accurate. Grinding of the tooth form is said to give a positive method of controlling the form of different cutters, and of obtaining duplicates. This ability to obtain duplicate cutters is of importance to gear manufacturers who especially desire uniformity.

The aligning of the teeth gives the cutters a free cutting action, which is largely due to the fact that each tooth does its share of the work. Faster feeds have been used with these cutters than with ordinary cutters, and it is claimed that more gears have been produced between resharpenings. The longer wearing qualities are said to be due to the even distribution of the work of cutting among all the teeth, so that the resulting heat is not confined to any one part of the cutter. This eliminates localized heating, which is one of the common causes of cutter wear. Another factor that adds to the life of the cutters is that a positive clearance is given to the teeth, which eliminates rubbing of the form back of the cutting edge. These cutters can be supplied in sizes of from 1¾ to 12 diametral pitch, inclusive.

BAUSH MULTIPLE-SPINDLE DRILLING MACHINE

Feeding of the drill head on the new multiple-spindle drilling machine built by the Baush Machine Tool Co., Springfield, Mass., is accomplished by means of a ram located at the center of the head so that the pressure is applied at the center of the drilling area. The main advantages claimed for this construction are a true alignment of the drill spindles and the elimination of head binding. Power for driving the spindles is transmitted to the gears of the drill head through a vertical shaft at the front of the column. Another feature of the machine is the quick approach of the drill head to the point where the drills are about to contact with the work and the quick return to the starting position when an operation has been completed. These fast forward and return movements are made possible by the use of friction clutches in the change-feed gear-box. No damage results if the drills come in contact with the work when fed at the fast rate, because the friction clutches will slip and thus stop the downward movement of the head. The fast return of the head is automatic.

The machine as illustrated is arranged for being driven by belt through a three-speed gear-box, but it may also be driven by belt through a three-speed cone pulley, by motor through a three-speed gear-box, or by a direct-connected variable speed motor. The feed ram is raised and lowered by a pinion meshing with a rack on the ram, this pinion being driven through the change-feed gear-box mounted on top of the column. For each change of speed, there are three feed changes, which makes nine rates of feed in all, varying from 0.0018 to 0.023 inch per spindle revolution. The feeds mentioned are standard, but faster or slower feeds may be provided to suit requirements.

Either round or rectangular heads can be furnished in a number of sizes. The head is equipped with the patented spindle arms which are in use on all Baush drilling machines. These arms allow a liberal vertical adjustment of the spindles and permit a center distance as short as the diameter of the spindle itself. The universal joints are also of the type used on Baush multiple-spindle drilling machines. The drill head has an automatic safety catch, which prevents the counterweight from falling in case of an accident to the cable. Owing to the head feeding arrangement, the distance from the center of the head to the face of the column is made considerably greater than is customary when the head is fed directly from the column.

Except in counterboring, the head is operated by hand only in an emergency and for adjusting tools to height and to align with jigs. For this reason the pilot wheel for hand-feeding is located at one side and is disconnected when not in use. The column has a hole at the back through which weights may be added or removed from the counterweight for adjusting the balance of the head. Tripping of the head may be accomplished at any desired point by means of an automatic mechanism. The bed has T-slots in it, and either a box or rotating table may be mounted on it. An oil-pump and oil-tubes are furnished when desired. The bed has grooves and a reservoir for collecting the coolant.

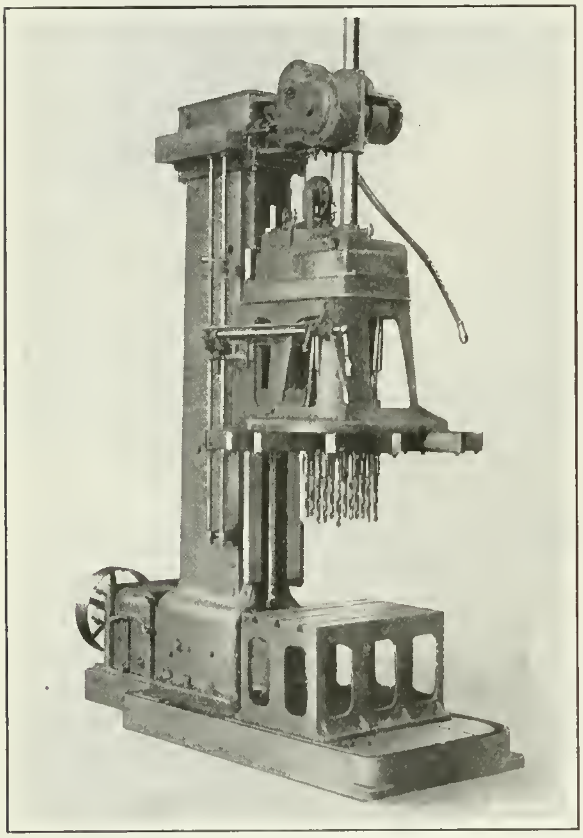


Fig. 1. Baush High-speed Multiple-spindle Drilling Machine

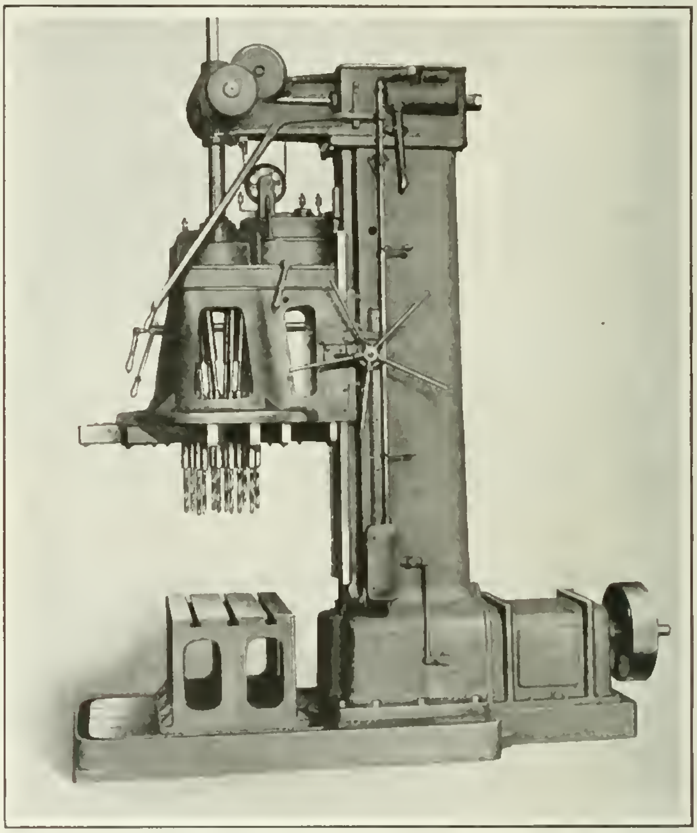


Fig. 2. The Multiple-spindle Drilling Machine from the Left-hand Side

A counterboring attachment adjacent to the pinion which feeds the head ram, provides for advancing the head very slowly by hand. This is convenient in spot-facing and similar operations. Back gears in the head may also be employed to reduce the spindle speed in such an instance. The machine is also built for tapping in addition to drilling. In the tapping model, back gears in the head are used to reduce the spindle speed, and these gears can be engaged or disengaged while the machine is running. In tapping, the operator brings the taps down to the work by means of the quick approach, after which a further downward movement of the head is controlled by the lead of the taps. At a certain point the direction of the rotation is automatically reversed and after the taps have cleared themselves from the work, the operator throws in the quick return. The head then rises quickly to the starting position, where it stops, and at the same time the rotation of the spindles is automatically reversed for the next operation.

Some of the important specifications of the machine are as follows: Maximum and minimum distance of spindles from bed, 45 and 20 inches, respectively; distance from center of head to face of column, 20 inches; total traverse of head, 25 inches; horsepower required for driving the machine, from 15 to 20. The machine has a capacity for drilling twelve 1-inch holes simultaneously through cast iron.

WILLIAMS CYLINDER GRINDER

One of the important points in grinding machine design is to provide against the likelihood of the abrasive dust working into bearings or between sliding surfaces. This has been taken care of in the construction of the Williams cylinder grinding machine, illustrated in Figs. 1 and 2, by placing the grinding wheel spindle in a vertical position and locating the entire driving mechanism of the machine above the wheel. Because of this arrangement, the abrasive dust falls through the cylinder being ground, and is not carried to bearings or sliding surfaces. The ways of the column on which the carriage moves are protected by a canvas curtain. Similarly, the longitudinal slide of the table has a sufficient movement from the center of the column in both directions to permit grinding three cylinders each way, without uncovering the ways of the slide. This machine is being placed on the market by the Hy-Way Service Co., 225 S. St. Joseph St., South Bend, Ind., and is intended for both automobile manufacturing plants and service stations.

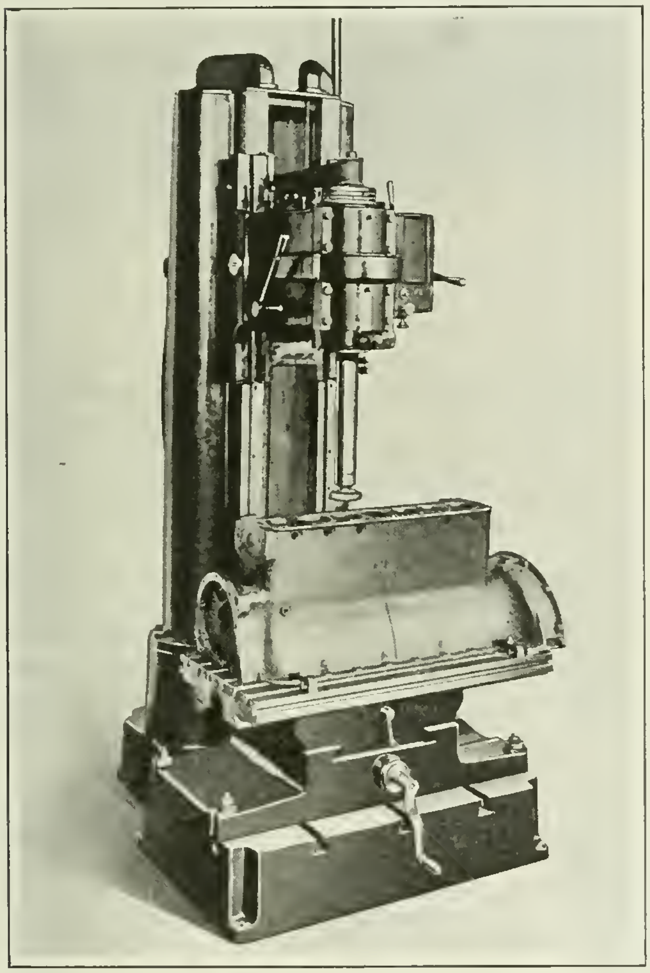


Fig. 1. Williams Vertical-spindle Cylinder Grinding Machine

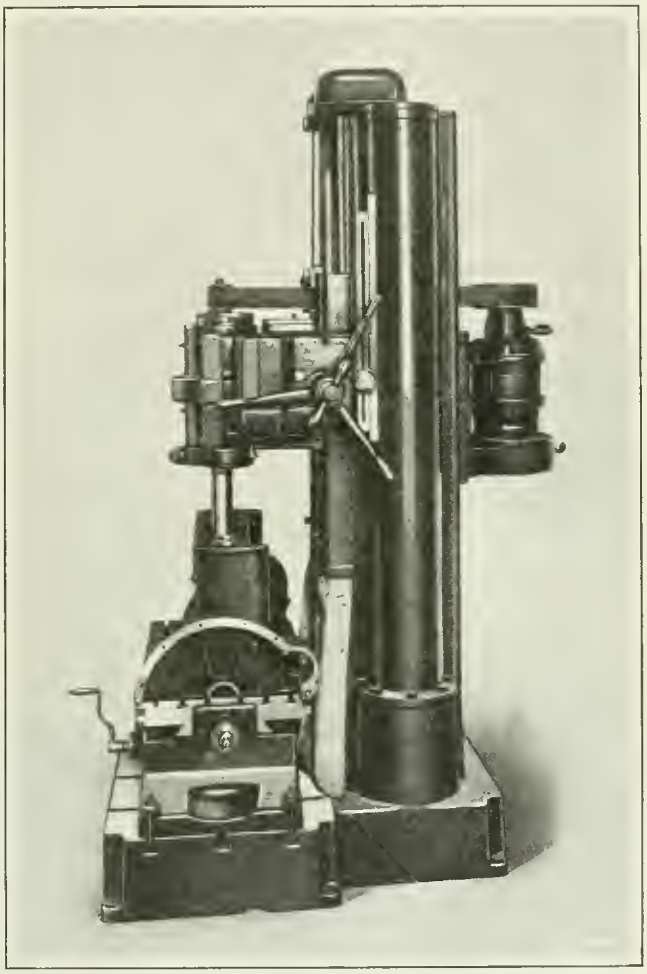


Fig. 2. View of Cylinder Grinding Machine from Right-hand Side

In setting up the machine for grinding any given size of cylinder, the correct transverse positioning of the cylinder under the grinding wheel is accomplished by means of the cross-slide controlled by turning the crank at the front of the machine. The entire driving mechanism is carried by the wheel-head, including the two-horsepower motor mounted at the back of the head. Three functions are performed by the power derived from this motor: (1) It rotates the wheel-spindle; (2) it actuates a planetary motion to the spindle unit; and (3) it feeds the head downward to advance the grinding wheel into the cylinder being ground, and also returns the head to the starting point.

The Grinding Wheel Spindle Drive and Planetary Rotation

The motor drives from both ends, through a pulley at the upper end and through spiral gearing at the lower end. The pulley transmits power direct to the grinding spindle through a fabric belt. In this way the high speed of the motor is utilized to give the required speed for the abrasive wheel. The correct speeds for the various sized wheels which are employed, are obtained through the use of different diameter pulleys on both the motor shaft and the grinding spindle.

The grinding spindle is mounted in a sleeve which, in turn, is eccentrically located in a second sleeve. There is a ring bevel gear on the second sleeve to which power is transmitted for rotating the entire wheel unit independently of the spindle rotation. The two sleeves are arranged in such a way that, by making adjustments, the grinding spindle may be set eccentrically any amount from 0 up to 1⅛ inches, to obtain the desired planetary rotation. This amount of adjustment is ample for the grinding of all commercial sizes of automotive cylinders. A graduated dial indicates the amount of eccentricity for which the unit is set.

The spiral pinion at the lower end of the motor shaft transmits power for the planetary movement through spiral, bevel, and spur gears to a pinion that meshes with the ring bevel gear on the second sleeve. Two different speeds of planetary rotation are obtained by manipulating the lever on the left-hand side of the spindle head, which controls a clutch.

The Feed and Return Movements

There are sixteen rates of feed ranging from 0.007 to 0.375 inch per spindle revolution, for advancing the wheel into the work. These feeds may be selected by manipulating plungers and a lever on the change-feed gear-box. After the grinding wheel has been lowered to the desired point, the feed is reversed to carry the wheel-head back to the starting position. This reversal of movement is automatically accomplished by means of stops on the column which trip a clutch. There is also a small plunger on the change-feed gear-box, which may be manipulated by hand to cause a reversal in the direction of the wheel-head movement.

It will be apparent from Fig. 1 that feeding of the head up and down on the column of the machine is accomplished through pinions which mesh with two racks. The capstan wheel at the right-hand side of the head provides for raising and lowering the head by hand, in addition to the power feed and return. The wheel-head is balanced by counterweights so that it may be easily moved. The mechanism of the change-feed gear-box runs in a bath of oil to insure efficient operation without undue wear.

KELLER AUTOMATIC DIE-SINKING MACHINE

One of the attractions of more than passing interest at the exposition of the American Society for Steel Treating held in Detroit during the early part of last month, was the Type F automatic die-sinking machine exhibited by the Keller Mechanical Engraving Co., 74 Washington St., Brooklyn, N. Y. This machine was shown in actual operation on an automobile crankshaft die and on a core-box for an automobile intake manifold. The machine is especially adapted for making forming, stamping, and forging dies. It is intended for work up to 36 inches in length and 20 inches in width, being intermediate between two other sizes built by this firm. It cuts to a depth of 8 inches.

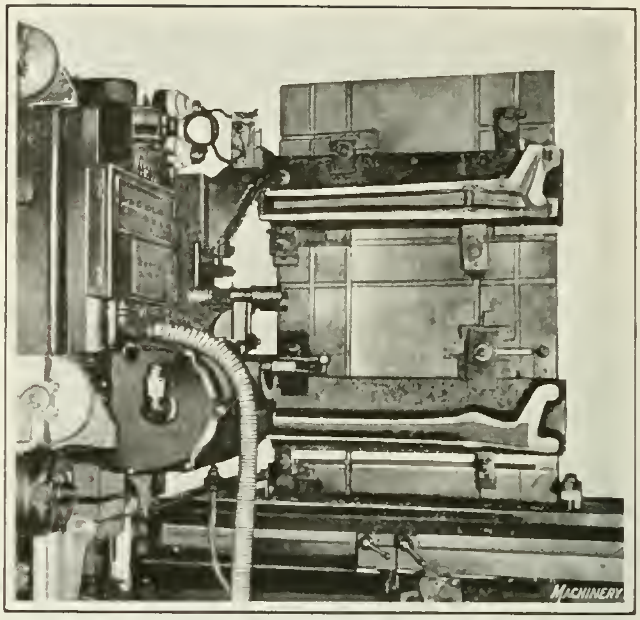


Fig. 2. The Automatic Die-sinking Machine engaged in an Operation on a Die

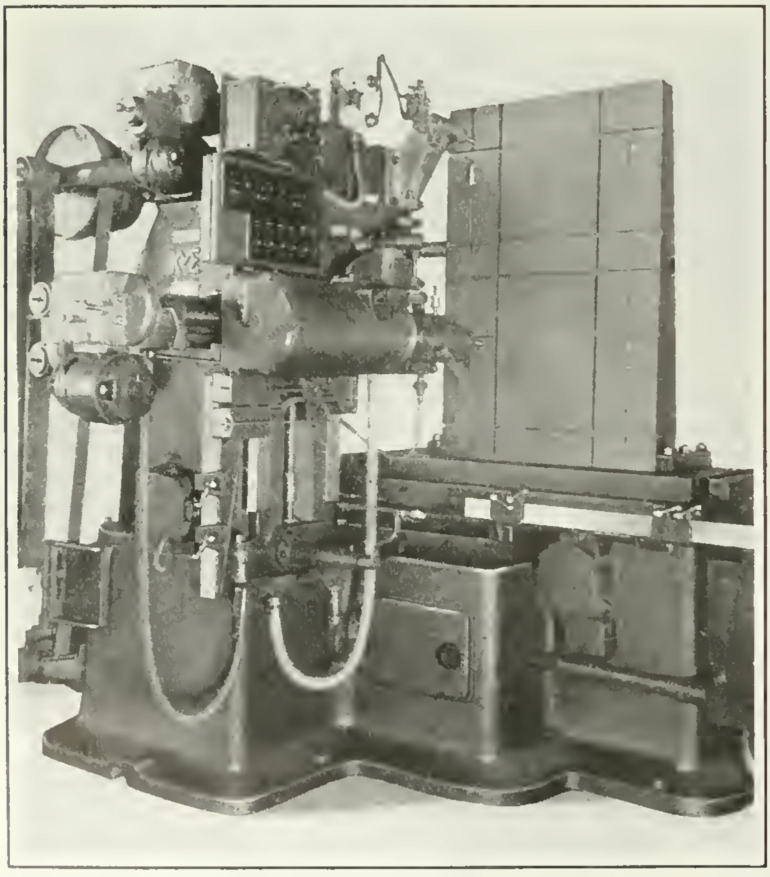


Fig. 1. Keller Type F Automatic Die-sinking Machine

The cutter is guided over the work and in and out by means of a tracer point which follows the outline and contour of a master placed directly above the work. This master may be made either of plaster, cement, or wood. Only a slight pressure is exerted against the master by the tracer, while at the same time sufficient pressure is applied to the cutting tool. The entire machine is controlled by a group of push-buttons, and it may be operated semi-automatically in addition to its automatic operation. Rectilinear motions in three directions are provided, these motions being obtained by means of lead-screws which operate the different slides. Automatic feeds are provided both vertically and horizontally and there is a quick return in both directions for the horizontal movement. There is also a contouring or profiling movement by means of which a templet, or the ridges or grooves of a master, may be followed.

When the work leaves the machine, it is in a condition that necessitates a minimum amount of hand work for finishing. In the case of dies and punches for sheet-metal work, most of the labor ordinarily required for fitting is eliminated, because even the allowance for stock thickness may be provided for in the master. The spindle head is carried on a wide vertical slide, the movement of which is controlled electrically. All slides are provided with taper gibs. There are two spindles, one slow-speed and one high-speed, and adjustments are provided on both to compensate for wear. The spindles are driven by a separate motor, direct-connected to a lower cone-pulley shaft at the rear of the column. The low-speed spindle is driven through a pulley which is connected by belt to the corresponding upper cone-pulley shaft.

Two interchangeable pulleys, 4 and 6 inches in diameter, respectively, are supplied. The low-speed spindle pulley with back-gears is mounted as a complete unit on the spindle head, and the high-speed spindle is driven from the low-speed spindle pulley shaft through a grooved pulley. There are eight speeds for the low-speed spindle through the back-gears, ranging from 80 to 324 revolutions per minute, and eight speeds through the open belt, ranging from 298 to 1212 revolu-

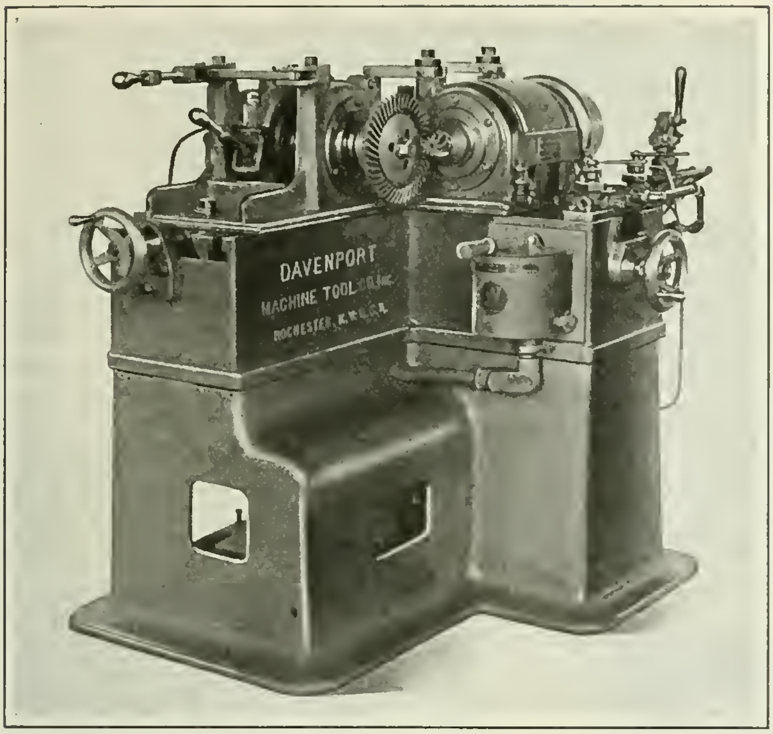


Fig. 1. Davenport Machine for testing Spiral-bevel Gears of All Sizes used in Automobiles

tions per minute, making sixteen speeds in all. There are also eight speeds for the high-speed spindle ranging from 894 to 3636 revolutions per minute. The spindles and their slide are lubricated from a sight-feed oil-cup, while the cutter receives lubricant from a gear-driven pump.

The control cabinet is a separate unit connected to the machine by wiring contained in a flexible conduit. The cabinet contains the main switches, motor starters, reversing switches, relays, drum controller, and motor-generator set. A series of push-buttons provides hand control for all movements of the machine. Some of the important dimensions of this die-sinker are as follows: Working surface of table, 53 by 22 inches; horizontal travel of table, 36 inches; speeds of table, from 1½ to 12 inches per minute; travel of vertical slide, 20 inches; feeding rate of vertical slide, from 0.010 to 0.830 inch per stroke; in and out movement of spindle head, 8 inches; floor space required, 9 by 8 feet; and height, about 6 feet 8 inches.

DAVENPORT SPIRAL-BEVEL GEAR TESTING MACHINE

Spiral bevel gears of all sizes used in automobiles may be tested by means of the machine illustrated, for bearing of the teeth, quiet running, and to determine the center distance at which mating gears run with the best bearing of the teeth and the least noise. This machine has just been brought out by the Davenport Machine Tool Co., 167 Ames St., Rochester, N. Y. The two gears to be tested are each mounted on the end of a spindle in headstocks placed at right angles to each other. Each headstock may be moved at right angles to its spindle through a dovetailed slide, which is provided with a taper gib. The headstocks have large bearing surfaces on the bed, and they may be clamped to these surfaces by bolts projecting from T-slots in the bed.

Inasmuch as there is usually but little adjustment required of the left-hand headstock, that is, the one on which the crown gear is mounted, this headstock is clamped to the bed by operating a lever attached to one of the holding-down bolts and having an adjustable connection to the second bolt. This arrangement permits quick tightening of the two bolts at the same time. The right-hand headstock, however, is moved quite a distance each time a gear or pinion is changed for testing, and because of this, provision has been made for quickly operating this headstock through the use of air pressure. A pneumatic cylinder is mounted on the back of the machine, as shown in Fig. 2, for this purpose.

After the slide has been drawn back a fixed distance and the pinion has been changed, the new pinion may be brought into mesh with the crown gear at exactly the same position as that in which the preceding pinion was tested or at any other position. The positioning of the pinion is controlled by the handwheel located underneath the right-hand headstock. This handwheel is provided with a graduated dial. Owing to the fact that the right-hand headstock is moved frequently, provision is also made for clamping it pneumatically. In addition to these time-saving arrangements, the machine is equipped with an air chuck to permit quick clamping of the pinion to be tested.

It will be seen from Fig. 1 that three air valves are located at the front of the machine. One of these valves is operated to clamp the work on the spindle, the second to slide the headstock forward to bring the pinion into mesh with the crown gear, and the third to clamp the headstock in the testing position. Reversal of these valve handles in the proper sequence will result in unclamping the headstock, moving the slide back to facilitate changing the pinion, and unclamping the pinion. Both headstock spindles have large Hess-Bright ball bearings at each end, and these are so arranged that the oil in the bearings is always kept at a certain height. The headstock spindles may be rotated in either a clockwise or a counter-clockwise direction. The machine is driven by a 3-horsepower alternating- or direct-current motor. The motor is mounted inside the base, and is so connected up that the correct tension is kept on the belt as the right-hand head-

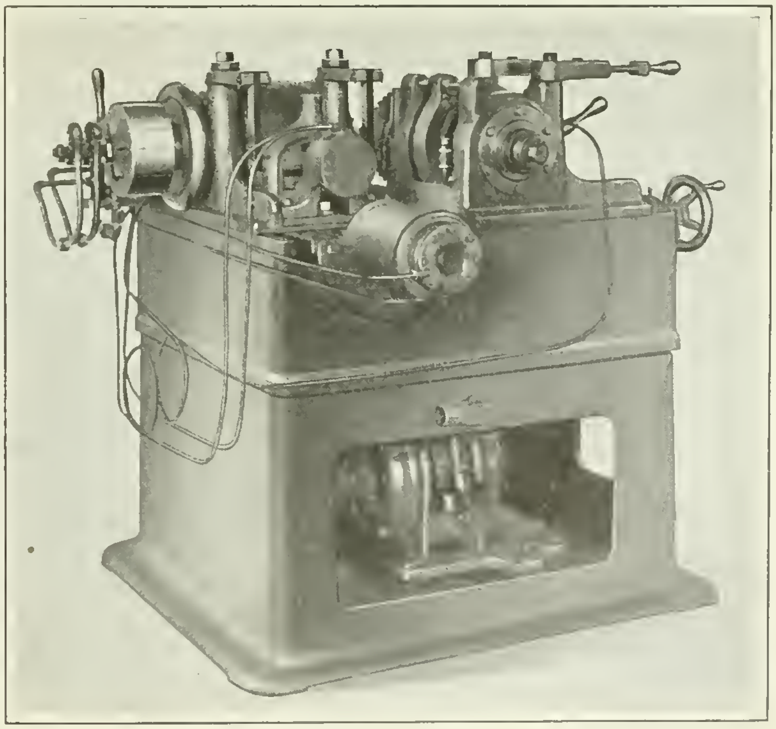


Fig. 2. View of the Gear Testing Machine showing the Location of the Motor and the Headstock Air Cylinder

stock slides back and forth. The exhaust from the air cylinder is piped to a brake band on the crown-gear headstock to cool the brake; however, water may also be circulated through the braking members for that purpose. The machine occupies a floor space four feet square, and weighs approximately 1500 pounds.

HOLMES TILTED THREADING MACHINE

Cap-screws, king bolts, spring clips, and similar parts, when produced in large quantities, can be threaded at high production rates by employing the six-spindle "tilted threader No. 3" shown in Figs. 1 and 2. This machine is a recent product of the Holmes Engineering Co., Oshkosh, Wis. By making a few additions and substitutions, the machine may also be arranged for tapping a large variety of parts, such as automobile steering-arm yokes and turnbuckles. The six spindles are placed at an angle of 30 degrees with the vertical, which prevents chips lodging in the self-opening die-heads and permits the use of self-clamping work-holding jigs. Twelve jigs are used, and these are fed in pairs of six to the die-heads, during which time the other six idle jigs are reloaded. A foot-treadle is used to bring the jigs to the die-heads, and thus the operator is able to employ both hands in reloading.

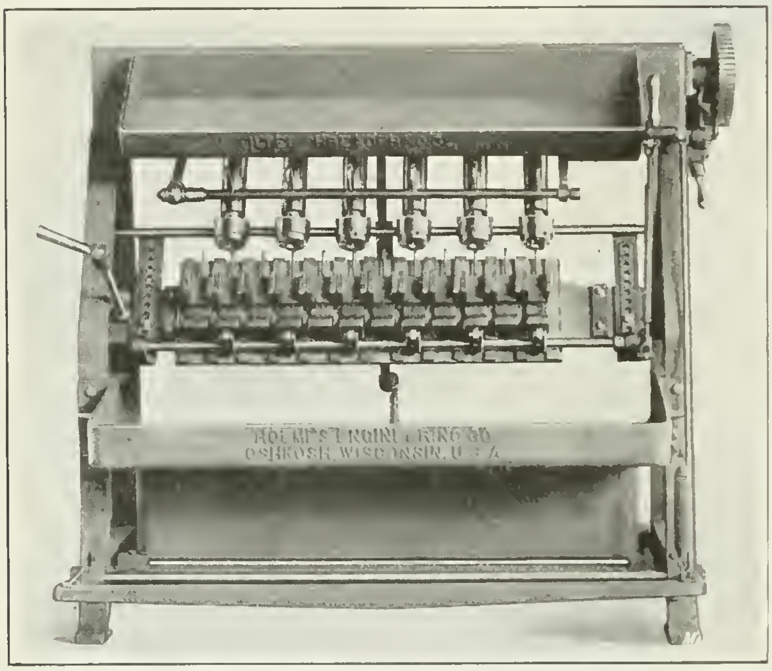


Fig. 1. Holmes Tilted Threading and Tapping Machine

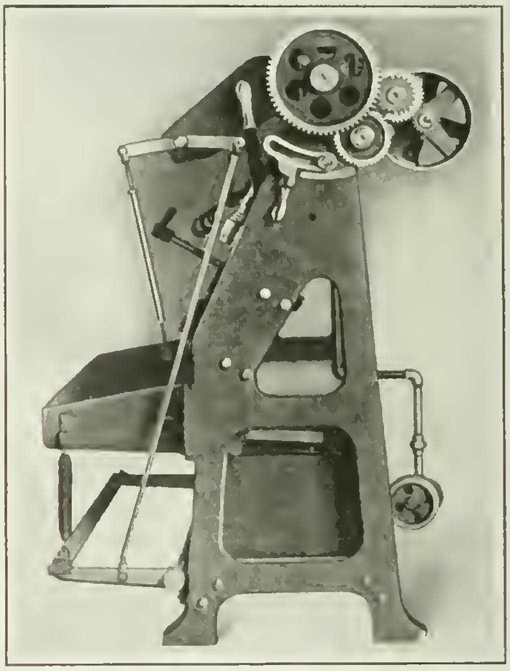


Fig. 2. End View of the Machine shown in Fig. 1

The jigs are mounted on a carriage which is slid either to the right or the left, as the case may necessitate, at the end of a threading operation, in order to bring the new pieces of work in the previously idle jigs, into alignment with the die-heads. The jigs are fed through the medium of rollers which are swiveled with the shaft running the length of the machine along the back of the jigs. This shaft is given a rotary movement when the foot-treadle is depressed. When the pieces have been sufficiently engaged by the die-heads, the jigs are pulled forward by them until the die-heads are opened, at which time the jigs, by their own weight, fall back into a neutral position. The handling of long and short work is provided for by two brackets one at each end of the roller shaft, which support this shaft. These brackets have a series of holes that permit a variation in the distance between the die-heads and the roller shaft.

Four changes of speed are obtainable through change-pinions, and right- and left-hand threads can be cut. Lubricant is supplied to each die-head from a rotary pump through individual pipes. Bronze bearings are used throughout, and all thrust points are relieved by grooved ball races. A work shelf, large enough to accommodate two tote boxes, is located just above the spindles. The inclination of this shelf brings the parts to be machined within easy reach of the operator. The machine has a threading capacity up to 1-inch U. S. standard or 1¼-inch S. A. E. standard threads.

When arranged for tapping, the taps are held in spring collets, and an attachment is added to the top of the machine. The taps are automatically reversed and returned at twice the cutting speed, whether cutting right- or left-hand threads. This reversal may be made at any depth of tapping. The machine taps threads up to ¾ inch U. S. standard or 1-inch S. A. E. The production on externally threaded work is from 1200 to 2000 pieces per hour, and on tapped holes, from 1000 to 1500 pieces per hour.

BAIRD SIX-SPINDLE CHUCKING MACHINE

Castings, forgings, and cut-off bar stock pieces which can be held in a chuck while being machined may have a number of operations such as turning, facing, chamfering, drilling, boring, reaming, and threading, performed simultaneously on five pieces by employing a six-spindle chucking machine now being introduced to the trade by the Baird Machine Co., Stratford Ave., Bridgeport, Conn. The machine handles work up to 6 inches in diameter by 6 inches in length, and might be classified as an "automatic lathe for short pieces." The pieces of work are held by chucks on a turret which indexes to bring each piece successively into position for being operated upon by each set of tools. One piece is finished per turret revolution. The finished part is replaced by an unfinished part, when it reaches the idle position at the front of the machine.

As the finished part reaches this position, the machine automatically stops, so that inattention on the part of the operator will not result in the work going twice through the cycle of operations. However, the machine need not stop for replacing the finished work, and so it can be set to run without stopping, on jobs where it might be more economical to have that arrangement. As many as fifteen tools can be mounted on the main tool carriage, which is fed forward to the work, and three tools can also be held on each of the two cross-slides at the front and rear of the machine, making a total of twenty-one tools which can be employed on the machine at one time.

The machine is driven through a single pulley, and when this pulley is run at a speed of 800 revolutions per minute,

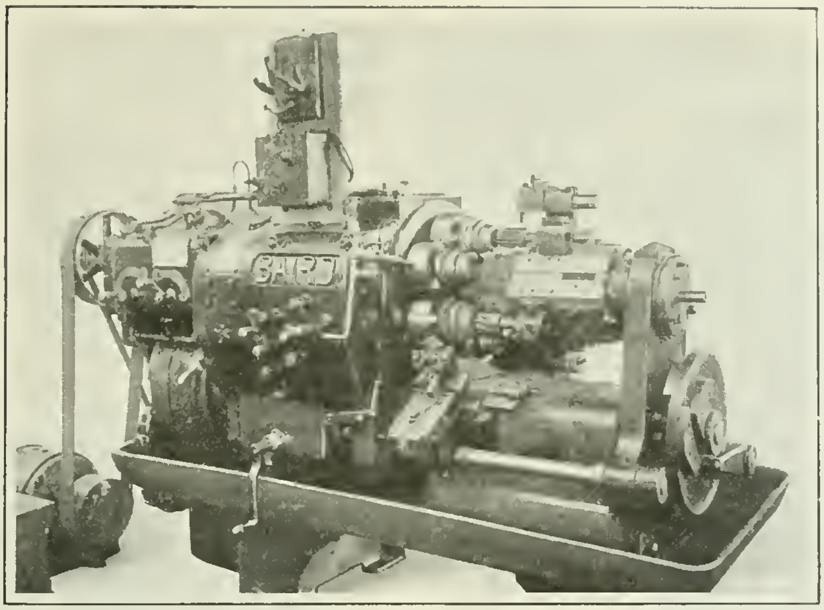


Fig. 1. Baird Chucking Machine for machining Small Castings, Forgings, etc.

the minimum spindle speed obtained through the medium of sliding gears, shifted by means of hand-levers on the housing near the pulley end of the machine, is 28½ revolutions per minute, while the maximum speed is 440 revolutions per minute. Spindle speeds between the minimum and maximum limits are obtained through eight possible combinations of the gears and three of the spindles, thus giving a total of twenty-four speeds. By means of this arrangement, the different spindles may at any time be revolved at three speeds. For example, if it should be required that one spindle operate at twenty revolutions per minute, each of the four remaining spindles might be operated at a speed of either twenty, thirty or forty revolutions per minute.

There are seventeen feeds for the tools, which are also quickly obtained through hand-levers on the main housing. The minimum production rate with the driving pulley running at 800 revolutions per minute is one piece every nine minutes, and the maximum rate is 2 2/3 pieces per minute. The spindle speeds and tool feeds are selected to give the maximum production for the particular job; thus a hole of small diameter can be bored at high rates of speed and feed, while at the same time the outside surface can be turned at the best feed and speed for that operation. The spindles may be adjusted independently to suit conditions. Each spindle is driven through a clutch which is disengaged during the indexing movements of the work-holding turret. The chucks may be replaced by special fixtures when necessary.

The main tool carriage has a separate slide for each station of the turret, and there is always a choice of two lengths of feed for the slides. The tool-holders are interchangeable. During the setting of a machine for a given job, the relation of the various movements may be determined by turning a hand-crank, which may be employed at either the front or rear of the machine. All operating levers are located at the front to afford a convenient control. Lubricant is supplied to the work by a power-driven pump. The machine occupies a floor space of about 8 by 4 feet, and weighs approximately 8500 pounds. When the machine is motor-driven, a motor of five horsepower is required.

BEARD INSIDE MICROMETER AND HEIGHT GAGE

A self-aligning and centering inside micrometer and height gage is being placed on the market by the L. O. Beard Tool Co., Lancaster, Pa. This instrument is especially applicable for determining the diameter of automobile cylinder bores. As shown in the illustration, the micrometer is held in the bushing of an aligning base, which can be moved along the walls of a cylinder by means of a wire handle. The micrometer body is a sliding fit in the bushing, thus permitting adjustment to be made for determining the diameter of different sized holes. The fit is such that the base can be slid forward on the micrometer body after a reading, so that the instrument can be tilted to facilitate its removal from a hole without altering the setting. After the micrometer has been placed in a cylinder, the mechanic bears down on the aligning base to cause the tool to center itself accurately. The spindle is then

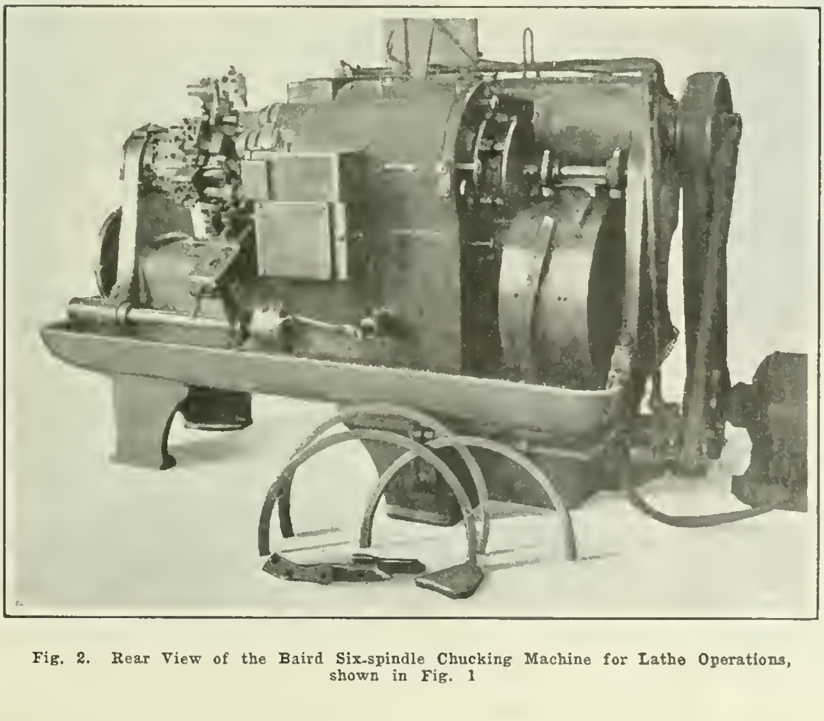


Fig. 2. Rear View of the Baird Six-spindle Chucking Machine for Lathe Operations, shown in Fig. 1

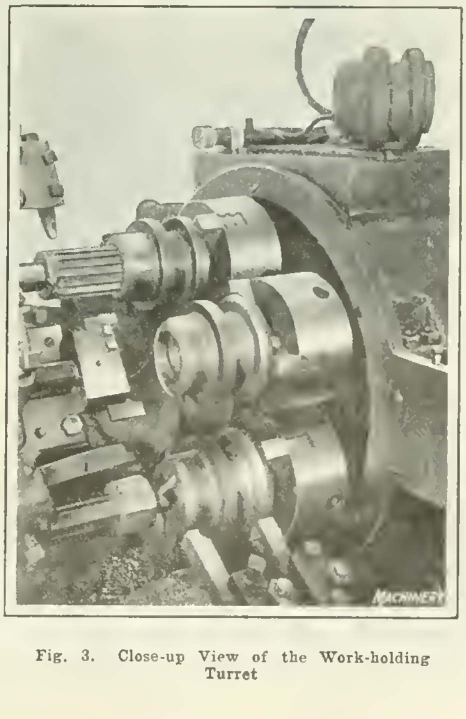
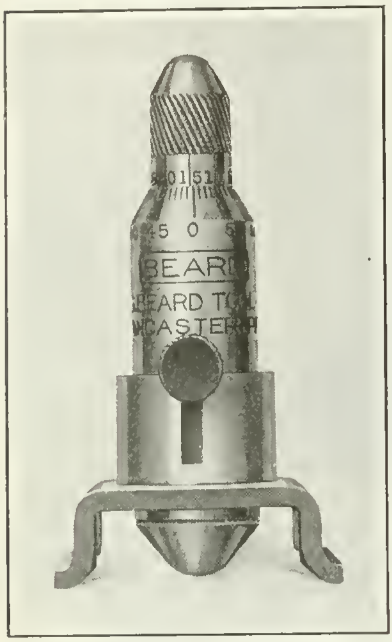


Fig. 3. Close-up View of the Work-holding Turret

screwed out by turning the knurled end until the point opposite the base touches the cylinder wall. The spindle is next locked by means of the clamping screw to retain the setting, and the instrument is then tilted, as previously stated, and removed from the cylinder.

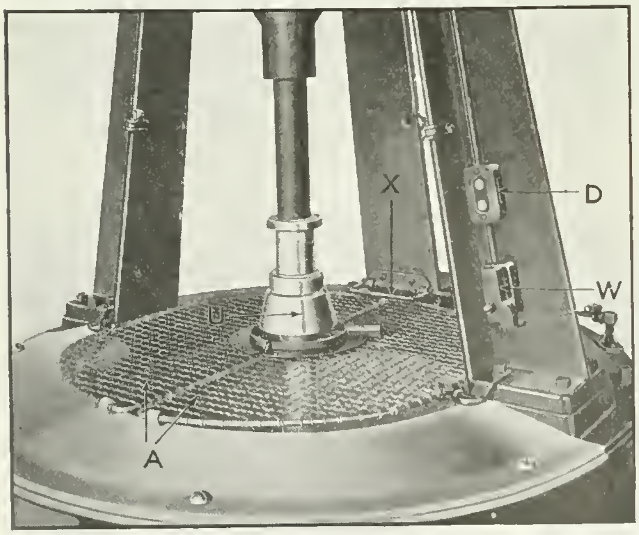
The micrometer gives a direct reading in thousandths of an inch, one complete revolution of the spindle causing the screw to move 0.050 inch. The reading is always given at two different places as a check. For instance, when 25 on the spindle is in line with 0 on the barrel, if the micrometer is turned half way around, the figures will be found to be reversed, that is, 25 on the barrel will be in line with 0 on the spindle. A ring at the bottom of the micrometer prevents it from dropping out of the base while in use. Both ends of the micrometer and the parallel edges of the base are hardened and ground.



Beard Self-aligning Inside Micrometer and Height Gage

TOLHURST CENTRIFUGAL EXTRACTOR GUARD

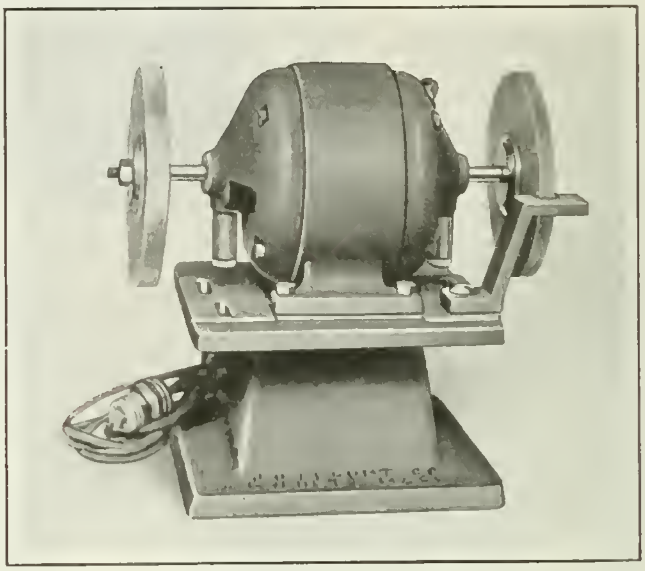
Centrifugal extractors, built by the Tolhurst Machine Works, Troy, N. Y., may now be equipped with a guard which is so interlocked with the driving mechanism of the machine that power cannot be applied until the guard is completely closed. It is also impossible to open the guard while the machine is in operation. This guard is applicable to both belt- and motor-driven extractors. The accompanying illustration shows the installation of a guard on a motor-driven machine, which is started and stopped by means of the push-button switch *D*. Interlock *W* is connected with loop *X* in such a manner that the switch is inoperative until the guard sections *A* are completely closed. Consequently the motor cannot be started before the guards are closed. Lock *U* prevents opening of the guard until the basket has come to a full stop. It will be seen that this lock is so small that it offers no interference to the reloading of the basket.



Wire Safety Guard for Tolhurst Centrifugal Extractors

BLOUNT COMBINATION GRINDER AND BUFFER

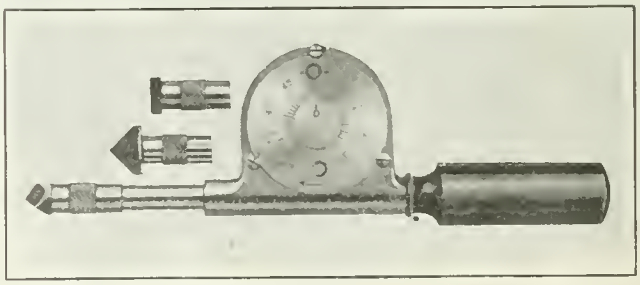
For grinding tools, smoothing small castings and numerous other applications in machine and repair shops, garages, etc., the J. G. Blount Co., Everett, Mass., is introducing to the trade a small plain-bearing motor-driven combination grinder and buffer. This machine is built for operation by either alternating or direct current. It is equipped with a Westinghouse 1/4-horsepower motor running at a speed of 1800 revolutions per minute. The wheel flanges are machined all over to insure balance. Guards may be furnished for both sides for use with grinding wheels, and two tool-rests may also be supplied. A pan supports the guards and the rests. The buffing wheel shown on the left-hand side of the motor is 7 inches in diameter by 3/8 inch thick, while the grinding wheel is 6 inches in diameter by 1/2 inch thick.



Blount 1/4-horsepower Combination Grinder and Buffer

BROWN & SHARPE SPEED INDICATOR

An indicator which registers up to 5000 revolutions in increments of five revolutions, although speeds in excess of 5000 revolutions per minute may be determined, has been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. This indicator accurately determines the speed of shafts rotating in either direction, and measures high and low speeds equally well. Readings are taken from one side, the two arrows on the face of the dial indicating which figures to use for the two directions of rotation and thus eliminating confusion. The figures appearing at the small holes of the dial each show five revolutions direct, and the

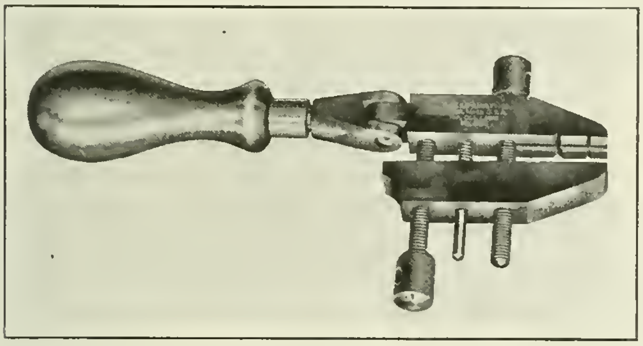


Brown & Sharpe No. 748 Speed Indicator

small inside dial indicates every 100 revolutions. This dial is quickly turned to zero for repeated use by means of a knurled knob on the back of the instrument. Three contact points are furnished—a steel point for ordinary speeds, and rubber points for high speeds. The fiber handle provides an insulation against electricity.

STARRETT HAND VISE

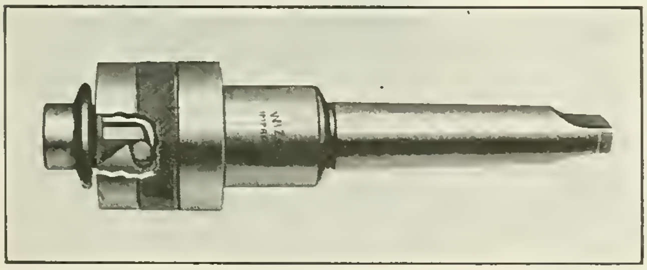
For holding small work conveniently in speed lathes and under drilling machine spindles while performing such operations as lapping or drilling, the L. S. Starrett Co., Athol, Mass., is placing on the market the hand vise shown in the accompanying illustration. This vise will hold work up to 1 inch in diameter or thickness, and the depth from the end of the jaw to the first screw is 1⅛ inches. Three V-grooves facilitate the clamping of round work. The handle may be adjusted to any position within 180 degrees, which is a feature that is of importance in many applications of the vise. A spring and rod prevent the adjustable jaw from dropping or sliding when the clamp is being opened or closed. The over-all length of the vise is 7½ inches, and its weight is 12 ounces. All the steel parts are casehardened.



Starrett Vise for holding Work in a Speed Lathe or Drilling Machine

McCROSKY QUICK-CHANGE DRILL CHUCK

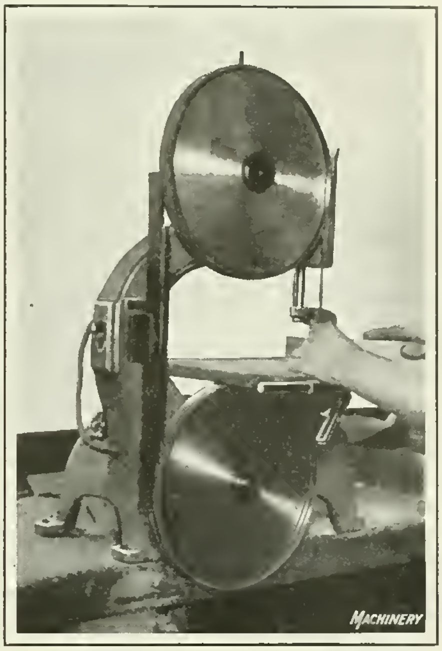
Easier operation of the "Wizard" quick-change drill chuck manufactured by the McCrosky Tool Corporation, Meadville, Pa., has been made possible by a number of improvements recently incorporated in its design. The chuck consists of two main parts, a driving body having a Morse taper shank for fitting into the socket of drilling machine spindles, and a collar for holding the collet in the driving body. Bayonet locking slots in the collar admit driving lugs on the collet, the design being such that the collet can be inserted or released with one hand without stopping or slowing up the rotation of the machine spindle. To insert a tool, the operator merely pushes the collet into the revolving body, and to release it he presses slightly on the knurled collar with his thumb and forefinger. The illustration shows the collet locked in place. The collar is hardened all over and is made straight to facilitate handling.



"Wizard" Quick-change Drill Chuck of Improved Design

JARVIS BENCH BAND SAW

A band saw intended for general application in pattern shops and manual training schools is here illustrated. This band saw is manufactured by Benjamin E. Jarvis, Inc., 113 Mechanic St., Newark, N. J. It may be bolted to a bench or left fastened to the bottom of the crate in which it is shipped, for portable use. The machine is supported by a one-piece cored casting which is designed to minimize vibration. The wheels over which the band saw runs are 12 inches in diameter, and have a 1-inch face. They are each made from two steel disks, riveted together, and are mounted on ball bearings. The band saw is furnished with top and bottom roller guides, which revolve on hardened centers.



Jarvis Bench Band Saw, which is also adapted for Portable Use

Current for driving the ¼-horsepower motor may be supplied from any electric light socket. The motor is started and stopped by means of a push-button switch located on the machine frame. The table is 13½ inches wide, 15 inches long, and may be tilted to any desired angle. The machine is designed to handle stock up to 2 inches in thickness, but it may be used for stock up to 3 inches in thickness. It is 28 inches high and weighs about 120 pounds. Special bands are furnished when it is desired to cut light metal or fiber.

EXPANDING PLUGS

With a view to lessening the tool-room costs of making jigs, punches, dies, master plates, and similar parts, the Expanding Gauge Co., 716 Reibold Bldg., Dayton, Ohio, is introducing to the trade a set of twenty-four expanding plugs which have a wide variety of applications. Each plug has six pins, which are placed radially in pairs of three, with their inner ends bearing on a taper shaft at the center of the plug. A screw is attached to one end of the taper shaft, and on this screw is mounted a nut. By means of the screw and nut the taper shaft may be adjusted longitudinally to cause the pins to expand or withdraw.

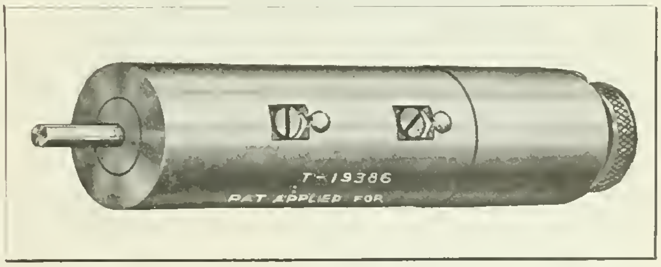


Fig. 1. One of a Set of Twenty-four Expanding Plugs made by the Expanding Gauge Co.

These plugs are especially valuable in accurately checking the center-to-center distance between two holes. A plug

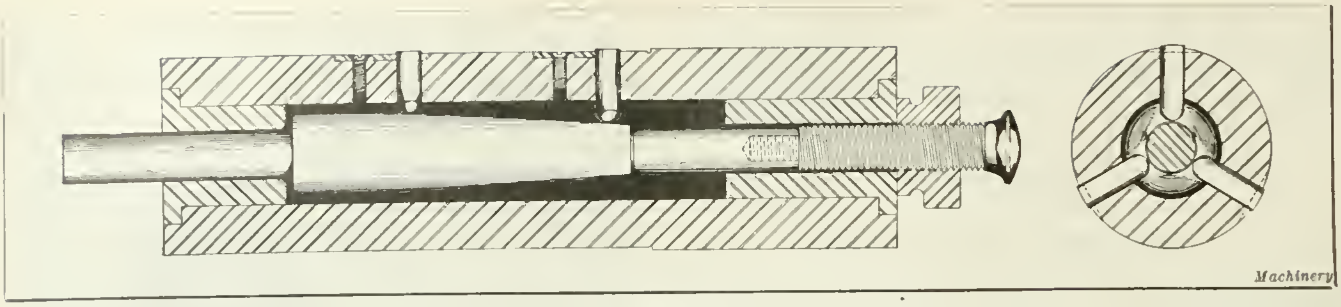
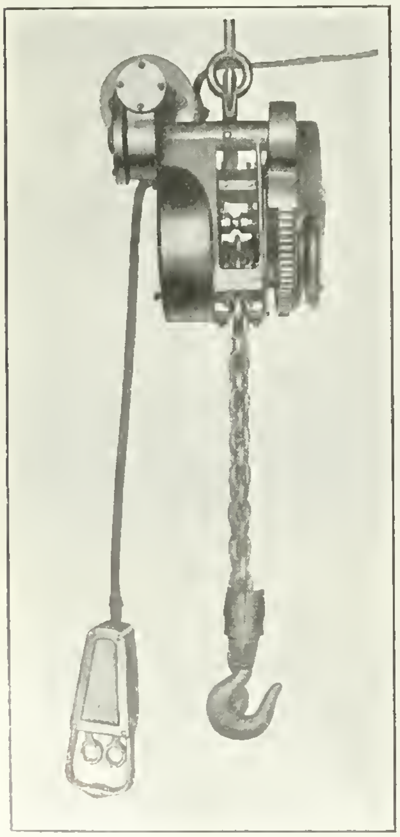


Fig. 2. Cross-sectional View, showing the Construction of the Expanding Plugs

is inserted in each hole, and the pins expanded until the plug fits the hole as desired, after which a vernier caliper or micrometer reading is taken over the two plugs. The diameter of a hole may also be determined by expanding the pins and measuring the expanded diameter after the plug has been removed from the hole. These plugs eliminate the necessity of making soft temporary plugs for determining the center distance between holes, and of making solid plug fits. The full set of twenty-four plugs provides for measuring and fitting 1248 holes, varying from 0.498 to 2.0005 inches in diameter. The 1-inch plug, for instance, will fit holes from 0.998 to 1.063 inches, varying by increments of 0.0001 inch. The total expansion on the smaller sized plugs is 0.0352 inch, and on the larger sizes 0.065 inch.

MOTORBLOC CHAIN HOIST

A chain hoist having a motor that drives through reduction gearing and a friction clutch is now being manufactured in various sizes with capacities of from 1/4 to 10 tons, by the Motorbloc Corporation, Summerdale, Philadelphia, Pa. This equipment is intended for service intermediate between that of the overhead crane and the hand hoist. The motor and other driving members are attached to the hoist proper by a malleable iron bracket, and thus comprise a self-contained driving unit, which is started and stopped through a pendant controller. As only one hand is necessary to operate this controller, the other hand is always free to guide the work being lifted. Electric current may be supplied to the motor by plugging into the nearest circuit connection.



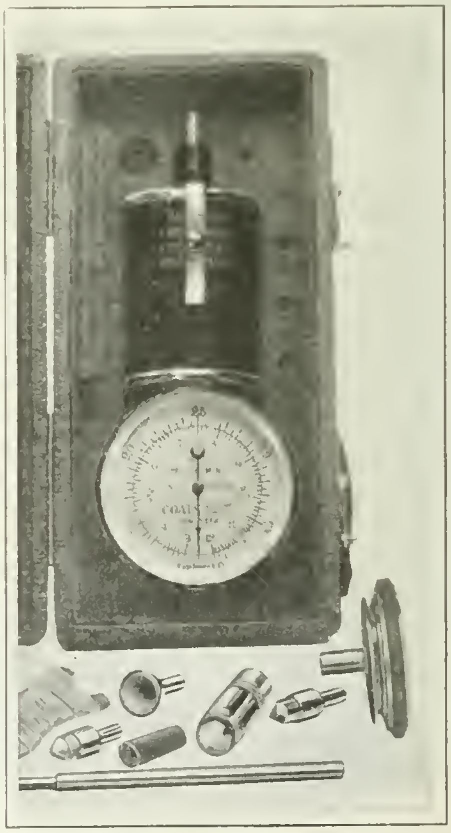
Motorbloc Chain Hoist

Care was taken in designing the hoist to make it compact and well balanced. It is said that by using high-grade materials strength has been obtained with lightness, the weight of the one-ton size being 148 pounds. The armature shaft and worm are carried in heavy-duty ball bearings, and supplied with automatic lubrication. The friction clutch is of the ring-oiled type; it prevents damage from over-running of the hoist, and also protects the motor from overload. It is claimed that by means of this hoist one man can handle parts that ordinarily require two or three men to lift and place. When electric current is not available, a hand chain can be quickly applied to operate the hoist as an ordinary block. Although regularly furnished with a complete hoist, the self-contained driving unit can also be readily applied to standard chain hoists.

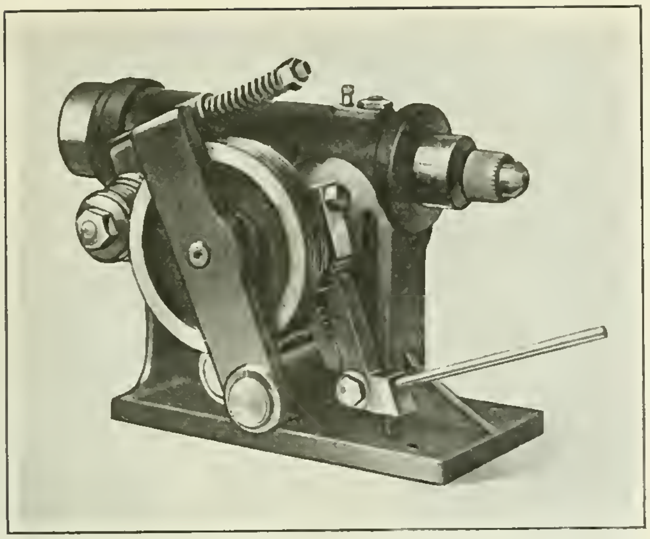
COATS HAND TACHOMETER

A hand tachometer designed on the pendulum or governor principle and having a mechanically operated level which indicates whether or not the instrument is being held in horizontal alignment with the shaft being tested, is being placed on the market by the Coats Machine Tool Co., Inc., 112 W. 40th St., New York City. The instrument is so balanced, however, that it may also be used when held vertically. The number of revolutions per minute of a member is read directly on the dial. A rubber-bound cutmeter wheel having a circumference of 6 inches is used in determining the surface speed of a member, in which case the dial reading is divided by 2 in order to find the speed in lineal feet per minute.

A damping mechanism eliminates vibration, and it is said that magnetic or electrical influences, or moisture and temperature changes do not affect the accuracy of the instrument. A steel coupling is used in determining speeds up to 200 revolutions per minute and a rubber coupling for greater speeds than this. An extension bar is provided for use in determining the speed of an internal surface or part. This tachometer is made in three- and four-speed types for determining speeds from 30 to 16,000 revolutions per minute. The instrument illustrated is of the four-speed type. Both types weigh about one pound and are small enough to fit the palm of the hand.



Coats Hand Tachometer



Kingsbury Ball-bearing Automatic Sensitive Drill Head, which may be used Singly or in Groups

KINGSBURY AUTOMATIC SENSITIVE DRILL HEAD

An automatic sensitive drill head which may be employed in connection with a work-holding fixture to obtain high production rates on small work has been brought out by the Kingsbury Mfg. Co., Keene, N. H. Several of these heads, one of which is here illustrated, may be mounted on a bench and tended by one operator when they are used for single-hole drilling. The operation of the head is simple; the attendant merely places the work in position, clamps it and then presses the trip-lever to release the spindle-feeding mechanism. On such a job as drilling six or eight oil-holes in a piston, the holes can be drilled simultaneously by spacing the drills properly about a circle and connecting a 1/4-horsepower motor to each. The trip-levers in such an installation should be connected to one foot-treadle so that the spindle-feeding mechanism of all the heads will be released by one motion of the operator.

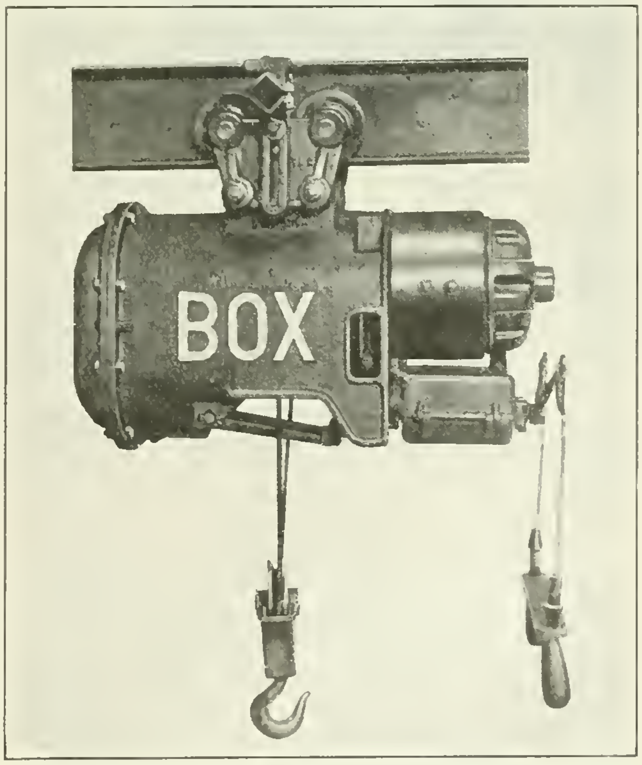
An automatic sensitive feed for the spindle is furnished by combining a cam with friction gears. The driven gear is mounted on a lever, and held in mesh with the friction driving roll or gear by an adjustable compression spring, the cam being cut on the inside of the driven gear. A follower roller is mounted on a gear segment, which meshes with a second segment clamped to the feed-shaft. The compression spring applies pressure to the drill spindle through the cam to the follower, and thence through the gear segments to the feed-shaft and quill. The cam is revolved by the friction gears and feeds the spindles forward under pressure. When this forward motion is resisted, as when the drill strikes the work, the follower roller is held momentarily and the rotation of the gears causes the cam to climb on the roller, thereby separating the friction gears and allowing them to slip.

As the drill penetrates the work under pressure, the follower gives way, bringing the friction gears into tight contact and causing the cam to revolve and again separate the friction gears when further resistance is met. However, this intermittent motion is not perceptible, the action being rapid and smooth. The standard cam gives a one-inch stroke to the spindle with a maximum feed of 0.011 inch per revolution, and there is a spindle adjustment of two inches. The drill is permitted to approach the work and break through at a comparatively rapid rate of feed, yet slowly enough to prevent injury to the drill. The actual drilling feed depends on the pressure adjustment, the hardness of the work, and the condition of the drill. Special cams with one or two reliefs may be used to permit the withdrawal of the drill during the operation so that chips can be removed. The cam may be cut on the outside of the friction gear for operating indexing and other automatic fixtures. This cam must be designed to function only during the idle or non-drilling time of the head; otherwise, the sensitiveness of the spindle feed would be impaired. This drill head is intended to receive drills from No. 60 to 1/4 inch. It is regularly furnished with a No. 7 Jacobs chuck.

BOX "LOAD LIFTER" ELECTRIC HOIST

An electric hoist which is rated to lift a load of 1000 pounds on a two-part line at a speed of 20 feet per minute, or a load of 500 pounds on a single-part line at the rate of 40 feet per minute, is now being placed on the market by Alfred Box & Co., Inc., Philadelphia, Pa., under the trade name of "Load Lifter." A feature of this hoist is that the trolley, which runs on the lower flanges of an I-beam, may be attached to the hoist as shown in the illustration, to bring the hoist parallel with the I-beam, or it may be mounted to bring the hoist at right angles to the I-beam. The trolley may also be replaced by a hook suspension. All these changes are simply effected. The trolley is adjustable so that the hoist may be used on 5-, 6-, 7-, 8- or 9-inch standard I-beams.

Attention is called to the compactness of the design, the hoist being only 28 inches long by 11 inches wide. Another point of interest is that the hoist is automatically lubricated from one point by a combination of the splash and forced-feed systems. It is only necessary to pour oil into the hoist about once every six months. The equipment is fully enclosed, all parts operating in oil-tight dust-proof cases. Because the motor and controller are totally enclosed, the hoist may be installed anywhere. Hyatt flexible roller bearings are supplied everywhere except for the motor bearing where the S K F self-aligning ball bearing is used. All gears have stub teeth, are made of forged steel, and are heat-treated, and all shafts are made of manganese steel. The controller is built especially for the hoist and is basically of the drum type. It has non-arcing fingers, and is insulated with bakelite. The controller cover is hinged to facilitate inspection, and a terminal block is built in the controller to make wiring easy. The hoist has a drum that accommodates about eighty feet of rope.

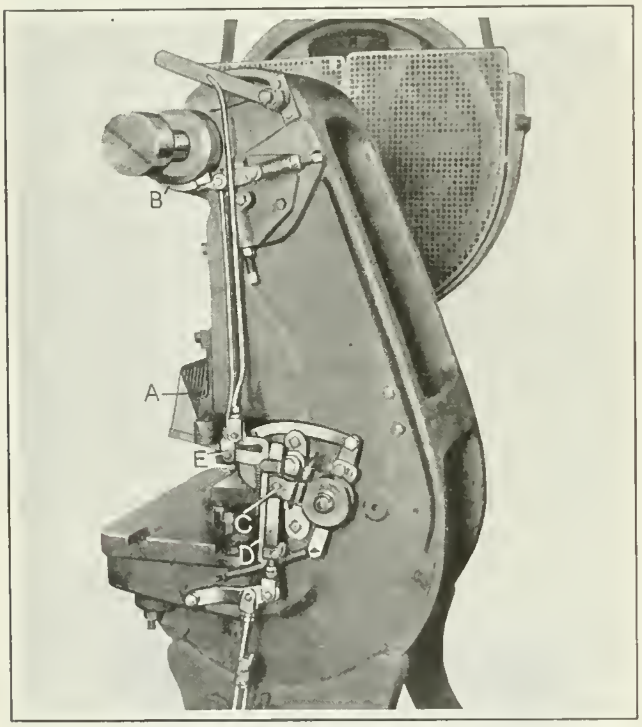


Box "Load Lifter" Electric Hoist, which will lift 1000 Pounds at the Rate of 20 Feet per Minute

KARTZMARK POWER PRESS GUARD

One of the exhibits that attracted considerable attention at the machine tool exhibition held recently at Yale University was a power press operated by a blind man. The safety of the operator was insured by having the press equipped with a Kartzmark safety guard, which is manufactured by the Standard Safety Mfg. Co., 263-265 Park St., New Haven, Conn. The accompanying illustration shows this guard installed on a machine which has the flywheel temporarily removed to give a complete view of the guard mechanism. When the operator depresses the machine treadle to actuate the ram, the fender or housing *A* is lowered around the die-block, and this housing must be permitted to go all the way down before the press can function.

When the housing is completely lowered, latch *B* is operated through mechanism *C* and permits the ram to make a stroke. However, should the hand of the operator be on the die, it would interfere with the lowering of housing *A*, and as latch *B* then would not be released, the ram could not go down, and thus the operator would not be injured. After latch *B* has been pulled, a cam on the flywheel shaft holds the latch down until the ram has completed its stroke. Then a second cam on the flywheel shaft disconnects the treadle through latch *D* and draws member *E* back into position to relock the press. As the entire mechanism is operated automatically by cams, the operator has both hands free to insert and remove the work. An adjustment provides for limiting the upward movement of housing *A*, and there is another adjustment to suit dies of different heights. This guard mechanism does not interfere with tilting of the press.



Power Press equipped with Kartzmark Safety Guard

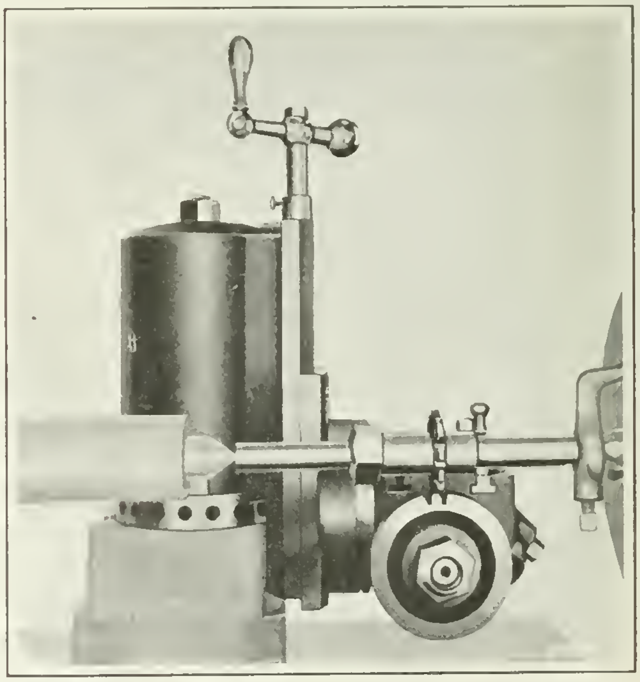
WIESMAN POWER PRESS GUARD

Several improvements have recently been made to the power press guard manufactured by the Wiesman Mfg. Co., 14 N. Canal St., Dayton, Ohio, of which a complete description was published in May, 1920, MACHINERY. On a power press equipped with this guard the eccentric movement of a pin attached to the crankshaft bearing cap causes a swinging arm to sweep directly past the die, and pushes away the operator's hand, should he neglect to remove it from the die-block. The most important of the improvements is the addition of two shock absorbers, which eliminate any vibration that might otherwise result as the swinging guard reaches the ends of its arc. An extra brace has been provided for the guard arm so that it is now supported at four points. The main bearing of the guard has also been enlarged, and the end of the swinging member, which contacts with the arm of the operator, is now provided with a molded piece of rubber, instead of the ordinary rubber tubing formerly supplied.

Wiesman Power Press Guard to which Several Improvements have been made

GARRETT LATHE MILLING ATTACHMENT

A patented attachment known as the "millerette converter," which has been developed for application on lathes to enable milling operations to be performed, but which may also be mounted on planers, shapers, and drilling machines, is now being placed on the market by the Production Machine Tool Co., 629 E. Pearl St., Cincinnati, Ohio. The device is built in three sizes for lathes from 12 to 24

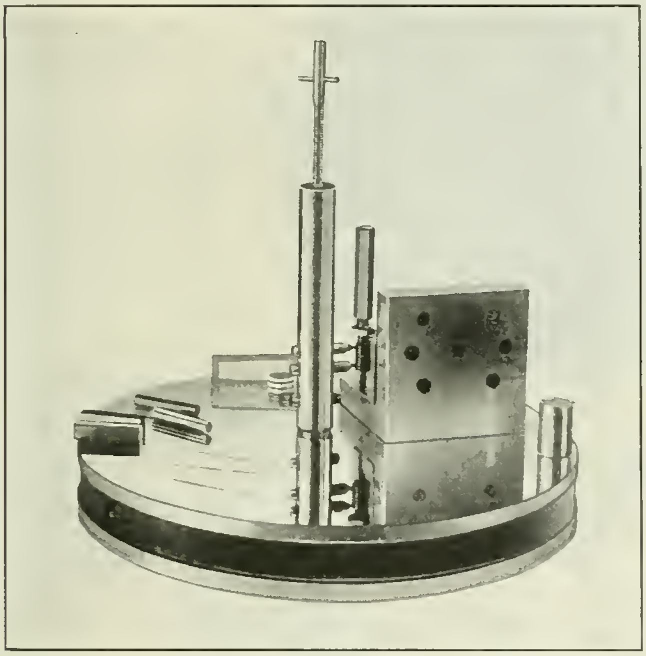


Garrett "Millerette Converter" which may be applied to Various Machine Tools inches swing. The work is mounted on the spindle of the device, and the cutter is carried on an arbor held between the headstock and tailstock centers of the lathe. Thus the lathe provides longitudinal and cross feeds for the cutter, while the work may be fed vertically by operating the slide of the attachment by means of a handle at the top.

The attachment has a dividing head, which permits such operations to be performed as the cutting of spur and bevel gears, surface milling, angle-cutting, splining, and keywaying. The dividing head is operated through change-gears which may be quickly set up, only two gears being used at one time. An index-plate shows what gears should be used, and gives the required number of turns of the index-handle to obtain any division from 2 to 360. The attachment fits the toolpost slot in the top slide of the compound rest of the lathe, and is quickly clamped in position. When attached to a drilling machine, the attachment enables the accurate drilling of holes and when used on a planer or shaper, it serves the same purpose as a dividing head.

VAN KEUREN STEEL SURFACE PLATES

The high degree of polish on the lapped surface of a new line of hardened steel surface plates being introduced to the trade by the Van Keuren Co., 361 Cambridge St., Allston, Boston, Mass., will be evident from the accompanying illustration, in which the reflections of parts lying on the lapped surface are as distinct as the parts themselves. At first glance it would seem as if in each case two identical parts were resting on each other. These surface plates are inspected during their manufacture by means of light waves. Gage-blocks may be wrung directly on the lapped surface. The plates are made in three sizes—5, 8, and 10 inches in diameter, respectively. They may be furnished with two handles, which are screwed into the edge of the plates, and also with a wooden box to protect the precision surface.



Van Keuren Steel Surface Plate

NEW MACHINERY AND TOOLS NOTES

Motor-driven Tool Grinder: Forbes & Myers, 178 Union St., Worcester, Mass. A Model 75 tool grinder of the same design as the Model 76 described in July MACHINERY. The new model, however, is arranged for single-phase current, whereas the former model is intended for two- or three-phase current. The grinding wheels are so mounted that they may be worn three-quarters away before the periphery comes into line with the front of the motor. The wheels are 6 inches in diameter, and 3/4 inch thick.

Roller Bearing: Whitney Bearing Corporation, 467 E. Ontario St., Chicago, Ill. A roller bearing in which the rolling action is obtained by means of disks. The rollers operate between parallel taper surfaces, the construction being such as to eliminate end thrust and the accompanying friction, which occur when taper rollers are used. The load is transmitted to the face of the roller only in a direction perpendicular to the axis of the roller. The series of rollers are carried in separate ring cages, as the rollers near the apex of the cone travel faster than those near the base. An adjustable spring permits just the right pressure to be exerted to keep the bearings in complete contact.

Portable Electric Grinding Machines: Saphil Electric Tool Co., Galesburg, Ill. A portable electric internal and external grinder, designed for attachment to various types of machine tools, including the lathe. This company has also brought out a portable electric valve grinder, in which the motor is held above the spindle on two supports, and drives the spindle through a belt. The motor can be raised or lowered on its supports. The wheel-slide base can be accurately adjusted by a micrometer screw having a dial graduated in thousandths of an inch. Both grinders are supplied with an extension for internal operations. The sales agent is the General Tool & Equipment Co., Chicago.

Inclinometer: Stevens-Prentice Mfg. Co., 377 National Ave., Milwaukee, Wis. A device intended for use in reading and checking bevels, angles, and levels. This instrument obviates mathematical calculations in determining or laying out angles. It has an aluminum housing which is mounted on a semi-steel base and carries a graduated dial. A vernier pendulum is pivoted at the center of the dial. The vernier is read in the same manner as the ordinary vernier caliper. A small brake can be employed to stop the oscillation of the pendulum and hold it stationary while taking a reading. The instrument may be held in any position for taking a reading, because the dial is graduated throughout its full circumference.

Power-feed Hollow-chisel Mortiser: Oliver Machinery Co., Grand Rapids, Mich. A hollow-chisel mortiser, somewhat larger than a machine of the same type described in October, 1921, MACHINERY, which is equipped with a power feed combined with a motor in the head. The power feed is controlled by a foot-lever, being brought into action by a belt tightener which, when released, brings a brake into action on the rim of the driving pulley. A ratchet holds the lever down for continuous operation. The power feed furnishes three stroke speeds of 18, 26, and 36 per minute through cone pulleys and a feed-belt shifter. By throwing out the ratchet, the continuous feed mechanism can be stopped instantly, and the machine operated by single strokes. Another feature is a rotary fan or blower direct-connected to the motor and placed directly above it. This motor is mounted on a shaft of the machine and furnishes a constant air blast for cooling the tools and keeping the work free from chips.

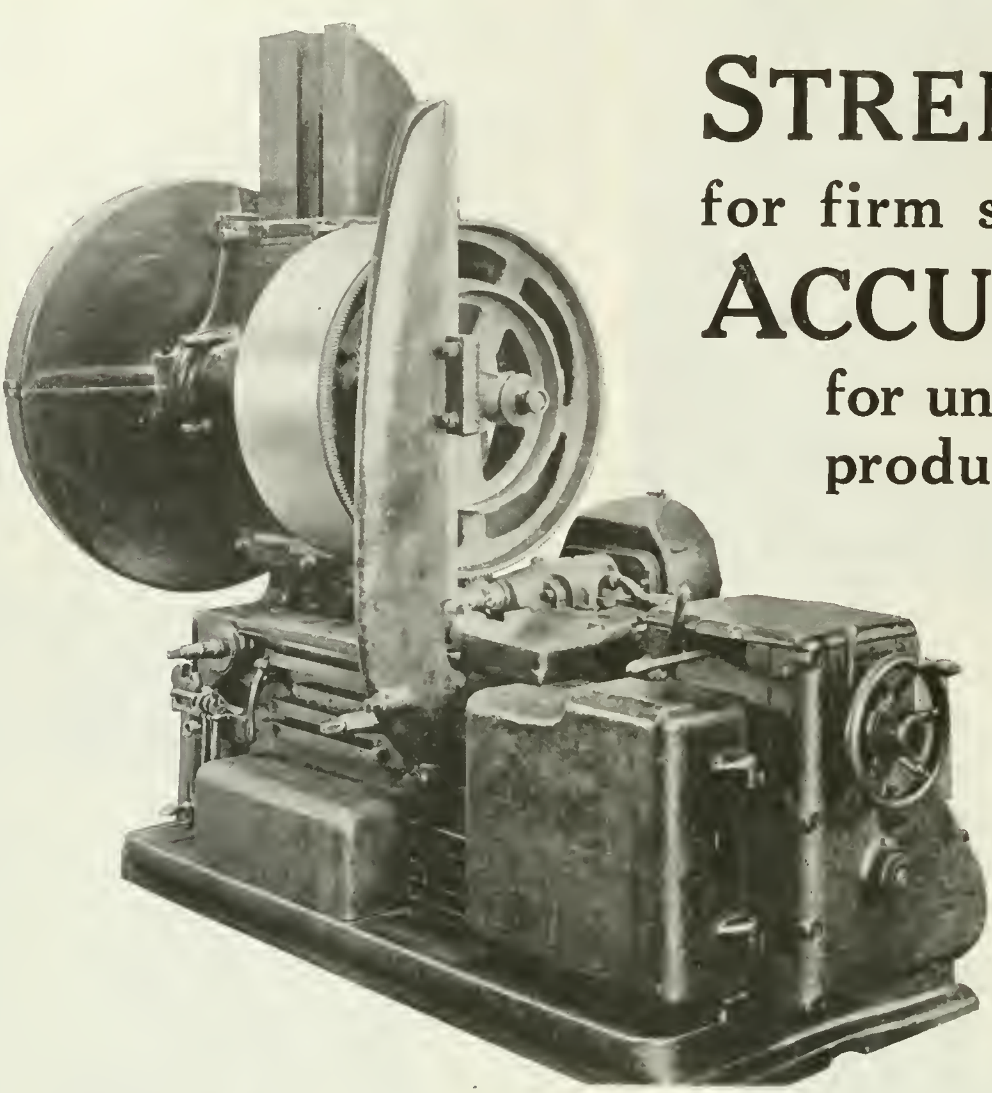
* * *

EIGHTIETH ANNIVERSARY OF RYERSON & SON

The firm of Joseph T. Ryerson & Son, of Chicago, Ill., celebrates this month its eightieth anniversary. Joseph T. Ryerson arrived in Chicago in 1842 as the accredited agent of Wood, Edwards & McKnight, Pittsburg iron masters. He rented a small two-story brick building at the corner of Clark and Water Sts. for $200 a year. The next year Mr. Ryerson moved his store to 90 Lake St., and a little later established a branch store at Urbana, Ill. In 1844 he secured land at 74 Lake St. and erected a two-story building, stocking it with heavy and light hardware, in addition to the heavy iron and steel products from Pittsburg.

In 1852 he purchased a dock lot, with an 80-foot front on the river at 218-224 S. Water St. In this location the business grew until October 9, 1871, when the great Chicago fire reduced the building to ashes. The burned store was rebuilt March 15, 1872. About ten years later property was purchased at 18-22 Milwaukee Ave., and a three-story office and warehouse building was erected. This building was soon enlarged, and in 1908, still larger quarters being necessary, the first buildings of the present plant were erected.

Today the Chicago plant occupies a ground area of over nineteen acres, with nearly a million square feet of floor space. In 1914 the company purchased the W. G. Hagar Iron Co., in order to serve the southwest territory direct from St. Louis. In 1915 the New York plant was built, and in 1917 the Detroit plant. The warehouse division of the Ferguson Steel & Iron Co. at Buffalo was purchased in 1919. The firm of Joseph T. Ryerson & Son now serves the entire country from five large steel-service plants, and there are offices in the principal cities to complete the organization.



STRENGTH

for firm support—

ACCURACY

for uniform production

BROWN & SHARPE

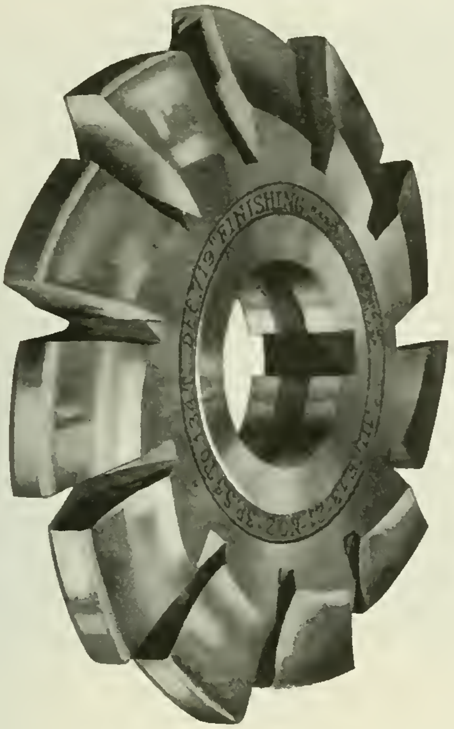
Automatic Gear Cutting Machines

STRENGTH—to hold these big 3-ft. drums true during cutting. Note the long bearing for the work arbor, and the rugged column and work support.

ACCURACY—to insure uniformity in the finished drums. Accurate spacing of the teeth is insured by the extreme accuracy of the index wheel of large diameter in proportion to the diameter of the work. The indexing mechanism operates without shock—an added insurance of accuracy. Absence of shock is important with work of large size which quickly shows the effect of any sudden jar.

Consider these features in connection with your own gear cutting problems.

Write for Catalog No. 137 describing our Gear Cutting Machines.



Unlimited Duplication of High-quality Gears

The ability to duplicate high-grade gears is the ambition of every maker of gears in quantity. For this exacting work he installs the best machinery and hires the most competent mechanics. He should also secure the most accurate cutters available—Ground-Form Gear Cutters—cutters of unvarying, uniform accuracy with which accurate gears can be duplicated again and again.

BROWN & SHARPE GROUND-FORM GEAR CUTTERS

are ground on the form, correcting all hardening distortions. This method of controlling the tooth form means that duplicates of any Ground-Form Cutter are always available. The ability to secure duplicates of these accurate cutters makes it possible for gear makers to produce unlimited quantities of the uniformly accurate gears demanded by modern requirements.

In addition to their higher accuracy, Ground-Form Gear Cutters have a freer cutting action which greatly increases production. Grinding the teeth on their forms eliminates all hardening distortions and prevents any tooth or group of teeth from doing the major part of the work. Every tooth must do its share. The increased production which results from this freer cutting action has been shown by actual test to be surprisingly great.

Secure the combined benefits of higher accuracy and increased production—use Ground-Form Gear Cutters on your most exacting work.

Brown & Sharpe Ground-Form Gear Cutters are available in sizes from 1¾ to 12 pitch inclusive.

Write for further information.

BROWN & SHARPE MFG. CO.

Providence, R.I., U.S.A.

Apprenticeships*

By P. C. MOLTER, Superintendent of the Department of Industrial Education, National Metal Trades Association

THE National Metal Trades Association has taken active steps to revive the practice of apprentice training in the metal trades industries; an explanation of the causes for this action may be in order at this time. The metal trades industries as a whole have adopted the economic principles of the division of functions, the simplification of processes, and the specialization of operations until there is little resemblance between the production methods of today and those of earlier times. This is especially true in the manufacturing industries where mass production is the order of the day.

One direct result of this change in method is the fact that unskilled or semi-skilled workmen can be readily taught to perform the comparatively simple special operations in very short periods of time, when instruction is systematically given; and ability to earn comparatively large wages follows this acquirement of productive capacity. It naturally follows that a great many workmen are satisfied to remain in the industry as specialists, rather than serve the comparatively long period necessary to complete an apprenticeship, especially when they see that the actual money earnings of the highly skilled man are but slightly greater than their own. Also, a great many bright young men have reasoned that they could earn the pay given to specialists, keep their eyes open, and thus learn the trade. This has continued until today it is practically impossible to find enough men to fill the positions in industry which are best filled by those who have a broad practical experience and all-around training and skill.

Need for Apprenticeships

Investigation in the metal trades industry has shown that most employers are painfully aware of the shortage of this class of help, but that comparatively few are providing the means whereby the necessary training can be given. Their reasons range from their inability to provide a complete and varied line of experience, to the frank statement that they are tired of spending time, effort, and money to bring boys along until they become useful and then have them leave for some other shop.

The Committee on Industrial Education of the National Metal Trades Association realizes the consequences that must inevitably follow continued indifference to the maintenance of an adequate supply of skilled workmen, and in an effort to arouse industry to action, has prepared a manual on apprenticeship which contains the fundamentals for apprentice training in any machine shop, regardless of its size, the training method employed, or the type of the product.

Apprenticeships in Gear Shops

In a highly specialized industry like the gear-cutting industry, it would be unreasonable to expect or require that a large proportion of the operative force should be apprentice-trained. However, such shops have the same equipment that is found in most machine shops, as well as the special machinery peculiar to the gear business. Aside from the specialists who operate the machinery for producing gear teeth, this industry needs men who can operate the standard machine tools, and also maintenance, repair, and experimental men, tool, jig, and fixture makers, job-setters, and men who can be assigned to any of the production machines when a workman is absent for any reason; it also needs a few who are prepared to become foremen and leaders. This is the group of workmen who need the broad general training best given through a carefully planned apprenticeship. A modified apprenticeship could be devised for the operators of the gear-cutting machines. One plan would be to divide these men into three groups—those who operate machines depending on formed cutters, those who operate generating machines, and those who operate the machines using the templet process. They can be taught their specialty in a much shorter time than is served by the ones who plan to become all-around skilled mechanics.

Methods of Training Apprentices

Granting that apprenticeship training is desirable and necessary, how can it be accomplished? First, there is the group of employers who feel that they should assume complete supervision of the training given to their employes. They will set up some method whereby their apprentices shall receive all their training within the plant of the employer, without any assistance from outside agencies. Should several of these employers be neighbors, they may pool their training and share the expense of supervision and instruction.

Second, there is the group that will take advantage of the facilities provided under the terms of the Smith-Hughes Law which provides federal assistance for vocational instruction. Practically all cities now have trade preparatory, trade continuation, and trade extension schools, which are supported by federal, state, and local funds. Many of these schools are doing excellent work and should be considered when plans for training are being made. Another form of the Smith-Hughes Law instruction is that given by itinerant instructors who travel from shop to shop on a regular schedule and do their teaching within the plants of the employers. All of this Smith-Hughes instruction is without expense to either employer or employe; my observation shows that the subject matter taught by the itinerant instructor is somewhat more closely related with the work of the individual plants than is usual in the other forms of federal and state aided instruction.

Third, there is the group that is willing to cooperate with the public schools, but that is unwilling to have machinery standing idle while the apprentices are attending classes. The cooperative school appeals to this body. Under this plan, the apprentices are paired, one being in school while the other is at work. The week-about and the two-weeks-about schedules seem to give more satisfactory results than either longer or shorter periods of rotation.

Fourth, there is the group that prefers to cooperate with private or semi-private trade schools in which the teaching methods are similar to those already outlined, the main differences being that tuition fees are required and that instruction can be arranged to meet the individual needs of the employer and apprentice more closely than is possible in most public schools.

These methods are being followed by employers who are trying to do their share in keeping up the supply of skilled workers. Each of these plans is susceptible of many variations. The only generalities that hold good in every case are that a definite plan must be followed, and someone must be directly responsible to the management for the success of any training method in operation for the education of apprentices.

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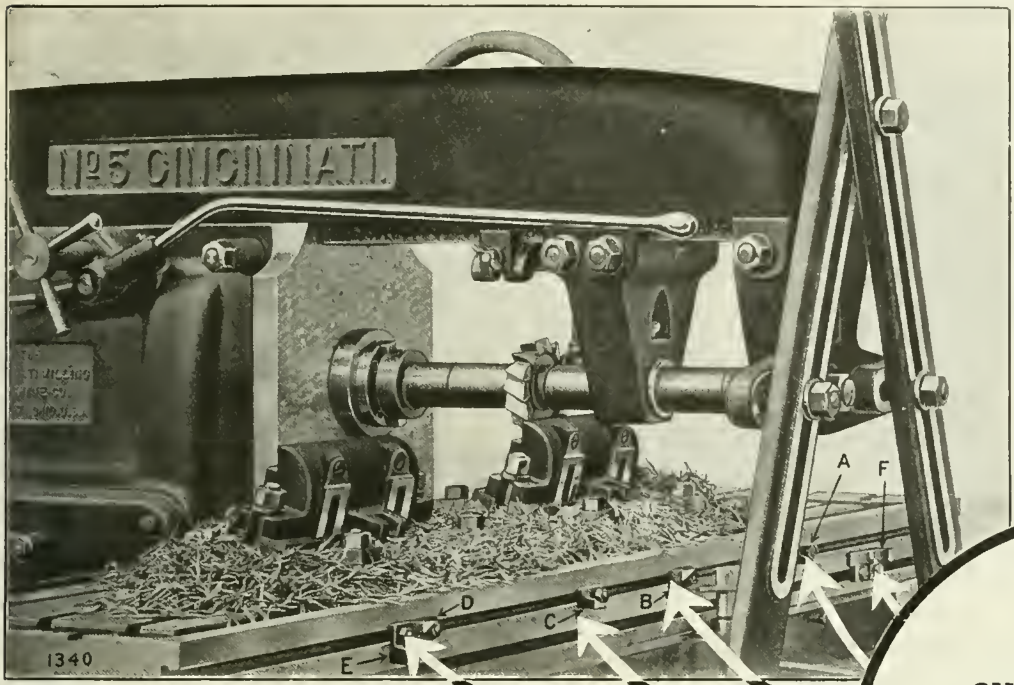
*Paper read before the American Gear Manufacturers' Association's convention in Chicago, October 9, 1922.



They
cut down the
non-productive
minutes —
automatically

The Intermittent Feed on the Cincinnati Millers Nos. 4 and 5—

—is one of the time-saving features that has made our Automatics so successful. It works on the Nos. 4 and 5 Cincinnatis just as well.

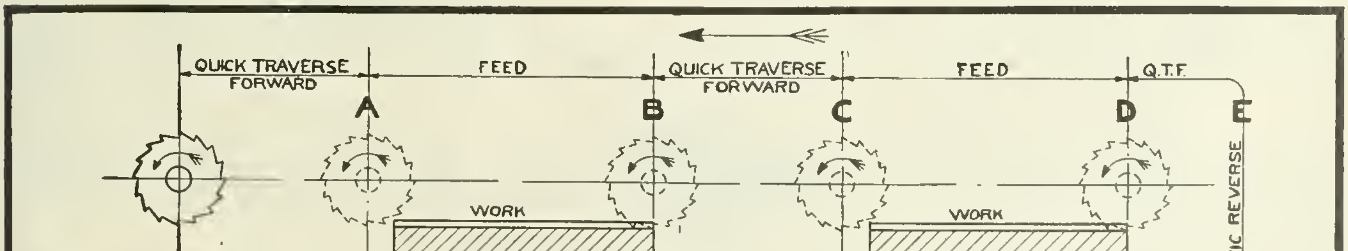
There is nothing complicated about it. All millers have dogs for limiting table travel. This feature is simply a step beyond.

The diagram below shows the cycle of operation in the photograph. Assume the machine ready to start. The operator engages the feed. The table advances at 100 in. per minute to the work; dog "A" trips to the feed rate; dog "B" engages the forward quick traverse between the pieces; dog "C" again trips to the feed rate and dog "D" engages the forward quick traverse, while immediately behind it dog "E" automatically reverses the quick traverse movement, which brings the table back to the starting point and it is stopped by dog "F."

Can the intermittent feed be arranged to expedite your production? Ask our Service Department.

The Cincinnati Milling Machine Co.

Cincinnati, Ohio



How the Intermittent Feed cuts down the time of "cutting air."

OBITUARIES

Herbert C. Follinger, manager of the Chicago office of the Chain Belt Co., Milwaukee, Wis., died of pneumonia at his home in Chicago, September 27, after a few days illness. Mr. Follinger was thirty-eight years of age at the time of his death. He was born in Fort Wayne, Ind.; in 1902 he graduated from the Chicago Manual Training School, now part of the University of Chicago, and subsequently entered the employ of the Otis Elevator Co. He became connected with the Chain Belt Co. in 1914, and in 1916 was appointed district manager for the Chicago territory.

Frederick E. Anthony, who for many years was in charge of the automatic screw machine tool designing at the plant of the Brown & Sharpe Mfg. Co., Providence, R. I., died October 8 on his fifty-eighth birthday. Mr. Anthony was born in East Providence, and at the age of seventeen entered the employ of the Brown & Sharpe Mfg. Co. as an apprentice. He remained with the company until January, 1890, after which he worked with the Eastman Kodak Co. and with Bugbee & Niles of North Attleboro. In October 1898, he again returned to the employ of the company, where he remained up to the time of his death.

Mr. Anthony represented the type of a trained mechanic who has made so much for the progress of mechanical lines in this country. He was fertile in devising ways and means of doing work, and his sound mechanical judgment and training kept him from various pitfalls that are so likely to embarrass a mechanical genius. Through his advice and experience, many of the details of the automatic screw machines were brought out, and there is hardly a large manufacturing plant in the country making use of this type of machine that is not using some of the plans that Mr. Anthony worked out. His loyalty to the company was such as showed itself in continually seeking to advance the solution of problems of customers with whom he came in contact. As a companion and shopmate, his untiring courtesy and cheerfulness made him a man who was able to impress himself upon all who came in contact with him as a companion to be cultivated from a sense of pure friendship.

M. L. BAILEY

M. L. Bailey, treasurer of the Union Mfg. Co. of New Britain, Conn., died in that city on September 26. Mr. Bailey was in his sixty-sixth year at the time of his death and had been connected with the Union Mfg. Co. for more than forty-five years. He was elected secretary in 1884, a director in 1887, and treasurer in 1888. The latter two offices, director and treasurer, he had held continuously since his election. Mr. Bailey was married in 1881 to Miss Georgiana C. Prickett, of Hazardville, Conn., who survives him. There are no surviving children. He was a member of the Official Board of the Trinity Methodist Episcopal Church, which position he held for a number of years, having given considerable of his time to the work of that church. Mr. Bailey was widely known all over the country in the hardware and machinery trades and had made many warm friends who will deeply regret his loss.

CHARLES S. GINGRICH

Charles S. Gingrich, for twenty-two years with the Cincinnati Milling Machine Co., Cincinnati, Ohio, and for many years in charge of the company's sales engineering department, died in Cincinnati, October 10, at the age of forty-eight years. Mr. Gingrich was widely known in machine tool circles throughout the country as one of the most active men in the business and as an acknowledged expert in his particular field. He was one of the group of able men who, during the last twenty years, have brought the Cincinnati Milling Machine Co. to its present position in the machine tool field.

Mr. Gingrich had many broad interests aside from his regular work. He took a deep interest in the engineering work of the University of Cincinnati, and in the young men in that institution. The very human side of his personality showed itself at its best in his contact with the young students, particularly those in need of advice and council. He had also a great interest in scientific subjects of a most diversified character — physics, astronomy, botany, and chemistry. These subjects occupied much of the time he could spare from his business career. Naturally, his mind turned frequently from the abstract scientific principles to their practical application, and his ideas as to the relation of science to business stimulated his unusual interest in engineering education.

JOHN B. FOOTE

John B. Foote president and treasurer of Foote Bros. Gear & Machine Co., Chicago, Ill., died suddenly on October 12 from an acute attack of gastritis, aged fifty-seven. Mr. Foote was a pioneer in making cut steel, casehardened gears for heavy-duty work, especially for use in farm tractors, and was known throughout the country for his skill as a gear-maker.

Mr. Foote was born April 6, 1865 and at the age of fourteen became a die-setter for the Chicago Stamping Co. When he was seventeen he was made foreman of the press and stamping room of the Cragin Mfg. Co. He became successively diemaker and toolmaker for Norton Bros. (now the American Can Co.), superintendent of machinery for the Cragin Mfg. Co., in charge of the machine shop of the American Can Co., and designer and builder of special machinery for the Fisher Mfg. Co. From 1893 to 1904 he was a partner with D. O. James in the firm of James & Foote, manufacturers of cut gears. When the business was wiped out by a disastrous fire in 1904, he organized the Foote Bros. Gear & Machine Co., which soon became one of the largest and best-known gear concerns in the country.

Mr. Foote shared with Henry Ford and Thomas L. Fawick the honors of pioneering the present light-weight type of farm tractor, with its live axle drive and all-enclosed transmission and with the engine, gear, and axle housings bolted rigidly together so as to render unnecessary the use of a frame. He was also the inventor of numerous automatic machines for making cans, and was regarded as an authority on machinery of many special types in which gears and cams are used. He was president and director of the Illinois Tractor Co., treasurer of the American Tractor Association, a director of the American Gear Manufacturers' Association, and a member of the Society of Automotive Engineers. He is survived by his widow and a brother, Bradford Foote who will continue the business of Foote Bros. Gear & Machine Co.

* * *

CATALOGUES REQUESTED FOR CHILE

Commercial attaché C. A. McQueen, Casila 27-D, Santiago, Chile, requests American firms engaged in machine building, who are interested in export trade, to send catalogues for the files of his office; in case the manufacturer has an agent or representative in Chile, the name and address of the representative should also be furnished. It is suggested that catalogues should be forwarded by registered mail, because parcels-post packages are subjected to a delivery charge in Chile, an expense which naturally the American manufacturer would not expect either the commercial attaché or his prospective customers in Chile to carry.

It is stated that at present there is particular interest in woodworking machinery, especially of the motor-driven type, as there is a constant trend toward the use of electricity for power purposes. Large hydro-electric developments are under way near Santiago, and it is expected that the rates made for electricity for industrial uses will be low enough to easily compete with the cost of steam power.

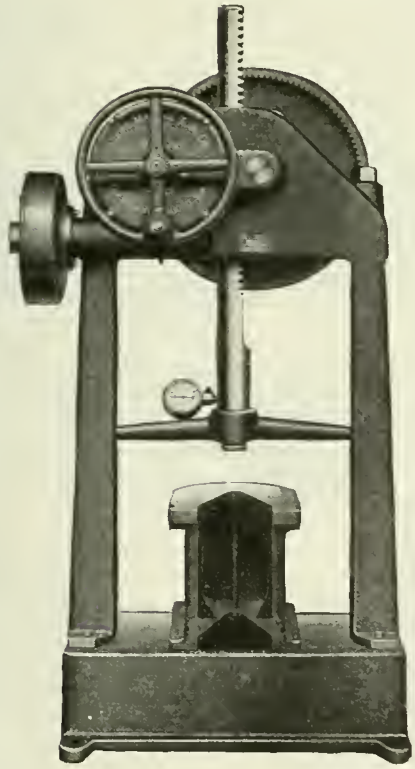
Take Us Into Your Confidence!

We frequently run across some peculiar job that can be done on the

LUCAS
Power Forcing Press

better than on any other machine.

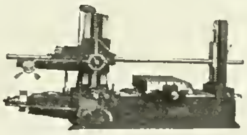
If you have any jobs requiring pressure let us look them over, maybe we can help.



Illustrated Circular
Tells the Whole Story

WE ALSO MAKE THE

"PRECISION"



BORING, DRILLING AND MILLING MACHINE

LUCAS MACHINE TOOL CO., NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

TRADE NOTES

Cincinnati Planer Co., Cincinnati, Ohio, announces an advance of 10 per cent in the prices on vertical boring and turning mills.

Bridgeport Brass Co., Bridgeport, Conn., has opened a Detroit office in the General Motors Building, Detroit, with Frank H. Longyear as district manager.

Down Tool Works, Inc., Fleetwood, Pa., announces that H. H. Colbus will represent the company in the Philadelphia territory in the sale of high-speed drills and tools. Mr. Colbus was formerly sales representative in the Philadelphia territory for the Halcomb Steel Co.

Alfred Box & Co., Ontario St. and Trenton Ave., Philadelphia, Pa., manufacturers of electric cranes and hoists, have opened a New York office in charge of N. C. Failor. This office will handle the sales for Connecticut, Greater New York, and northern New Jersey.

Frostholm Bros., Syracuse, N. Y., tool manufacturers and cylinder grinders, have purchased a new factory at 1009 S. Clinton St., Syracuse. The new location is central, and the company is installing new equipment which will enable an increasing volume of business to be handled.

Alvord Reamer & Tool Co., Millersburg, Pa., announces the appointment of C. C. Strout in the capacity of vice-president in charge of sales. Mr. Strout was formerly connected with the Victor Saw Works, as western sales manager, and with the Safety Wrench & Appliance Co., as general sales manager.

Hartford Tap & Gauge Co., Hartford, Conn., has changed its name to the Hanson Tap & Gauge Co. This change was made in order to connect the products of the company with the inventor and originator of its processes and equipment. No change has been made in the conduct of the business.

Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich., has decided to discontinue its New York office. The company's California agency was formerly handled by Harron, Rickard & McCone. This agency is now in the hands of the Smith-Booth-Usher Co., 50-60 Fremont St., San Francisco, and 228 Central Ave., Los Angeles, Cal.

Walter S. Ryan Co. has recently been organized in Detroit, Mich., to deal in new and used machinery. A store has been opened at 130 E. Larned St. Mr. Ryan worked for the Potter & Johnston Machine Co. for four years in Michigan, Ohio, and western Pennsylvania. Previous to that he was connected for three years with Charles A. Strelinger & Co., of Detroit.

Brown Instrument Co., Wayne Junction, Philadelphia Pa., has opened a New England branch at 185 Devonshire St., Boston, Mass., with George Goodman in charge. The company has also opened a southern branch at 619 Brown-Marx Bldg., Birmingham, Ala., with Charles L. Saunders in charge. These local offices will be completely equipped for sales and service.

F. S. Pearson Engineering Corporation, Fisk Bldg., 57th St. and Broadway, New York City, has re-established its department for industrial management and technical auditing of industries and public utilities. This department will be carried on together with the company's usual work of financing, developing, designing and constructing engineering projects and industrial plants.

R. G. Haskins Co., manufacturer of flexible shaft equipments and portable tools, moved to larger quarters on November 1 at 516 W. Monroe St., Chicago, Ill., which affords large store space for the display and demonstration of machines, as well as larger facilities for handling the routine of the business. A display room will be maintained where machines can be tested out on a great variety of actual operations.

Meldrum-Gabrielson Corporation, Syracuse, N. Y., manufacturer of Gabrielson milling machines, Syracuse adjustable-limit snap gages, and special machinery and tools, has purchased and removed to its new plant at 601-607 W. Fayette St., the entire equipment and business of the Killington Machine Co., and is now prepared to undertake contracts for screw machine work, gear-cutting, and production grinding.

Metallo Gasket Co., New Brunswick, N. J., announces that its business has grown to such proportions that it has become necessary to establish a general sales office at 242 Lafayette St., New York City. A complete stock of the company's products will be carried in the New York office, and a staff of experts including P. L. Rhodes, William A. Gormley, L. A. Ward, and W. B. Goering, will be available on short notice for consultation.

Porter-Cable Machine Co., Syracuse, N. Y., manufacturer of lathes and vertical milling attachments, has purchased the Syracuse Sander Mfg. Co., and expects to move the business into its own plant, and sell the building and machinery of that company. The Syracuse Sander Mfg. Co. has been manufacturing disk sanders, oscillating-spindle sanders, belt sanders, hand saws and wood lathes, all of which were motor-driven and designed especially for pattern shops.

National Tool Co., Cleveland, Ohio, has taken over the Simmons Method-Hob Co., of Philadelphia, Pa., including all the equipment, machinery and tools, patents, trademarks, and copyrights. The National Tool Co. proposes to manufacture immediately, under the Simmons Method patents, hobs with generated teeth for cutting gears, spline shafts, threads, hacksaw blades, machinists' files, pipe, taps, chasers, and sprockets for silent chains and roller chains, as well as hobs for special purposes.

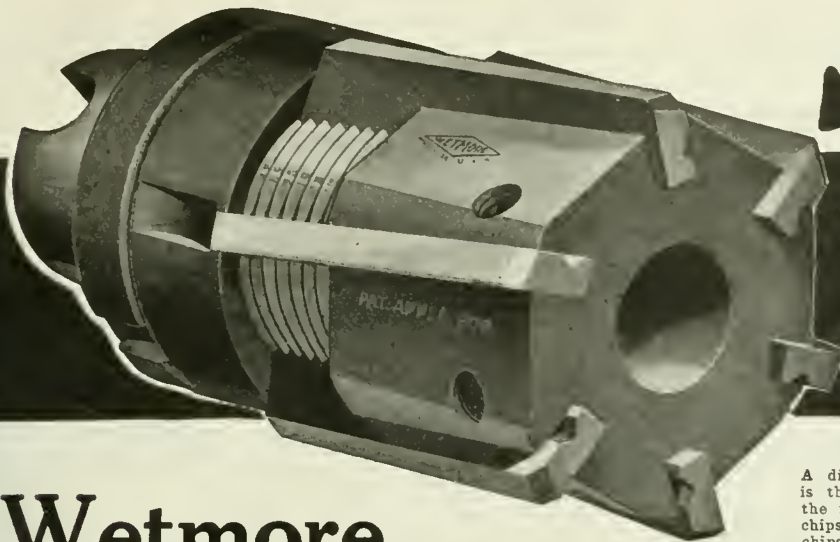
Industrial Tool Co., 5518 Euclid Ave., Cleveland, Ohio, has just been organized. The principal line of the company will be machine tools, dies, and special machinery, and contract work will also be undertaken. The officers are as follows: President and general manager, G. H. Sommerfield; vice-president, C. M. Lee; and secretary-treasurer, Charles D. Gerland. Mr. Sommerfield has had many years experience in the mechanical field, and was connected with the J. C. Ulmer Co. of Cleveland, Ohio, for over eight years.

Norma Co. of America, Anable Ave., Long Island City, N. Y., has acquired the American patents and business of the Hoffmann Mfg. Co., of Chelmsford, Essex England, maker of Hoffmann roller, ball, and thrust bearings; and the line of Norma precision ball bearings will now be supplemented by Hoffmann precision roller bearings and other bearing products in the Hoffmann line. The Norma Co. will erect a new plant for the manufacture of Hoffmann products in America. In the meantime, they are being imported and sold under the regular Norma engineering service.

Rivett Lathe & Grinder Co., Brighton District of Boston, Mass., manufacturer of precision bench lathes, internal grinding machines and radial grinding machines, announces a change of address of its Detroit sales office, which is operated in conjunction with that of the Reed-Prentice Co., Becker Milling Machine Co., and Whitcomb Blaisdell Machine Tool Co., under the management of T. C. McDonald. The new quarters, which provide ample space for the exhibition of sample machines, are located at 6526 Cass Ave., opposite the General Motors Building. The sales force has been augmented by the addition of E. B. Barber, formerly superintendent of the factories of the Lafayette Motor Co.

Pawling & Harnischfeger Co., 3826 National Ave., Milwaukee, Wis., announces the appointment of the following agents for its machine tool line: Cadillac Machinery Co., Detroit, Mich., of which G. L. Campbell is president, will have the territory including the state of Michigan with the exception of the counties bordering on Lake Michigan and the extreme northern section of the state; the Cleveland Duplex Machinery Co., Cleveland, Ohio, of which G. J. Hawkey is president, will have the northern section of Ohio; and the Seifreat-Woodruff Co., with offices at Dayton and Cincinnati, will have the lower section of Ohio with the counties bordering on the Ohio River in the state of Kentucky.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder, thread lead variators, and permanent-alignment wheel-truing heads, which was recently acquired by A. T. Doud, president of the company, has appointed William H. Frick chief engineer in charge of the engineering development, and service departments. Mr. Frick is a grinder expert, and is well known in the machine tool industry. Before joining this company he was equipment engineer for the Budd Wheel Corporation. He has been master mechanic at the Landis Tool Co., efficiency engineer of the Cleveland Automatic Machine Co., assistant superintendent of the Gisholt Machine Co., mechanical superintendent of the Diehl Mfg. Co., superintendent of the Van Dorn Electric Tool Co., and general superintendent of the Hero Mfg. Co. He was associated with Mr. Doud at both the Diehl Mfg. Co. and the Hero Mfg. Co. D. F. Bruce has been appointed superintendent in charge of manufacturing and production. Mr. Bruce has had extensive mechanical experience with such concerns as the Remington Arms Co., and the J. E. Lonergan Co., and was formerly superintendent of the McCambridge Co. The company is preparing to give field and consulting service, including time and production reports on questions regarding precision and thread grinding. New products and attachments are being developed, which will soon be announced.



Note this Advantage

NOTE THIS ADVANTAGE

A distinctive feature of this Wetmore Shell Reamer is the 1/8" projection of the blades over the end of the reamer body for chip clearance. This allows the chips to fall off ahead of the reamer body and prevents chips from clogging up along cutting edge of blades.

Wetmore
Expanding Shell Reamer

Several unusual features of this Wetmore Shell Reamer are appealing to superintendents, production men and mechanics in many of America's largest plants.

It is adaptable for both line and pilot reaming. It fits all standard bars and shell reamer arbors. Body, lock nut and cone nut are of finest heat-treated alloy steel. Has .087" expansion. This Shell Reamer is made in the following sizes: 1½" to 3", 6 blades; 3 1/16" to 5", 8 blades; 5 1/16" to 6", 10 blades. Made also with straight hole, if desired.

Blades for all Wetmore Reamers

Wetmore Blades are scientifically ground to the exact bevel best suited for working various metals—steel, cast iron, bronze, etc. Best high-speed steel, ground to thickness, length and on seat. Tested for hardness and toughness. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron or bronze.

Wetmore Precision and Durability Features:

In every detail—design, quality of materials, workmanship, finish—Wetmore Expanding Reamers set a new standard of reamer value. The following features are a few of the reasons why Wetmores are being used *exclusively* in so many shops:

Adjustment to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body—guaranteed against breakage.

Left hand angle cutting blades that prevent digging in, chattering, and scoring of the reamer while backing out.

Shearing effect of blades increases life of cutting edges.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

Write on your business letterhead for your copy of the new Wetmore Reamer "Handbook." This book contains valuable information on precision tools. Sent *free*, postpaid, on request. No obligation to you.

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60-64 27th Street
MILWAUKEE, WIS.

Manufacturers of Expanding Reamers and Cylinders Reaming Sets, Blades, Arbors and Thread Gauges.

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

PERSONALS

Preston M. Smith has resigned as sales manager of the Dubilier Condenser & Radio Corporation, 48 W. 4th St., New York City.

David F. Julian, formerly connected with the E. J. Manville Machine Co., of Waterbury, Conn., has been appointed general factory manager of the Columbus Bolt Works, Columbus, Ohio.

W. B. Anderson, who has been in the Cincinnati office of Henry Disston & Sons, will be transferred to the Chicago office on January 1, 1923. He will specialize on railroad work for the company.

Walter S. McKee has resigned as vice-president and director of the American Manganese Steel Co. and will develop the business of the Inland Engineering Co., Chicago, Ill., of which he is president.

Louis W. Byrne, formerly with Burton Griffiths & Co., Ltd., New York City, has been appointed sales manager of the Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich., manufacturer of grinding machines, effective November 1.

R. L. Heaton has become advertising manager of S. F. Bowser & Co., Inc., Fort Wayne, Ind., manufacturers of oil and gasoline storage systems, tanks, pumps, and filters. Mr. Heaton succeeds L. E. Porter, who assumes the duties of assistant general manager of the company.

James H. Jordan has recently been appointed treasurer and general manager of the Madison Tool & Stamping Works, 1970-1984 Helena St., Madison, Wis. This company is engaged in the making of tools, dies, metal stampings and models, and in experimental and pattern work.

Bert N. Greenwood, formerly with the Greenfield Tap & Die Corporation, manufacturer of the Greenfield grinders, and with its predecessor the Greenfield Machine Co., has joined the sales force of Russell Holbrook & Henderson, Inc., of New York City, and will be stationed at Bridgeport, Conn.

John F. Price has been appointed vice-president of the George T. Trundle, Jr., Engineering Co., 118 St. Clair Ave., Cleveland, Ohio. Mr. Price was formerly comptroller of the Brown Hoisting Machinery Co. of Cleveland, with whom he was associated for fifteen years. At one time he was vice-president of the Society of Industrial Engineers, and is now one of its directors. He will be associated with Mr. Trundle in the management of the company and will serve its clients on matters of financing, costs and sales. The company is engaged in developing labor-saving machinery and tools, and inventions, simplifying products and their manufacture, and making investigations for banks.

COMING EVENTS

December 4-7—Annual convention of the American Society of Mechanical Engineers, in the Engineering Societies Bldg., 29 W. 39th St., New York City. Calvin W. Rice, secretary.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager. Grand Central Palace, 46th St. and Lexington Ave., New York City.

March 18-24, 1923—Second general meeting of the International Chamber of Commerce in Rome, Italy. Lacey C. Zapf, secretary American Section, Mills Bldg., Washington, D. C.

NEW CATALOGUES AND CIRCULARS

General Electric Co., Schenectady, N. Y. Bulletin 46108, illustrating and describing Type M-4 demand meters.

Griscom-Russell Co., 90 West St., New York City. Bulletin 910, illustrating and describing oil-coolers, heat-exchangers, and condensers.

Wagner Electric Corporation, St. Louis, Mo. Folder illustrating Wagner transformers, furnished in both distribution and power types in a wide range of styles and sizes.

Joseph T. Ryerson & Son, Chicago and New York. Folder entitled "Expanded Metal Lath and Reinforcing," describing and giving the sizes in which expanded metal lath is obtainable.

Crescent Machine Co., 56 Main St., Leetonia, Ohio. Catalogue of Crescent woodworking machinery, specifically pointing out improvements on saw tables, motor-driven shapers, and hollow chisel mortisers.

J. G. Blount Co., Everett, Mass., manufacturer of machine tools, has a booklet ready for distribution, describing and illustrating the company's line of ball-bearing motor grinders and motor buffs. Copies will be furnished upon application.

John Steptoe Co., Cincinnati, Ohio. Circular illustrating and describing the Steptoe standard engine lathes having a quick-change gear-box. These lathes are built in 14-, 16-, 18-, and 20-inch sizes, with lengths of beds according to requirements.

Century Wood Preserving Co., Century Bldg., Pittsburg, Pa. Bulletin 24, descriptive of preservative treatments for railroad ties and timbers for industrial plants. The processes used in timber treatment are described in detail, and the seasoning of ties and timbers is discussed.

Mida's Trademark and Patent Bureau, Ellsworth Bldg., Chicago, Ill. Folder entitled "Digest of Patent Laws of the World," which gives, in a brief space, the most important information relating to patent applications, the cost of patents, and their duration in different countries.

Sprague Electric Works of General Electric Co., 527 W. 34th St., New York City. Circular 67901, descriptive of Sprague safety type panel boards and cabinets, which are designed for places where the bus-bars and other live parts must be covered, and yet where the fuse plugs must be left accessible.

Oilgear Co., 60-64 Twenty-seventh St., Milwaukee, Wis. Bulletin 23, illustrating and describing the Oilgear hydraulic broaching machine. The bulletin covers the design and construction of the machine in considerable detail, and contains information with regard to its efficiency and work-producing capacity.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf circulars 97 FE and 98 FE, illustrating applications of ball bearings in drives for elevator worm-gearing and vertical shaft and drive pulley support. Bulletins 149 FE and 150 FE, illustrating applications of ball bearings in drive units for glass tube drawing machines, and cream separators.

American Abrasive Metals Co., 50 Church St., New York City. Catalogue containing information on carborundum anti-slip tile for stair treads, elevator landings, swimming pools, and general floor surfaces. A specification guide for the setting of the tile both in new and repair work and a table of standard sizes and prices are included.

Niagara Machine & Tool Works, Buffalo, N. Y., are publishing a series of bulletins covering the entire line of machines and tools for sheet-metal working that they manufacture. Bulletin 58 deals with inclinable open-back power presses, Bulletin 59 with power presses, and Bulletin 61 with power punch presses. Bulletins on other machines will follow shortly.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa. Circular descriptive of an attachment for the multi-graduated precision thread grinder, consisting of an extension spindle and housing by means of which deep internal grinding may be done in places that would otherwise be inaccessible. The circular also gives a price list of grinding wheels for use with this tool.

Brown Instrument Co., Wayne Junction, Philadelphia, Pa. Catalogue 85, illustrating and describing Brown automatic control signaling and alarm instruments, adapted for low-temperature control up to 1000 degrees, and for high-temperature control up to 3000 degrees F. The catalogue is illustrated with photographs of actual installations, as well as with detail photographs of the instruments described.

Norma Co. of America, Anable Ave., Long Island City, N. Y. Booklet descriptive of the "Minimeter," a precision measuring instrument which makes it commercially possible to measure to 0.0001 inch in manufacturing machine parts. It is especially applicable in the quantity production of rollers, balls, gears, rings, wrist-pins, push-rods, valves, disks, washers, keys, pins, bushings, and other small parts.

Medart Co., St Louis, Mo. Catalogue 43, entitled "Lineshafting Equipment." This catalogue covers 192 pages and includes illustrations and descriptions of the wide range of lineshafting equipment manufactured by the company—shafting, couplings, hangers, bearings, pillow blocks, floor stands, pulleys, gears, sprocket chain, clutch pulleys, belt-tighteners, rope sheaves, and numerous other transmission accessories.

Societe Genevoise D'Instruments de Physique, Geneva, Switzerland (**R. Y. Ferner**, representative in the United States, 1410 H St., N. W., Washington, D. C.) Catalogue 373, illustrating and describing the company's high-precision screw-cutting lathes. Three types and sizes are shown, No. 2 having a capacity of 8 inches length of screw by 2 inches diameter; No. 3 with a capacity of 12 inches length by 2 inches diameter; and No. 4, for internal as well as external threads, with a capacity of 8 inches length of screw by 4 inches diameter.

Skybryte Co., 349 Bangor Bldg., Cleveland, Ohio. Book entitled "Daylight the Natural Illuminant," containing a treatise on the reasons why daylight in offices and factories is the best illumination for all classes of work, and indicating how it can be obtained. The book should be of especial interest to plant owners and executives, and may be obtained by men of this class, free of charge, by addressing the Skybryte Co. on a business letter-head, giving the writer's official title.

Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Catalogue entitled "Examples of Turning on the Lodge & Shipley Manufacturing Lathe," containing a study of equipment and methods, showing the possibilities of economic quantity production on the automatic or special lathe. The catalogue describes the Lodge & Shipley manufacturing lathe in detail, and contains illustrations showing a large number of tooling equipments for different classes of work, made from photographs taken of actual set-ups.

General Electric Co., Schenectady, N. Y. Catalogue 6001, containing 1338 pages, 7½ by 10¼ inches. This is a general catalogue, giving a representative list of the products of the company, including turbines, motors, generators, controllers, switchboards, electric fans, meters, insulators, lamps, switches, rheostats, and other electric equipment. The information on supplies includes identification for ordering and in most cases prices. The publication contains a complete index to subjects, and an index to catalogue numbers is also given.

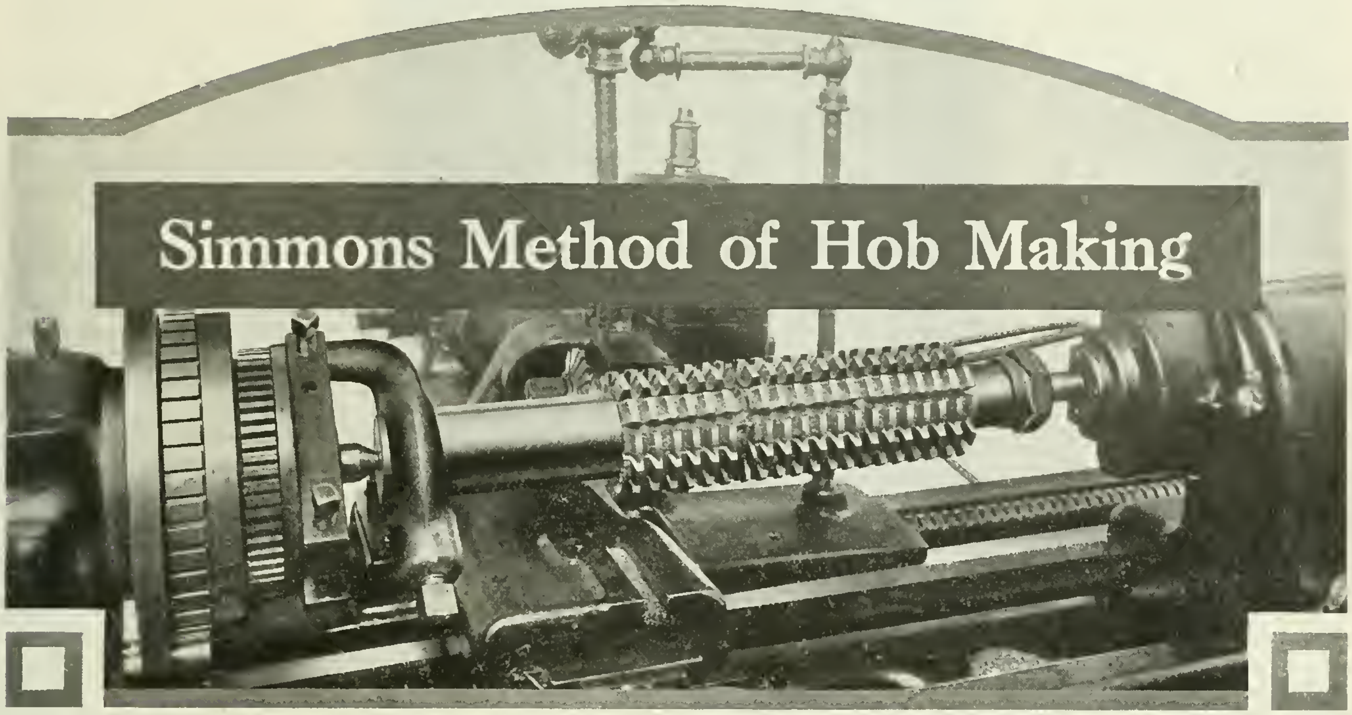
Edgar Bourquin, 1353 Main St., Waltham, Mass. Pamphlet 100, descriptive of the Ames lettering instrument and Leroy tubular pens for use in the production of charts, maps, drawings, data, etc. With the lettering instrument the time consumed in placing guide lines on drawings when lettering titles or notes can be materially reduced. It can also be used for drawing cross-section lines and slanting lines for letters. The device consists of a steel frame having a celluloid disk that contains three rows of tapered holes and that can be swiveled about into different positions. The Leroy tubular pens are designed to insure a uniform line; they are held in a swivel socket fitting a standard pen-holder.

Metal & Thermit Corporation, 120 Broadway, New York City. Pamphlet 21, containing instructions for the use of thermit in railroad shops. This is the fourth edition of the pamphlet, and contains many revisions, chief among which are instructions for applying important improvements in practice in thermit welding which have been developed by exhaustive research. The drawings and instructions illustrating and describing the making of thermit welds in various parts of locomotive frames and other locomotive and railroad equipment have been completely revised to conform to improved practice. The book should be of interest to superintendents of motive power, general foremen, blacksmith foremen and thermit welders.

Skinner Chuck Co., New Britain, Conn. Bulletin entitled "Questions and Answers on Chucks and Their Uses," published in connection with a booklet recently brought out by the company entitled "Chucks and Their Uses." The latter booklet has been widely adopted by industrial schools and colleges for instruction purposes, and the present supplementary pamphlet "Questions and Answers" will be found serviceable in aiding instructors in directing the attention of students to those points and principles which practice and experience have proved to be essential. The booklet will also be found of definite practical help to men already engaged in machine shop work. The company has also published an arbor chart, listing the arbors made by the company to fit any type of drill chuck, and a sheet illustrating and describing the Skinner drill chucks.

DECEMBER MACHINERY 1922

Simmons Method of Hob Making



A Method of Simultaneously Generating and Relieving the Teeth of Gear Hobs with a Revolving Cutter Resembling a Spur Gear

By CHARLES O. HERB

GEAR hobs generally have the threads cut by chasing in a lathe or milling with a formed cutter in a milling machine. Then, after gashing the flutes and heat-treating the hob to remove internal strains set up by the preceding operations, the teeth are relieved to provide peripheral and side clearance. Subsequent operations include hardening, tempering, and grinding.

The main point of difference between the manufacturing process developed by the Simmons Method-Hob Co., Philadelphia, Pa.,* and the procedure outlined is in the relieving step. In the Simmons method, a standard worm thread is first milled on the hob in a thread milling machine by means of a straight-sided formed milling cutter. After heat-treating, this preliminary thread is generated to the true tooth form in the relieving step by the action of a rotating cutter somewhat similar to that employed on the Fellows gear shaper. This cutter is inclined so that as each tooth engages the work the face is in a plane at right angles to the helix of the hob thread. Thus the hob teeth are "generated" rather than "formed." The rear view of one of these cutters is shown at *A*, Fig. 1. The teeth are of the true involute form and will mesh with standard gears of the same diametral pitch. The front face of the cutter teeth has a rake of about 5 degrees.

The relieving operation is performed in a lathe equipped with a standard relieving attachment and a special attachment, mounted on the carriage, which rotates the cutter in the correct relation to the work. Another operation of particular interest is the grinding of the cutter teeth, which is done in a machine designed especially for this purpose. This article will describe the different steps in the manufacture of both hobs and cutters. The Simmons method is applicable to the manufacture of hobs of all types for producing the teeth of spur, helical, worm and Hindley gears, hacksaw blades and ratchets, and for milling threads and splines. Gear hobs may be made with single or multiple threads, and other types may be made with or without lead, and with the teeth staggered or in a straight line.

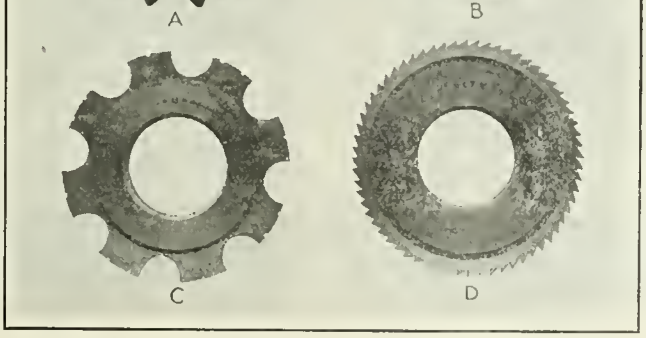


Fig. 1. Cutters used for generating and relieving Hob Teeth

Preliminary Operations—Drilling, Turning, and Boring

After the round stock from which a hob is to be made has been cut to length, it is rough- and finish-drilled in a Baker vertical-spindle drilling machine. The jig illustrated on the table of this machine in Fig. 2 is used in drilling stock of any diameter, and insures that the stock will be drilled at the center. As this jig is adaptable to drilling many other kinds of work, its application will be described in detail.

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*All the manufacturing rights of the Simmons Method-Hob Co. have been acquired by the National Tool Co., Detroit, Mich., since this article was written.

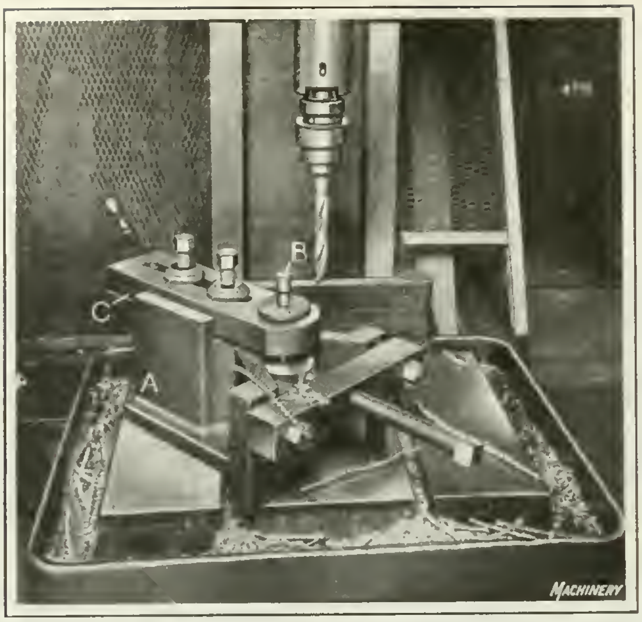


Fig. 2. Jig for drilling the Bore in the Hobs

The first piece of a hob lot of one diameter has the center located by means of a common center square, after which it is clamped in the vertical vee of base *A*. A plain center *B* which accurately fits the bushing in the front end of the sliding bar *C* is then inserted in this bushing. The sliding bar is next pushed back and forth until the point of the center registers at the intersection of the scribed lines used in determining the center of the work. Bar *C* is then clamped, center *B* removed, the jig shifted to bring the bushing directly beneath the machine spindle, and the hole drilled.

It will be obvious that any number of pieces of the same diameter may now be drilled without changing the setting of the sliding bar and without first scribing lines on the work to determine the location of the center. When the hole in the hob is to be 1¼ inches in diameter after grinding, it is rough-drilled to ¾ inch in diameter, then to 1 7/32 inches in diameter, and finish drilled to 1.240 inches in diameter. In the latter step, use is made of a three-fluted drill which has the lands ground in such a manner that a reamed finish is obtained. It is, of course, necessary to substitute bushings in the sliding bar of the right size to accommodate the larger diameter drills used in the second and third steps.

The part is next mounted on an arbor in a lathe for turning the cylindrical surface, and then placed in a drawback adapter which fits the collet chuck of another lathe. Both ends of the work are then faced, and the hole recessed for about one-third its length at the middle. The edges of the hole are also beveled slightly on each end to permit the seating of a 60-degree conical center in a later operation. In performing these steps, it is necessary to change the work end for end in the collet chuck. Cutting lubricant is supplied copiously in this as well as in all the succeeding machining steps.

Milling the Thread and Gashing the Flutes

From this stage of the manufacturing process and until the hobs leave the relieving machine, they are mounted three at a time on a hardened and ground arbor for the different operations. This results in a higher rate of production than would be possible if the hobs were handled individually. The next two operations consist of milling the thread in a Pratt & Whitney thread milling machine, and gashing the flutes on a Becker milling machine. Either of these operations may be performed first, the choice depending upon which type of machine happens to be ready to receive work. The heading illustration shows the thread milling machine set up for cutting a thread on three hobs after the flutes have been gashed. This is a 29-degree worm thread, and is produced by a staggered tooth cutter. The hobs are of 5 diametral pitch and were milled in approximately three hours.

All Simmons hobs on which the helix angle of the thread is less than 5 degrees are gashed straight, that is, parallel to the axis. Those with a helix angle of 5 degrees or greater are gashed spirally or at right angles to the thread helix. Theoretically, the flutes of all gear hobs should be spiral to obtain the most efficient cutting action, but because most shops are not equipped for grinding spiral-gashed hobs as they become worn, the hobs are gashed straight until the helix angle becomes so great that the non-uniform cutting action of straight-fluted hobs would be unsatisfactory. A prime number of flutes is always cut on Simmons gear hobs for a purpose which will later be mentioned in connection with the relieving operation.

For gashing the flutes, the work is supported on the centers of an index-head and footstock, as illustrated in Fig. 3, and indexed in the ordinary manner. The hobs illustrated are of 5 diametral pitch, and have eleven flutes.

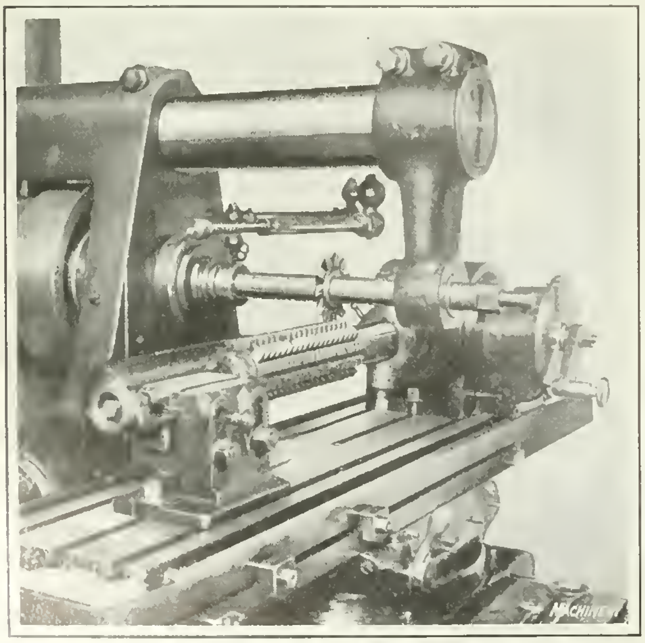


Fig. 3. Gashing Straight Flutes across Hobs on an Arbor supported by an Index-head and Footstock

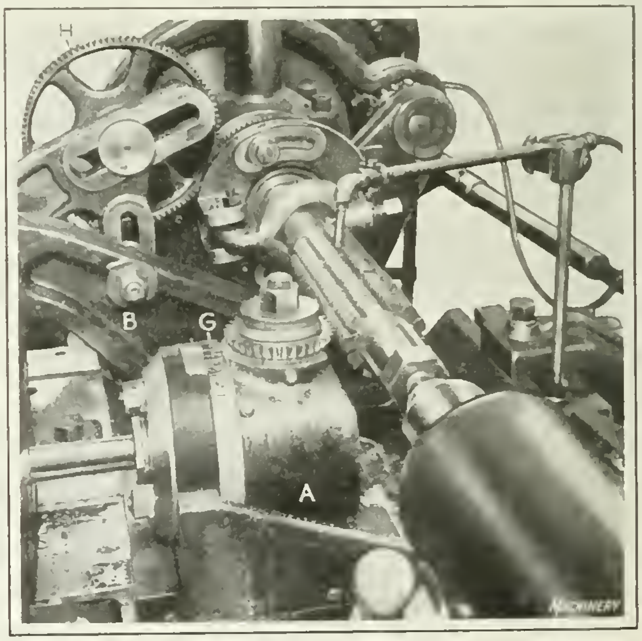


Fig. 4. Generating and relieving Hob Teeth by employing a Revolving Cutter and a Standard Relieving Attachment

The cutter has an included angle of 33 degrees between the tooth faces; however, cutters with angles anywhere between 20 and 40 degrees are used. The cutting time for this operation was two and one half hours, only one cut being taken across each flute.

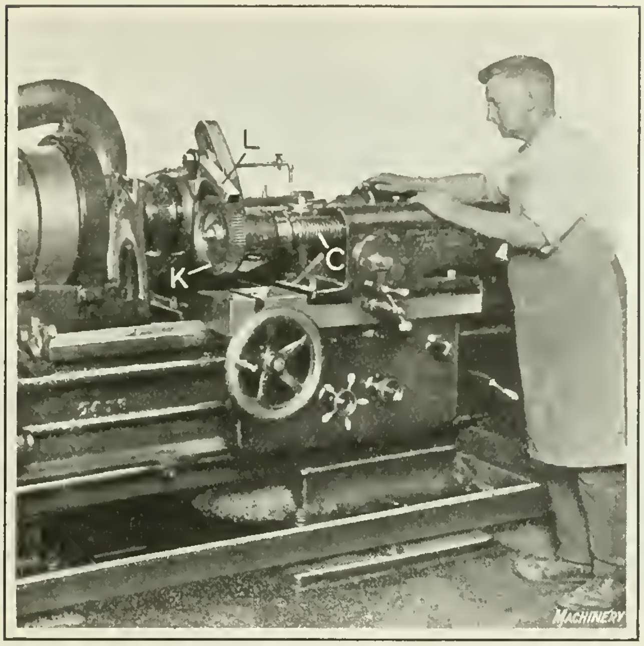


Fig. 5. Front View of the Special Hob-tooth Generating Attachment, showing the Driving Gear disengaged

Heat-treating to Relieve Internal Strains

The hobs are next packed in containers with pulverized willow charcoal for annealing. They are heated to from 1550 to 1660 degrees F. in a Leeds & Northrup electric furnace, and allowed to cool in the container. They are then removed from the container and heated slowly to from 1300 to 1350 degrees F., this heat being maintained for one-half hour, after which they are cooled in dry air. While they are cooling, special care is taken to protect the hobs from cold drafts and a chilled floor.

The Generating Mechanism

The generating and relieving operation is performed on a Hendey 24-inch lathe equipped with a Hendey Style D relieving attachment, and the Simmons special attachment previously mentioned, which may be seen in Fig. 4. It consists essentially of a cutter head *A*, mounted on a special cross-slide of the lathe and a unit attached to the front of the carriage for transmitting the rotary motion to the cutter. Power is delivered to this unit by means of a gear on the headstock spindle directly in back of the faceplate which meshes with idler gear *H* on bracket *B*. This idler gear, in turn, drives a gear *K* on the forward end of the large screw *C*, Fig. 5, which is also designated by the letter *C* in Fig. 6.

From this screw, power is transmitted through worm-wheel *D* and sliding shaft *E*. At the cutter head end of the sliding shaft is an integral bevel gear which meshes with a second bevel gear on the lower end of cutter-shaft *F*. By designing shaft *E* to slide through worm-wheel *D* the cutter may be moved toward the work at the same time that the carriage is operated along the ways of the bed, either by hand or by means of the feeding mechanism. The gear at the end of screw *C* is chosen to suit the cutter and has two and one-half times as many teeth as are in the cutter.

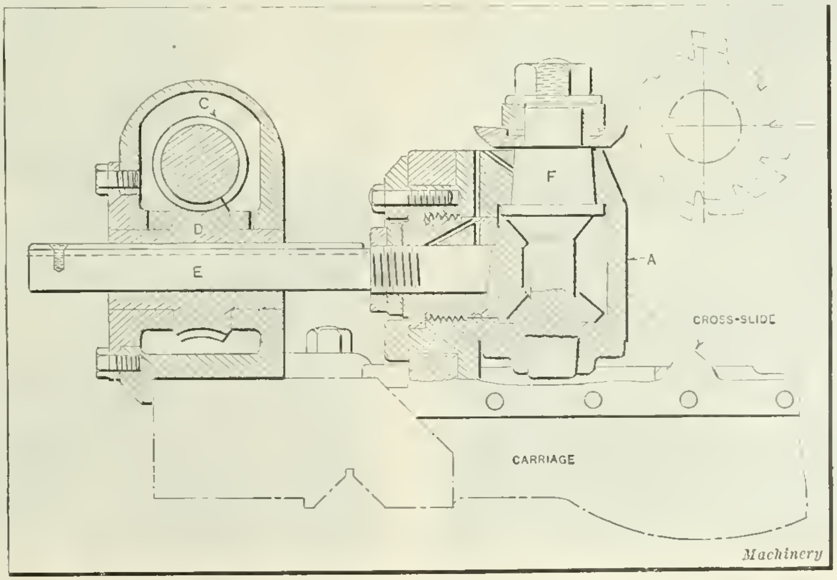


Fig. 6. Cross-sectional View through the Cutter-head and Driving Unit of the Special Generating Attachment

After the cutter has been set properly relative to the hob teeth and gashes, and the dog on one end of the work-arbor has been clamped to the faceplate to eliminate lost motion, if the cutter is moved away from the work, along the bed, and then forward toward the work again, its teeth will always properly engage the spaces between the hob teeth. This is certain, because the rotation of the cutter and the rotation of the hob are always correlated. When the carriage is moved along the bed, the cutter rotates faster than when the carriage is stationary, due to the rolling of worm wheel *D* on screw *C*.

Generating and Relieving Gear Hobs

In arranging the generating attachment for an operation, the helix angle of the hob teeth is first determined and then the cutter-head is swiveled in its bracket to this angle and clamped by means of nuts on bolts at the rear of the head. Graduations at *G*, Fig. 4, insure a close setting. Shims are placed beneath the cutter to raise it so that a radial center line through each tooth at the top cutting edge will be on the same horizontal plane as the axis of the work when the tooth center line also coincides with the helical center line of a space between two hob teeth. The dog on the work-arbor is then clamped to the faceplate, and one tooth of the cutter is meshed between the teeth of the hob and fed to depth, after which the cutter is clamped in position.

The relieving attachment at the rear of the machine is next set to move the cross-slide of the lathe in and out so that the cutter will form a peripheral, side, and bottom relief on the hob teeth. The number of these reciprocations per revolution of the work is one-half the number of flutes, and the cutter is withdrawn sufficiently so that when it again contacts with the hob teeth it has skipped one flute, and thus cuts alternate rows of teeth. A micrometer stop provides an accurate means of controlling the stroke of the cutter-head. By machining alternate rows of teeth in this manner there is ample time to again feed the cutter to the cutting point after it has been withdrawn.

The teeth that are skipped on the first revolution of the hob are generated and relieved during the second revolution. If the hobs had an even number of flutes, this procedure could not be followed, and it is for this reason that all Simmons hobs are made with an uneven number of flutes. Three cuts are taken across the hobs with the same cutter—two roughing and one finishing cut. The hobs illustrated in Fig. 4 are for cutting 8 diametral pitch, spur or spiral gears of 14½ degrees pressure angle, and they have eleven gashes. The relieving attachment is set for operating five and one half times per revolution of the work. In this case, the helix angle of the hob teeth is

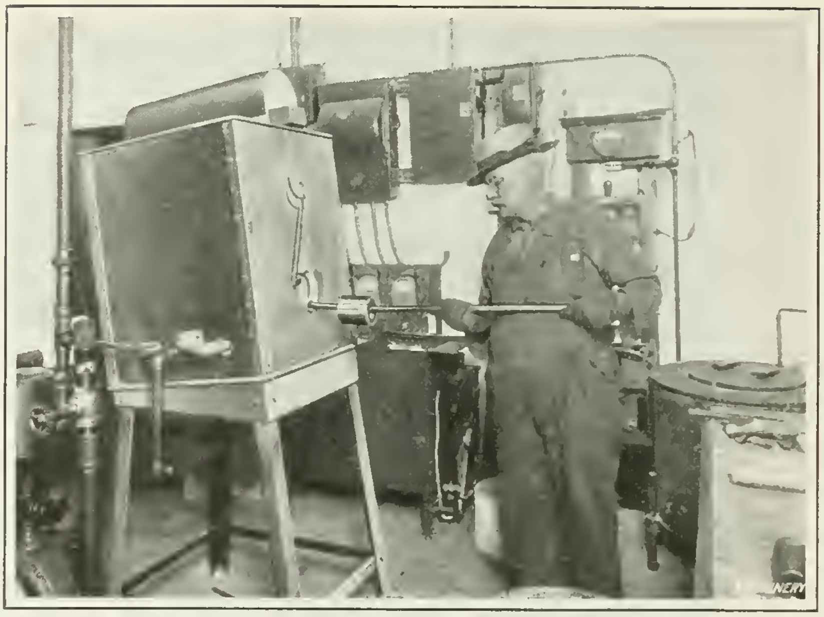


Fig. 7. View of the Hardening Room, showing a Hob being removed from the High-temperature Chamber of the Muffle Furnace

2 degrees 26 minutes, and hence the cutter-head is swung to this angle.

During the first and second cuts the carriage is fed 0.010 inch per revolution of the work, while during the finishing cut the feed is preferably 0.005 inch per revolution, the work in each case revolving about sixteen times per minute. The amount of peripheral relief is ¾ inch per complete revolution of the work; that is, if the relieving cutter were permitted to cut an uninterrupted spiral, the lead of this spiral per revolution of the work would be ¾ inch. The diameter of the hob has no influence on the selection of the generating and relieving cutter. These three hobs are generated and relieved in approximately four hours.

Generating and Relieving Other Types of Hobs

The procedure in generating and relieving hobs for common worm-gears is similar to that outlined, but for Hindley worm-gears the lathe carriage is stationary, and the rotating cutter is automatically fed into the work to the required depth. Hobs having no lead, such as those for threads, or hacksaw blades, come to the generating and relieving machine without a preliminary thread milling operation, the teeth being completely generated and relieved in this step. A cutter for producing a hob for Briggs pipe threads is shown at *B* in Fig. 1. The cutter at *D* is for producing hobs for hacksaw blades. As these hobs are without lead, the cutter does not rotate in generating and relieving, except as it is revolved by the action of worm-wheel *D*, Fig. 6, in running along screw *C* when the carriage is fed along the bed. For this reason, the idler gear *H*, Fig. 4, is replaced by bar *L*, Fig. 5, which has a special tooth at the front end engaging the teeth on gear *K*. The bar is clamped in this position to prevent the screw from revolving during an operation. The cutter is fed only once across the hobs in producing thread milling and hacksaw blade hobs.

Hobs having no lead, but with the successive rows of teeth staggered, as on hacksaw blade hobs, can be conveniently made with an even number of flutes. In this case the relieving mechanism is again set so that the cutter engages alternate rows of teeth, but the intermediate rows are not machined until after the cutter has been traversed the length of the hobs. The front section of the faceplate is then loosened and swiveled sufficiently so that when clamped again and revolved, the cutter teeth will engage the intermediate rows of hob teeth. On a sixteen flute hob, the faceplate would be indexed 1/16 revolution. This adjustment is facilitated by graduations on the faceplate.

The cutter must also be indexed one-half the circular pitch of the teeth to properly engage the teeth in the second series of rows. The indexing of the cutter is accomplished by unclamping gear *K*, turning it a sufficient amount, and then clamping it again. The cutter illustrated at *C*, Fig. 1, is employed for producing hobs for splining an automobile transmission shaft. The rounded teeth of hobs made by means of this cutter have a radius of ⅜ inch. The small recesses on the teeth of the cutter break up the chips in the generating and relieving operation.

Broaching, Hardening, and Tempering

A keyway is broached in the holes of the hobs as they leave the relieving machine, after which the hobs are

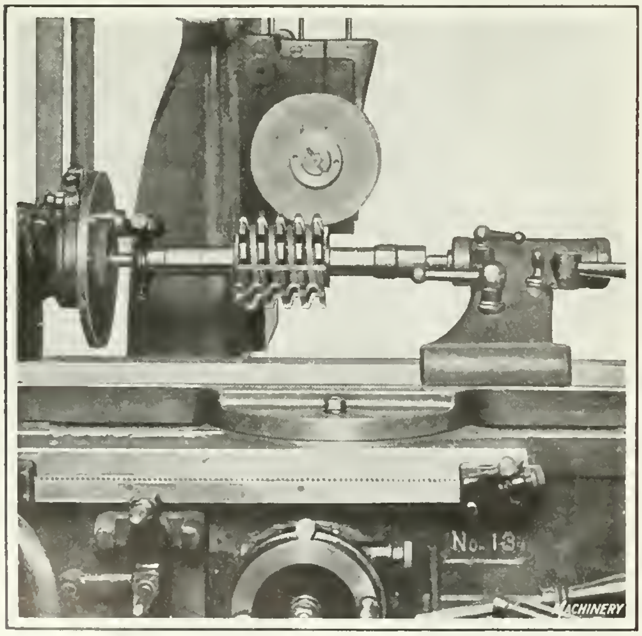


Fig. 8. Grinding the Tooth Faces

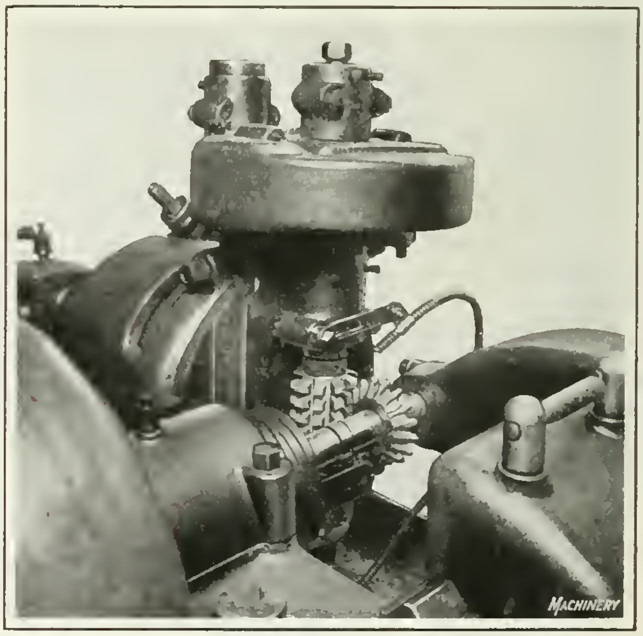


Fig. 9. Hobbing the Cutter Teeth

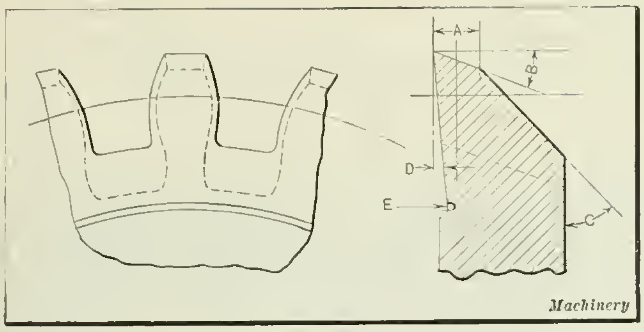


Fig. 10. Design of the Teeth on a Cutter for Spur- and Spiral-gear Hobs

taken to a stamping machine, where the dimensions, type and similar information are stamped on one end. All high-speed steel hobs are then hardened in the special three-compartment furnace seen in the foreground in Fig. 7. This furnace is of the muffle type and has an atmospheric control. It may use either gas or oil for fuel, the former being used in this installation. There are two burners on each side of the furnace and a pilot light on the left-hand side.

The hobs are given a preliminary heating in the compartment at the top of the furnace in which a quantity of hobs may be placed at one time. They are heated slowly in this chamber until they reach a temperature of approximately 650 degrees F., and are then removed to the intermediate chamber which is heated to about 1650 degrees F. The hobs remain in this chamber for about four and one-half minutes and are then finally placed in the high-temperature compartment, the approximate temperature of which depends upon the steel, but which ranges from 2250 to 2400 degrees F. They also remain in this compartment for about four and one-half minutes.

While in both the intermediate and the high-temperature chambers, the hob is supported on a bar which is revolved continuously in the hands of the attendant. The heating of the high-temperature compartment to 2300 degrees F. from the normal room temperature, consumes about 410 cubic feet of gas, and takes about 1 hour and 45 minutes. For the maintenance of this temperature, about 260 cubic feet of gas per hour is consumed. The design of the furnace is such that when the high-temperature chamber reaches the desired temperature, the intermediate and low-temperature chambers also reach the desired temperature.

When the hobs are removed from the high-temperature chamber they are quenched in oil heated to 300 degrees F. They are then allowed to cool in a receptacle which protects them from drafts. After cooling, the hobs are tempered by reheating to a temperature of 1050 degrees F. in a Leeds & Northrup electric furnace, and again permitted to cool in dry air. Carbon-steel hobs are hardened by quenching in oil, after having been heated to from 1450 to 1540 degrees F. in the electric furnace, and they are then tempered by heating to from 350 to 450 degrees F. in the same furnace and cooling in dry air.

After tempering, the hobs are free from scale, but they are of a bluish black color. They are cleaned to a gray color by a sand-blasting operation in which steam of 90 pounds pressure and powdered sand are used; this operation is called the "mud bath," because it is essentially a scouring or cleaning process.

Final Grinding Operations

After the mud bath, a number of dry grinding operations are performed on each hob, a B. & S. No. 13 universal grinding machine being used. The first step consists of grinding the hole; during this operation one end of the hob is seated on a conical center in the index-head by means of the 60-degree bevel which was machined at the edge of the hole in the boring step and which was polished after tempering. The other end of the hob is supported by a steadyrest. With this set-up it is necessary to turn the hob end for end in order to grind both ends of the hole. The internal grinding attachment is, of course, mounted on the machine.

The external grinding attachment is then mounted on the machine, and the hob is placed on a drawback adapter for grinding the hub face and the narrow shoulder on each end. These shoulders provide a means of accurately setting up the hob in hobbing machines. Finally, the hob is mounted on an arbor, as illustrated in Fig. 8, for grinding the face of the teeth. This is done by traversing the work past the wheel and indexing for each flute. Both straight- and spiral-gashed flutes can be ground on this machine. Every hob is later tried out in a hobbing machine, and the work produced is checked to determine the accuracy of the hob.

Design of Hob Cutters

Cutters for producing gear hobs of from 3 to 7 diametral pitch are made about 6 inches in diameter, and those for hobs of 8 diametral pitch or over are about 4 inches in diameter, the exact diameter depending upon the number of teeth and the diametral pitch. Cutters for thread-milling and hacksaw-blade hobs are also made 4 inches in diameter. Dimension *A*, Fig. 10, represents the width of tooth allowed for regrinding gear hobs, and is 1/4 inch. Angle *B* is 20 degrees on all hobs, and angle *C*, 45 degrees on gear hobs only. On other hobs, the surface of relief is continued to the back of the hob. Angle *D*, as previously mentioned, is usually 5 degrees for gear hobs, and 10 degrees for thread-milling and hacksaw-blade hobs.

It will be seen from this illustration that the depth of the tooth remains the same as the tooth faces are reground, but as the pitch diameter of the teeth also remains the same, the tooth addendum is decreased, and the dedendum increased. In order to compensate for the difference that will exist in a new and a nearly worn out hob, the plane where a cross-section through a tooth is of standard dimensions, is located one-half of the distance *A* from the tooth face, before any regrinding. About 0.001 inch of stock is removed from the cutter teeth in sharpening, and each cutter will produce from 200 to 240 hobs.

The cutters are made from forged disks, it having been found more satisfactory to purchase the disks in this form

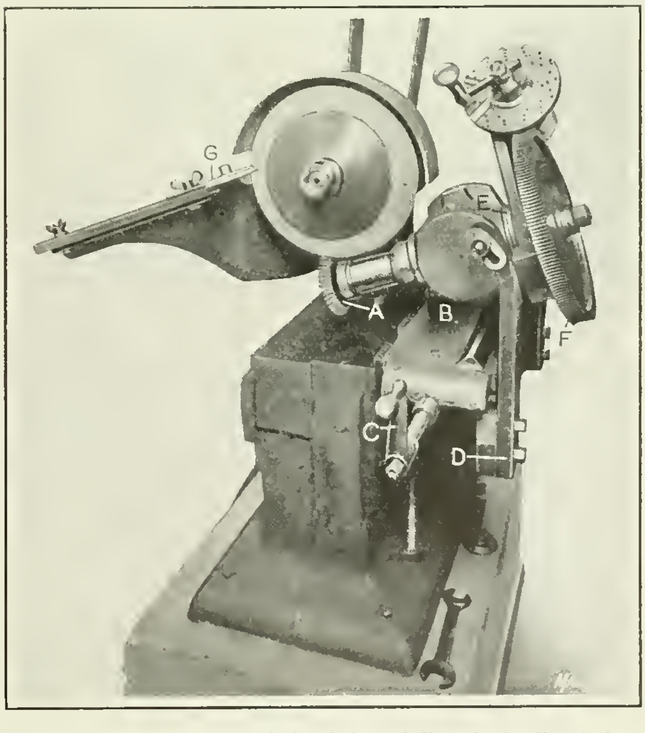


Fig. 11. Special Machine designed for grinding the Profile of the Cutter Teeth

than to cut them from bar stock. The disks are rough-drilled by using the fixture illustrated in Fig. 2, rough-faced on both sides, and rough-turned in a lathe, given an annealing similar to that described in connection with the hobs, and then permitted to season. The next step consists of finish-boring, finish-facing both sides and finish-turning the peripheral surfaces to the required angles.

The teeth of the cutter are hobbed in a specially adapted Lees-Bradner hobbing machine set up as shown in Fig. 9. The operation is standard, except that in order to hob out the teeth according to angle *B*, Fig. 10, it is necessary to feed the hob a predetermined amount toward the cutter as the cutter is fed past it. This feeding movement is obtained by gearing the work-spindle of the machine to the shaft that actuates the hob slide. The operation requires a special hob, corrected to compensate for the angular cut that it takes, the correction being made by grinding. The cutter is next placed in a lathe for machining the rake angle *D* and cutting recess *E* to provide a clearance for the grinding wheel in a later operation. The cutter is then subjected to the same hardening and tempering treatment as the hobs and permitted to season before being brightened by the mud bath.

Grinding Operations on the Cutter

The cutters are ground all over. The first step consists of rough-grinding the sides, rake, and hole, and is performed on the B. & S. grinding machine previously referred to, after which it is finish-ground on the same machine. In grinding the hole, the cutter is clamped to the faceplate, after being trued by means of an indicator. For the other grinding operations, it is held on a special arbor and also set up by means of an indicator.

The machine illustrated in Fig. 11 was designed and built especially for grinding the tooth profiles. The cutter *A* is placed on the spindle of a housing which slides along a way on bracket *B* when handle *C* is revolved. Simultaneously with the traversing of the housing, the work-spindle is given a rotary movement by means of a wire held taut between brackets *D* at the front and rear of bracket *B*. This wire is wrapped tightly around the cylindrical surface *E* of the work-spindle, causing the spindle to turn when its housing is moved along bracket *B*. The work-spindle is swiveled in its housing to the angle at which the cutter teeth are machined, which in the case illustrated, is 20 degrees. Graduations on the housing facilitate this setting.

In mounting a cutter on the work-spindle, it is accurately indexed by means of the worm and worm-wheel mechanism at the right-hand end of the machine, to bring the grinding wheel into proper contact with a tooth. This mechanism is also employed to index the cutter for grinding all the teeth. The 192-tooth worm-wheel *F* and a vernier permit indexing of the work to one thirty-thousandths of an inch on a 4-inch diametral pitch cutter. Bracket *B* is mounted on a vertical slide which is adjustable to suit any diameter of cutter.

The first cut is taken on the bottom of the tooth spaces by the flat edge of the wheel which is dressed to a truncated wedge having an included angle equal to the pressure angle of the teeth. When this cut has been taken around the entire cutter, the cutter is indexed slightly to bring one side of a tooth in contact with a side of the truncated wedge. The desired involute is then ground on this side of each tooth as handle *C* is revolved, due to the rotary movement of the work-spindle. The cutter is, of course, indexed one tooth after each traverse of the work-spindle housing. The opposite side of each tooth is next ground by indexing the cutter slightly to bring it in contact with the opposite side of the truncated wedge. In this operation the vertical center line of the grinding wheel passes midway between the portion of the cutter teeth which is relieved 20 degrees.

About 0.0015 inch of stock is removed from the bottoms and sides of the teeth, after which they are again seasoned before finish-grinding. In the latter operation the process is the same as in the preliminary grinding, and about the same amount of stock is removed until the teeth are ground to size. Before the work is removed from the machine, the operator must be able to produce only a bare trace of a spark on each tooth without a noticeable change in the sound of the grinding. The teeth are then checked by means of vernier gear-tooth calipers, and the root diameter is measured. After that a dummy hob is cut from close-grained cast iron and checked. It has been found that the greater the amount of seasoning given a cutter between the different operations, the more satisfactory its service will be.

Dressing the Wheel for Different Tooth Forms

In the foregoing description of grinding the cutter teeth, it was assumed that the cutter had standard involute teeth of 14½ degrees pressure angle. If the pressure is other than 14½ degrees, bracket *B* is swiveled on its slide to compensate for the difference. In grinding cutters of hobs for gears that are to mesh with gears produced by B. & S. form cutters, or on Fellows gear shapers, the grinding wheel is dressed in a special manner by means of a truing diamond controlled by a mechanism, mounted on the machine at *G*. The wheel must also be dressed similarly to suit special tooth forms.

* * *

COMMERCIAL STANDARDS FOR TAPS AND DIES

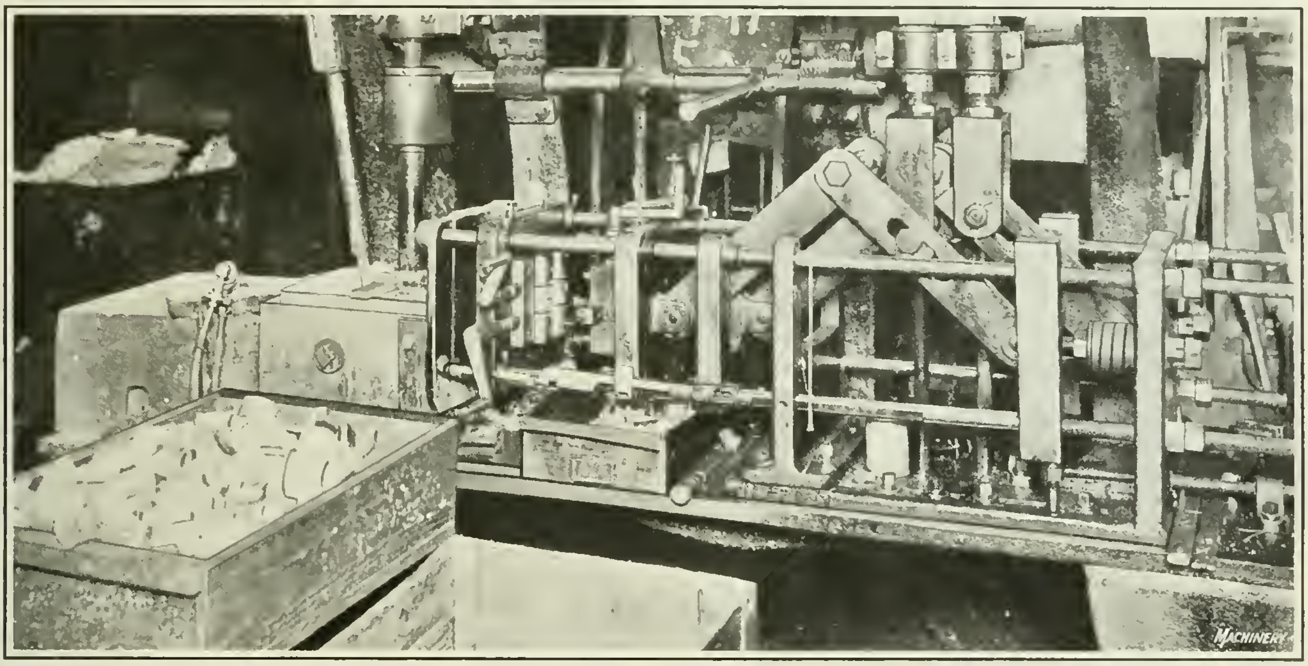
Several years ago the Tap and Die Institute, 116-120 W. 32nd St., New York City, realized that there was a definite demand among users of taps and dies for a greater degree of uniformity in these tools. A comprehensive work of standardization was therefore begun, and as a result a number of standard tables relating to taps, drill sizes, and chamfers on dies have been prepared and adopted. The more important of these standards are incorporated in a pamphlet recently published by the Tap and Die Institute and are presented by the Institute to the trade. Many other standardized dimensions of taps and dies not shown in this pamphlet will be found in the trade catalogues of the various manufacturers of taps and dies. This work of standardization is continually going on and from time to time additional standards will be adopted. The tables in the pamphlet mentioned cover dimensions of hand taps and pipe taps; commercial tolerances for hand taps, pulley taps, machine screw taps, and nut and tapper taps; tap drill sizes; and a table of chamfer on dies. Where tolerances are given, it is understood that these are commercial tolerances for taps, the figures representing the measurements of the taps themselves and not the tapped hole.

* * *

HARDENING STEEL WITHOUT SCALING

Processes for hardening steel without scaling have had much attention in England during recent years. One of the most successful hardening furnaces that meets these requirements is that made under the Walters patents. In this furnace the work is suspended in a vertical tubular muffle heated by an electric resistance winding of nichrome. The atmosphere in the heating space is coal gas, which is admitted to the lower end of the muffle and escapes slowly through an outlet near the top. The atmosphere therefore is non oxidizing and in fact, slightly reducing. When the work has reached the required temperature, it is dropped straight into a quenching tank without coming in contact with atmospheric oxygen. The result is a surface quite free from pits or scaling. At present the furnace is in use chiefly in tool-rooms and for laboratory purposes, but larger furnaces have been used with great success in the hardening of crankshafts, rolls and other heavy work up to 200 pounds.

Equipment for Making Die-castings



Applications of Die-castings—General Principles of Die-casting Machines—Points on the Design of Parts to be Die-cast—First of a Series of Articles

By A. G. CARMAN, Chief Metallurgist, Franklin Die-Casting Corporation, Syracuse, N. Y.

DIE-CASTINGS are rapidly becoming recognized as a substitute for accurately machined castings or forgings where the requirements placed on the parts are not too severe for the metals that are commercially adapted to the die-casting process. Die-castings may be defined as castings produced by forcing molten metal into metallic dies by a force greater than atmospheric pressure. This definition differentiates them from the class of castings made by the permanent mold process often referred to as die-castings.

Die-castings are uniform accurate, and cheap, equal to the product of a skilled workman, but produced by unskilled labor. Their advantage over machined parts is due to the rapidity with which they are produced and the relatively small amount of labor necessary after they are cast to produce a finished piece ready to be assembled. The principal reason that die-castings are not used in much larger quantities than they are is that the attention of engineers has not been called sufficiently to their advantages from a mechanical as well as an economical standpoint.

A brief description of the process by which die-castings are produced, covering the machines and their operation; the dies, their construction and operation; and the metals, their chemical and physical properties, will contribute to a better understanding of the possibilities of die-castings and their application to the requirements of various industries. It is not the intention to give a description of the specially designed automatic machines, which have only a limited field, being confined to smaller castings required in very large quantities, but rather to describe the simpler die-casting machines with the idea of dealing with the general principles of the die-casting process.

Die-casting Equipment

The die-casting equipment consists of a cast-iron heating pot for the metal, located at a convenient distance from the die-casting machine. The metal in this pot is heated by gas, and is kept slightly above the melting point by regulating the heat and by occasionally adding new metal to take the place of that used in making the castings.

The casting machines proper are of two general types, the plunger type and the compressed air type. The plunger type consists of a cast-iron container for the metal heated by gas. In this container is submerged a rectangular or cylindrical chamber fitted with a plunger. This chamber has two openings, one of which is located in the side or bottom, just at the end of the plunger when it is drawn back preparatory to forcing the metal into the die. This allows enough metal to enter the chamber by gravity to make the casting. When the plunger is forced forward, it closes the opening, and the metal is forced from the chamber through the second opening into the die. The plunger may be actuated by hand, with a long lever, by compressed air, by steam, or by any other suitable power which will supply a heavy, rapid pressure. This type of machine is suitable for casting metals having melting points below 800 or 900 degrees F., and having only slight corrosive action on the cast-iron plunger.

The compressed air type of die-casting machine consists of an air-tight cast-iron chamber for the metal, suitably heated to keep the metal at the desired temperature. This chamber is connected with the die by one opening and with the compressed air line by another. In the latter opening a valve is fitted with a lever for the sudden release of the air into the metal chamber. This valve also permits of a gradual decrease of the pressure on the metal after it has filled the die. This type of machine may be used on metals cast by the plunger type, but is especially suitable for metals that cannot be cast in the plunger type of machine on account of their high melting point or corrosive action on the cast-iron plunger. The air pressure used may vary from 150 to 500 pounds per square inch, depending upon the size and shape of the casting and other conditions under which the casting is made.

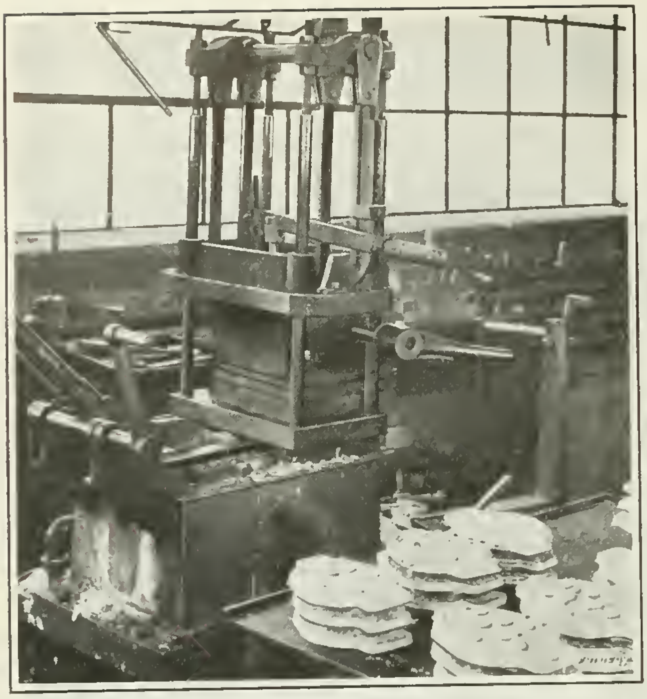


Fig. 1. Plunger Die-casting Machine with Tilting Vise in Vertical Position

The die is attached and held firmly to the pressure chamber by a vise. This consists essentially of two rectangular plates having the two surfaces facing each other held parallel by four legs which hold the lower steel plate rigidly in place but allow the upper cast-iron plate to move backward and forward. The two plates form the supports for the two halves of the die and, by means of a lever and toggle joint attached to the upper plate, serve to lock the two parts of the die securely together while the casting is being formed, and to separate the halves of the die for removing the finished casting. The lower plate has an opening with a nozzle which fits perfectly the nozzle of the pressure chamber for the admission of the metal to the die.

The vises are of two general types, horizontal and tilting. The horizontal type, shown in the heading illustration, is placed at the side of the machine, and by means of four legs allows the plates carrying ono half of the die to move only in a horizontal direction for the casting process. The tilting type of vise, illustrated in Figs. 1 and 2, is fastened to the casting machine by a hinge which allows the vise to assume a vertical position (see Fig. 1) while the casting is being formed and a horizontal position (see Fig. 2) while the die is being opened and the casting removed. The horizontal type is especially suitable for automatic power machines while, in general, the tilting type is more suitable for hand-operated machines.

Die-casting Dies

The die is by far the most important part of the casting equipment. It requires considerable ability and experience in die construction to so design the location of the gate, cores, vents, and other details, that everything in the construction will add to the rapid production of perfect castings when the die is placed in operation. In addition, skilled machinists, experienced in die construction, are required to carry out the design faithfully in the construction of the die. When it is considered that a single die may cost from $200 to $2000, and that a small error may ruin it, the importance of skilled workmanship will be realized. The dies are made of a high-grade tool steel for the lower melting point alloys, and of a high-grade chrome steel for aluminum alloys.

A die-casting die consists essentially of two parts, held in their proper relation to each other by dowel-pins. In the center of the die is a depression or depressions, an exact duplicate of the casting desired, allowing, of course, for the shrinkage in the metal. Leading to this depression is an inlet through the lower plate for the admission of the metal. The depression may be located wholly in either one of the two parts of the die, or it may be located partly in one and partly in the other. In any case, the parting line must be so located that when the two parts are separated the casting can be easily removed.

Cores in Die-casting Dies

Some dies have cores *B* (Fig. 2) to form holes or depressions in the castings where they require it. These cores may be stationary, if they are parallel with the direction in which the parts of the die move when being opened, but must be movable when they are not parallel with that direction. Small cores are operated by small levers, and are locked in place by a toggle joint to keep the metal under pressure from forcing them back when the casting is made. Large cores are operated by a rack and pinion, and may be locked in place by dowel-pins whenever the core does not have to be drawn before the die is opened. Still other castings require slides in the die to form special surfaces; these also are usually held in place by dowel-pins while the casting is being made. The die is fastened rigidly to the vise by screws, the upper half *A* to the movable upper plate and the lower half to the lower plate.

Some dies operate best when heated; this is accomplished by means of torches directed on the surface of the die. Others operate best when a cooling system is applied, either by means of a current of air, or by circulating water through channels in the die. There is no rule for determining the conditions under which the dies work best; they must be experimented with when they are placed in operation.

After the casting has been formed, the die opened, and the cores and slides drawn, it is removed from the die by means of ejector-pins. These are small rods fastened to a plate moved by a rack and pinion, by means of handle *C*. The ejector-pins pass through the upper part of the die and extend flush with the surface of the casting depression when pulled back as far as possible. When moved forward by the pinion, they extend into the depression. It is necessary that the pins be so located that the ejection of the casting will not strain the metal, which is still hot.

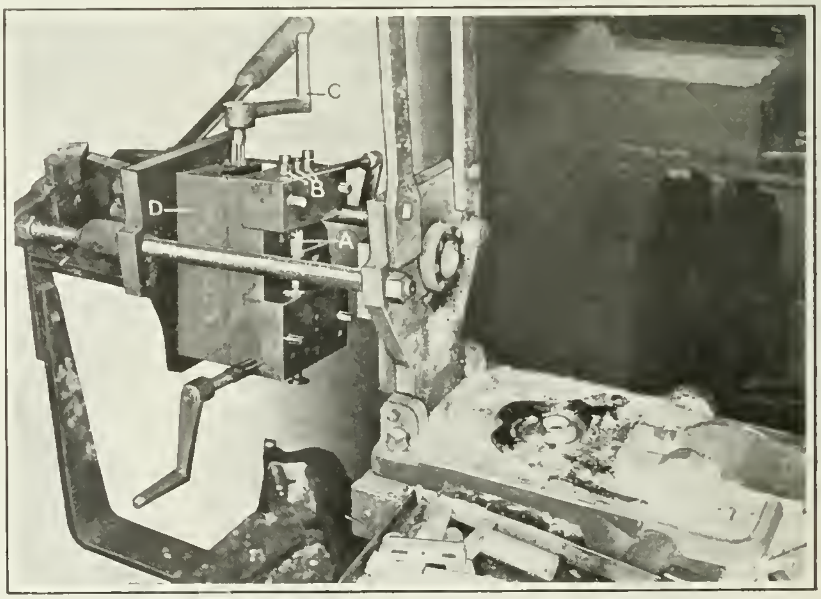


Fig. 2. Plunger Die-casting Machine with Tilting Vise in Horizontal Position

As the metal is forced into the die, it is necessary to provide a means of escape for the air contained in the depression of the die and the passage to the compression chamber; if this is not done, the air will be trapped in the metal and the castings will not be sound. This escape is provided for either by small grooves machined in the parting of the die, or by removing the air from the die by a vacuum pump just prior to the admission of the metal. The former method is the one most commonly used.

Inspection and Trimming of Die-castings

After the castings leave the foundry, they are taken to the trimming room where they are inspected, the fins removed, holes tapped, and any additional work necessary to prepare the casting for assembly. If castings require polishing, this is also done in this room. The equipment of this room consists of drilling machines, grinding and polishing wheels, band saws, punch presses, lathes, etc. Fig. 3 shows a small portion of the trimming room. From the trimming room the finished castings are taken to the shipping department where they are packed ready for shipment.

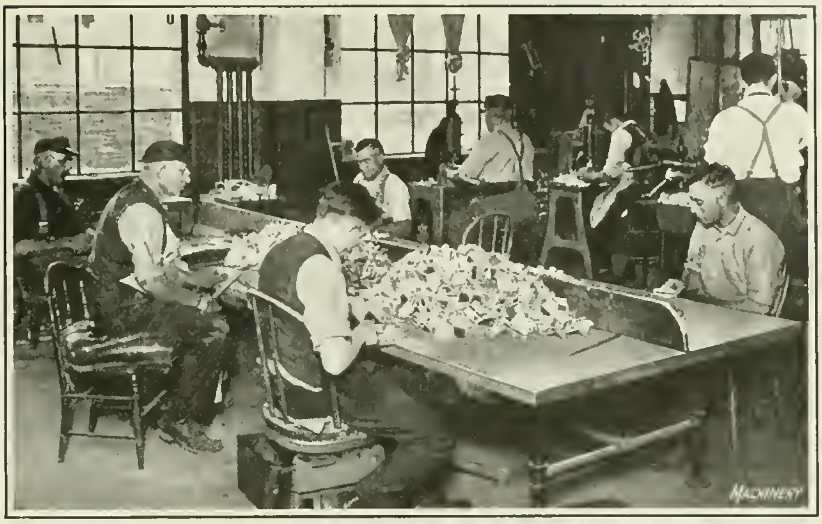


Fig. 3. Trimming Room where Die-castings are inspected and the Fins removed

Designing Parts to be Die-cast

In considering die-cast finished parts, there are certain general points, which if borne in mind by designers, will result in better service, a higher grade of castings and increased production. Under-cuts or recesses in the castings should be avoided. In many cases, it is, of course, possible to use collapsible cores for under-cuts and recesses, but this increases the cost of both the die and the casting process. A slight draft is desirable, especially in the die-casting of aluminum alloys. It is cheaper to cast raised letters than depressed ones, since for the former, it is necessary only to stamp or engrave the letters in the die, while in the latter the surface surrounding the letters must be cut away. However, the use of both kinds of letters is practicable. The sections of die-castings should be as uniform as possible, and small fillets should be added wherever there are sharp corners.

General Application of Die-castings

Die-castings are not intended to take the place of the parts produced in power presses or automatic machines, or of forgings requiring little machine work; they are intended especially for intricate parts requiring a considerable amount of high-grade machine work. Such castings, in order to be made most profitably, must be required, ready for assembling, in large quantities, at least in lots of thousands, and still better, in 100,000 lots.

As the physical characteristics of the metals for die-castings closely resemble those of cast iron, die-castings readily replace parts usually machined from that metal, and may even supplant brass or steel, with proper changes in design. The low fusion temperature of the die-cast metals also makes it possible to incorporate steel, copper, or brass inserts at points requiring special strength and wearing qualities.

At present, by far the largest number of die-castings are used in the automobile industry, but a great many are also used for electrical equipment. Many miscellaneous parts are employed for household utensils, dental apparatus, phonographs, safety razors, sewing machines, vacuum cleaners, washing machines, and many other devices in general use in the home, office, and factory.

Fig. 4 shows a number of parts, which will give an idea of the diversified purposes for which die-castings are used. *A* is a mounting used on automobiles; *B*, an automobile friction wheel; *C*, a frame for a ticketing machine for department stores; *D*, a frame for dental equipment; *E*, a part for a cream separator; *F*, an accelerator guide for automobiles; *G*, a reel for electrical equipment; *H*, a measuring roll for a cloth-measuring machine; *I*, a jeweller's casting flask; *J*, a stamp case for office equipment apparatus; *K*, a part for dental equipment; *L*, a split gear for knitting machines; *M*, a locking boss for an airplane; and *N* an indexing quadrant for a meat-slicing machine. The parts, *A*, *B*, *D*, *F*, *G*, *K*, and *M* are cast from aluminum-base metal; parts *C*, *I*, *J*, *L*, and *N* from zinc-base metal; and *E* and *H* from tin-base metal.

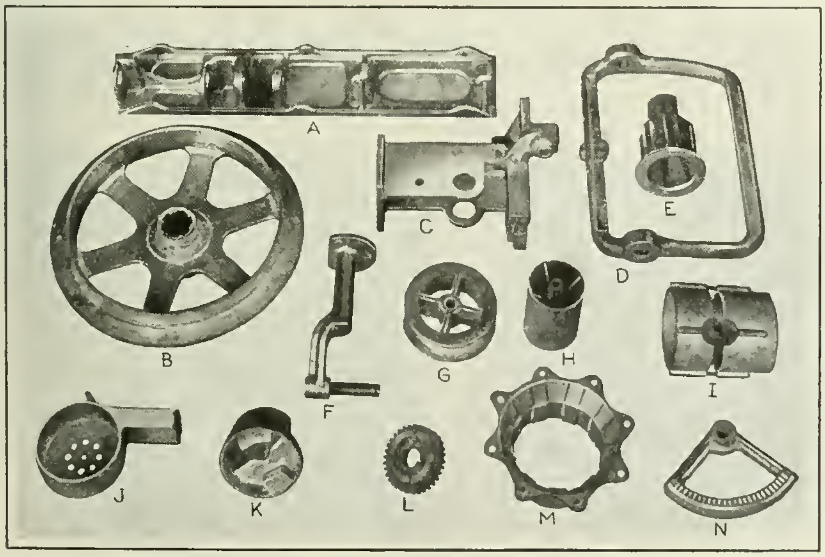


Fig. 4. Examples of Parts made by the Die-casting Process

Subsequent installments of this series of articles will deal with die construction, showing the methods used in the design of dies for many different purposes, including wheels having raised letters, figures, or characters on their periphery, dies for instrument housings, dies for venturi tubes for gas-engine mixing chambers, and dies for door checks. Another article will deal with the metals used in die-casting, giving definite compositions, and will also contain the possible limits for different types of die-castings, and other information of particular value to those who contemplate the use of die-castings in machines or devices of their manufacture. The entire series will present a comprehensive treatise on the subject of die-casting.

Follow-die for Switch Plates

By GEORGE W. WILDER

SWITCH plates like the one shown at *A*, Fig. 1, are used on the walls and floors of houses to cover electric switches. The brass stock from which this type of plate is made is 0.017 inch thick. As shown, there are four pierced holes in the plate and the outer edges are bent down to give the work a beveled appearance. The work is shown drawn to a larger scale than the die. The two larger holes in plate *A* are for the switch buttons, while the two small holes receive the fastening screws. The plates are given a brush finish, and the corners are required to be stamped sharp on the outside. The various parts of a follow-die used to pierce, stamp, and trim the plates from the strip stock are shown in the sectional view, Fig. 2.

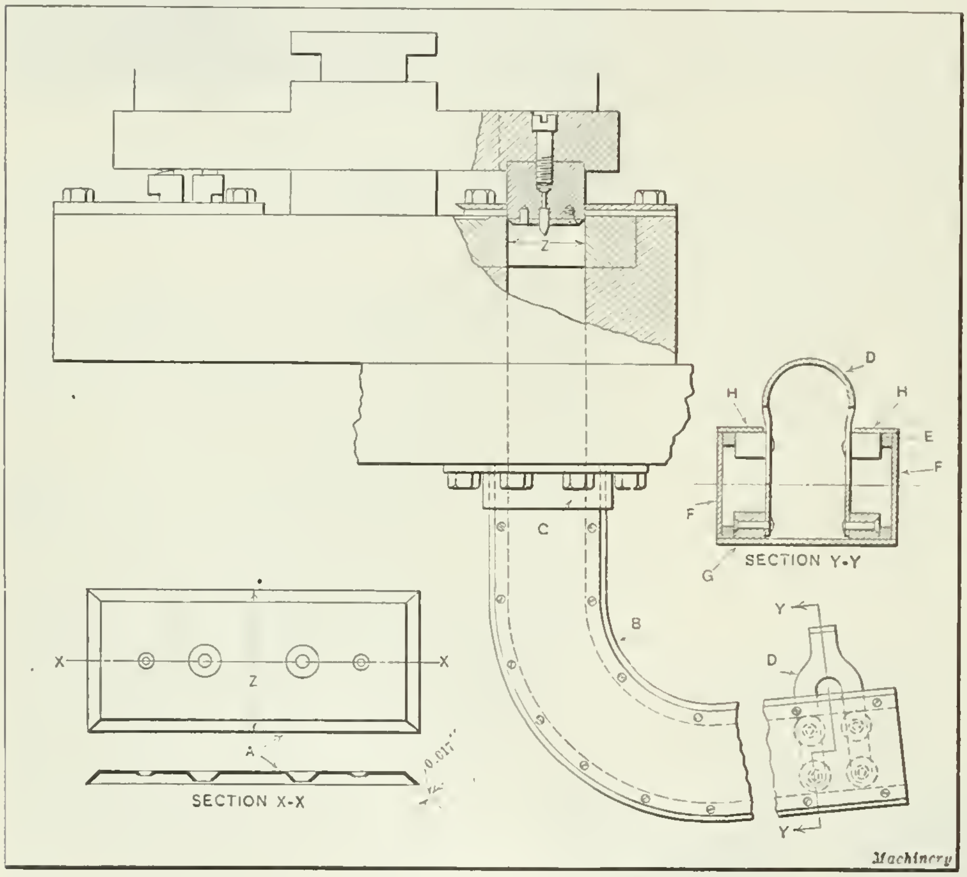


Fig. 1. Follow-die equipped with Stacking Device

The method of production before this die was made consisted of first cutting the metal up and piercing the holes to the proper size and in their correct positions. The plates were next stacked in boxes which were trucked to the stamping room, where they were fed, one at a time, under a drop-hammer, which stamped them to the desired shape. After this operation the plates were again stacked and trucked back to the press room where they were fed by hand, one at a time, into a trimming die. It is important that the faces of the plates should not become dented or nicked, as this would prolong the buffing operation, and if the dent is too deep to be removed by buffing, the plate must be scrapped. It will be seen, therefore, that it was necessary to catch the plates as they came from the trimming die, and stack them again, in order to prevent them from becoming dented.

The follow-die shown in Fig. 2 was so designed that one operator could attend to all operations on the plates except buffing. In order to accomplish this, a catching and stacking device was necessary. The device developed to perform this operation is shown at *B* in Fig. 1, attached to the die. It is commonly referred to by the operators as the "cobbing" chute. The die is of the open sub-press type of construction, and the successive operations pierce, stamp, and trim the work. The stamping operation forces some of the metal below the top surface of the strip stock, thus forming a projection on the under side. It is therefore necessary to arrange for lifting the stamped portion out of the die and providing clearance for the stamped portion when the metal is lowered again in the succeeding position.

The operation is as follows: The metal is started at the left and fed under plate *A*, Fig. 2, until the entering end is flush with the right-hand edge of the plate. The roll feed is then engaged and the press started. As the ram descends, stripper *B*, which supports the piercing punch *C* and receives its tension from springs *D* (only one of which is shown), engages the metal between it and the spring pad *E*, which, in turn, receives its tension from springs *F*. The stock is then carried down into contact with the top of die *G*, where it is pierced by punch *C*. The scrap passes out through a hole in the die-block. As the ram ascends, stripper *B* strips the metal from the piercing punch *C*, and spring pad *E* lifts the metal up high enough so that it will clear the forming die *H*.

For clearness the smaller punch which pierces the screw hole is not shown, but it should be borne in mind that all four piercing punches are in line and held in the same manner as punch *C*; Fig. 2 shows only a cross-section taken through one of the punches.

The strip is again fed forward, and on the next stroke the metal is engaged between the forming pad *J* and the forming punch *K*. When in this position, the stock is located by the forming pegs at the center of pad *J*, which act as pilots. All four forming pegs are held in plate *M* in the same manner. The forming pad *J* is supported by three springs *N* so that the metal, when it is drawn over the beveled edge of the die *H*, will have no tendency to wrinkle or pull. The stock is also kept from wrinkling by the spring pad *P*, which holds the surrounding stock between its lower face and the die *H*. This pad is held in place by screws *Q* and receives its tension from springs *R*.

At first, much difficulty was experienced in forming sharp corners on the outside of the plate, but this was overcome by making the punch as shown in the enlarged section at *S*. The ridge around the edge of the punch was ground from 0.004 to 0.005 inch higher than the major face of the punch.

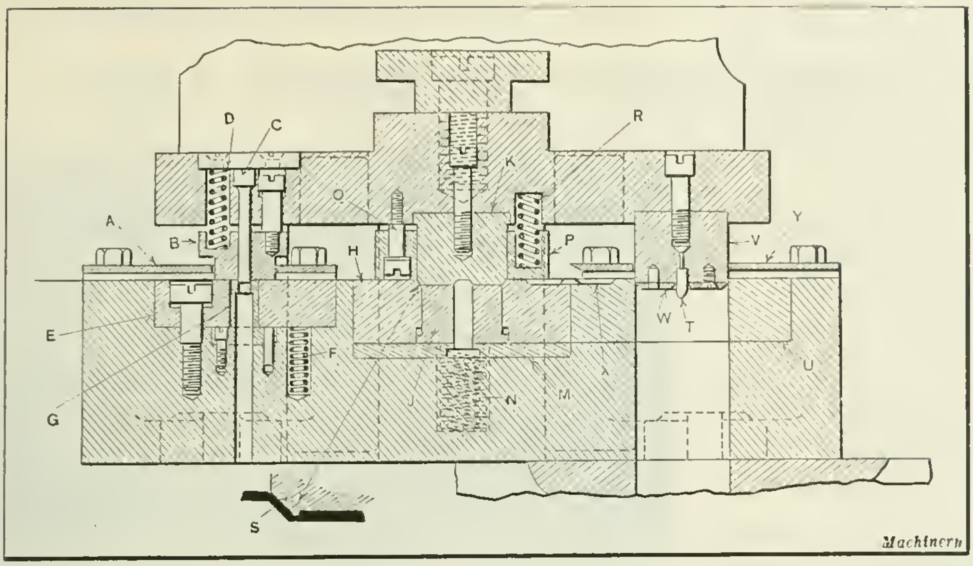


Fig. 2. Sectional View of the Follow-die for piercing, forming and trimming Switch Plates

and about 0.040 to 0.050 inch in width. This ridge forces the metal out so that it fills in the space in the die (and sometimes throws a slight "fin," which is removed in the buffing operation), making a sharp corner where otherwise there would be a round corner having a radius equal to the thickness of the metal. As the ram ascends, the springs *N* force the pad *J* up, which, in turn, lifts the formed plate up so that it can be fed across the die *H* without catching on the corners of the die recess. The pad *J* bottoms on the steel plate *M*, which receives the extreme pressure at the end of the downward stroke.

The metal is again fed forward, so that at the third stroke of the press the holes pierced in the first position are in line with pilots *T*. The plate is trimmed as the punch *V* enters the die *U*. The punch *V* has a formed plate *W* of soft steel fastened to it which fits the work. This form is removed when the punch is being ground. As the distance between the centers of the piercing and forming dies is equal to two blanks plus the bridging, it was necessary to cut a clearance at *X* to receive the impression made in the stock by punch *K*. As the ram ascends, the metal is stripped from the punch by the stripper plate *Y*, which is beveled at its front end to eliminate any tendency for the metal to catch or stick when being fed forward.

The plate, when trimmed, passes down through the die bed into the cobbing chute *B*, Fig. 1, which is fastened to the bolster plate by four angle-irons *C*. The cobbing is started by placing friction spring *D* up as far as it will go in chute *B* and filling the remaining space between it and the die with plates. Then when a plate is trimmed, it is forced through the die, and presses the friction spring *D* down a distance approximately equal to the thickness of the plate. The chute is bent to an angle of slightly less than 90 degrees, and after the plates are cobbed beyond this bend, the friction spring may be removed, and the plates taken out in small stacks and put in boxes near the operator.

The sectional view of chute *B* shows the friction spring *D* and the rolls that ride inside the chute. The chute frame is built around four square steel pieces *E*. It is closed in on three sides by the plates *F* and *G*, and is partially closed at the top by plate *H*. The chute has a support at the extreme end, which is fastened to the floor. The 200-ton Bliss press on which this follow die and stacking device are used is run at a speed of 30 revolutions per minute. The coiled stock is fed to the press by a single-roll feed, and the scrap is wound on a reel. The press thus equipped turns out and stacks one plate at each stroke, or thirty plates per minute. This die enabled the production to be greatly increased, and the three operations were performed by one operator.

* * *

RESULTS OBTAINED BY MACHINE-LAPPING

A number of interesting comparisons between ground, hand-lapped, and machine-lapped surfaces were shown in April, 1922, MACHINERY. The accompanying illustrations show other examples of similar work. Fig. 1 shows a cylindrical ground surface of very good quality, magnified one hundred times. Fig. 2 shows very good hand-lapping on a similar cylindrical surface; and Fig. 3 shows high-grade machine-lapping on the same class of work. It will be seen that in the hand-lapping the scratches run in all directions, while in the machine-lapped surface the marks or scratches run practically in one direction only. Several concerns have now developed means for doing machine-lapping satisfactorily, and consider the results obtained by this means in gage work to be superior to hand-lapping.

* * *

It has been found of advantage in thermit welding to cut a channel or trough in the top surface of the mold connecting the pouring gate and the top of the riser. The purpose of this channel is to cause the first slag that overflows on the top of the mold to drain quickly into the riser while the metal is still very liquid. This has a tendency to equalize the pressure on the pouring gate and the riser.

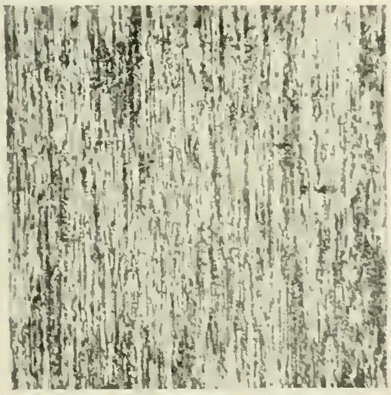


Fig. 1. Ground Surface; Magnification, 100

Fig. 2. Hand-lapped Surface; Same Magnification

Fig. 3. Machine-lapped Surface; Same Magnification

Using the Turret Lathe for Small Lots

Examples Showing How Small Quantities of Bar Stock Parts can be Economically Produced on the Turret Lathe

By ALBERT A. DOWD, President
and
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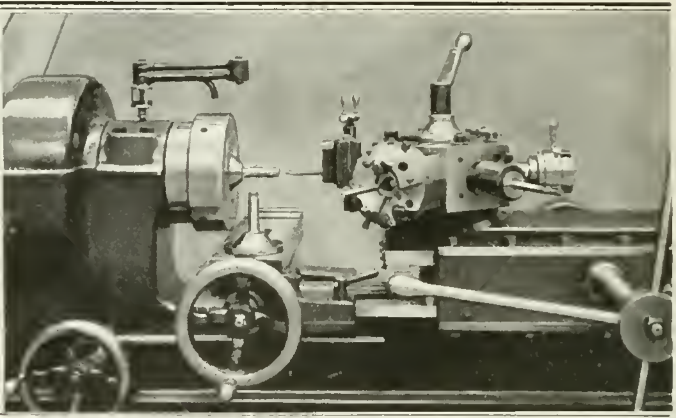
Dowd Engineering Co., New York



IN the average shop, when business is dull and the factory is not engaged in high-production work but largely on small orders of different kinds, engine lathes are generally found busy and turret lathes idle. If the foreman is asked the reason for this, he will probably say, "Well, there are only a few pieces of each kind to be made, and it would take too long to set up a turret lathe for the job." This statement is based on a misconception, and it is the writer's belief that many manufacturers sustain losses because of this mistaken attitude. As a matter of fact, the turret lathe can be used economically on short jobs.

When turret lathes are used on small orders, the work is quite different from production work, although many of the same tools are used. The economies effected are dependent to a great extent upon the rapidity of the operator in setting up the machine. A man who is finicky in his methods will not prove successful on work of this kind, although he may be a good operator on high-production work. He must know the machine thoroughly and understand how to get the most out of it, not only by using proper speeds and feeds, but also by the selection of suitable tooling equipment.

Work that could be Economically Handled in Small Lots

In order to illustrate the adaptability of a turret lathe for small jobs, a few examples of bar work will be presented. The work at *A* in Fig. 1 is a shaft which is to be finished all over to the dimensions specified. None of the tolerances are extremely close, and a good commercial job is all that is necessary. Ten pieces are required, and for such a job the average manufacturer who has not considered the problem carefully would say that the best method of handling it would be on an engine lathe. In the second example a half dozen special bolts, such as shown at *B*, are to be turned and threaded from hexagonal stock. The sleeve *C* is another part which would ordinarily be considered more suitable for an engine lathe when only a few parts are to be made. Twelve of these pieces are wanted. They are to be finished all over, but a high degree of accuracy is not required. Only three parts *D* are wanted and these are all to be held rather close to size. The special collar shown at *E* is to be made of bronze and finished all over. Twelve of these pieces also are wanted.

Procedure in Performing the Operations on Engine Lathes

If example *A* were machined on an engine lathe, it would doubtless first be centered at both ends and then held on centers while the various cylindrical surfaces and shoulders were turned one after the other, using a micrometer to establish the various sizes. Each piece would be handled separately and measured separately, although the diameters could be approximated very closely by means of the micrometer dial on the cross-slide. The shoulder distances would need to be measured or else it would be necessary to provide some special arrangement on the ways of the lathe to determine the proper distance to the various shoulders.

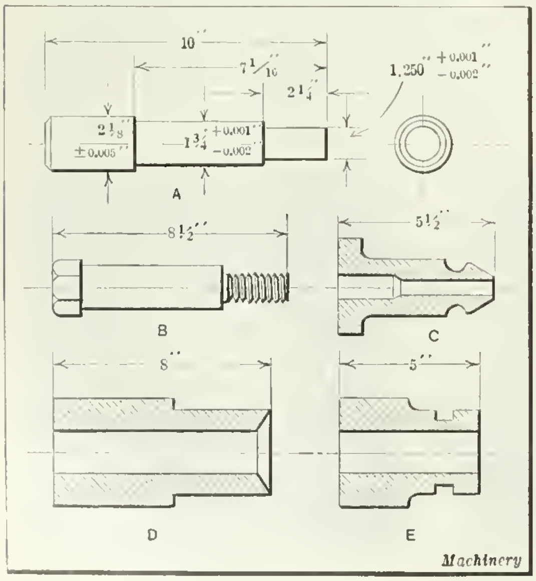


Fig. 1. Examples of Parts made from Bar Stock

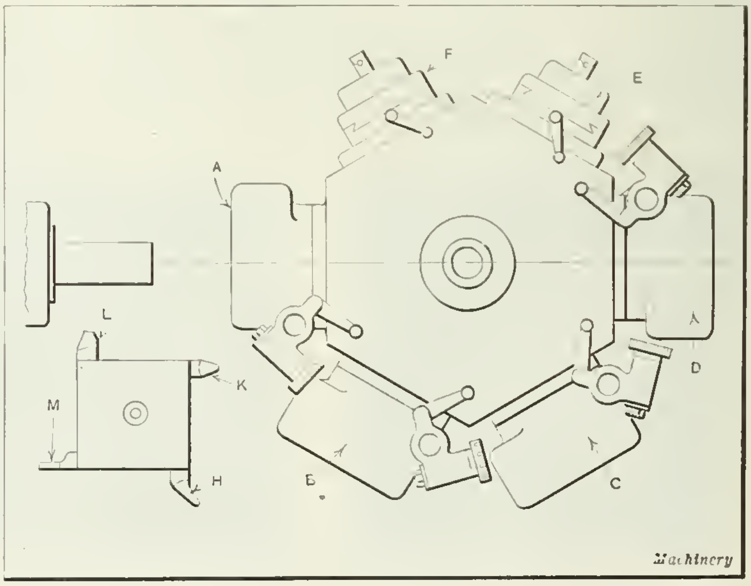


Fig. 2. Turret Lathe Tooling adapted for making a Variety of Parts

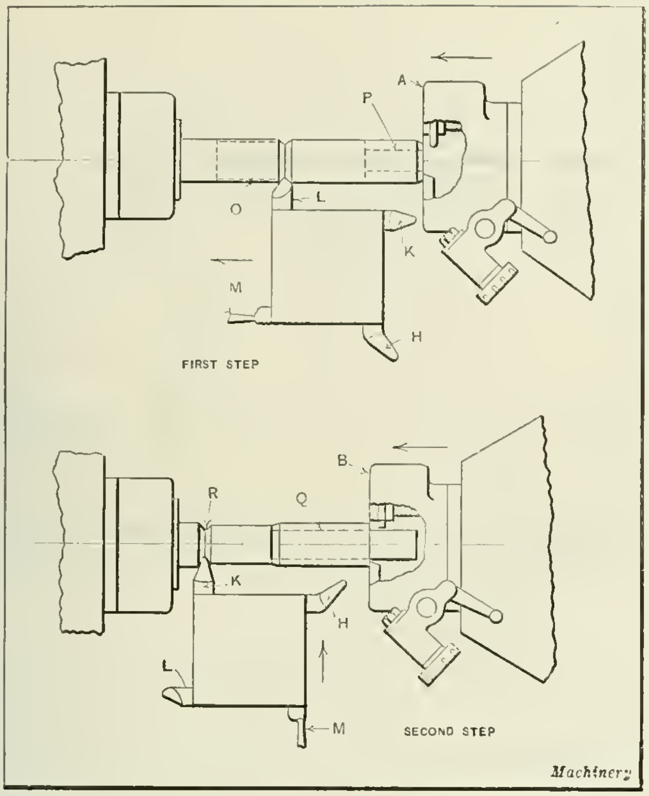


Fig. 3. First and Second Steps in machining Part A, Fig. 1

With example *B*, the work would be centered, as in the preceding case, the various surfaces turned, and the end threaded by chasing it with a single-point threading tool. Example *C* might be held in chuck jaws to permit the two holes to be drilled and the outside of the flange turned in the first operation. For the second operation, the work might be held on an arbor, in soft chuck jaws, bored out to the diameter of the flange, or perhaps a chamfer might be machined in the outer end of the holes to allow it to be held on centers and driven by a dog. The angular part at the small end could be turned by a flat forming tool, while the groove on the outside of the piece could be produced by a round-nose tool.

Part *D* would be held in chuck jaws, and the hole bored, reamed, and chamfered at one end, as shown. The work could then be placed on an arbor, and the outside turned and faced. Work *E* would be handled in a somewhat similar manner, being held by the outside while the hole was drilled and reamed, and on an arbor in a second operation to finish the outside diameter and face the ends. If only one piece were needed of any of these parts, the engine lathe would of course, be most suitable for its manufacture, but when several parts are needed a turret lathe is preferable. It is possible to set up a group of more or less standard tools on the turret and cross-slide toolpost of certain types of turret lathes in such a way that a considerable variety of work can be handled without making any radical changes in the tooling. In the following, tooling equipments adaptable to turret lathes built by the Warner & Swasey Co., Cleveland, Ohio, will be considered.

Typical Turret Lay-out for Jobbing Work

Fig. 2 shows the turret and square toolpost of the cross-slide equipped with a number of standard tools and several special ones. This lay-out is not suitable for all kinds of work, but it has a considerable range for certain varieties of bar work. When work is made from bar stock, the collet mechanism, of course, is used, jaws of suitable size being placed in the chuck according to the diameter of the work. The turret is equipped with four universal turning tools *A*, *B*, *C*, and *D*, and two slide-tools *E* and *F*. The square toolpost of the cross-slide carries a rough-turning tool *H*, double chamfering tool *K*, finish-turning tool *L*, and parting tool *M*. The cross-slide tools can be easily replaced by others of different form when the nature of the work requires it. The universal turning tools can be used for turning all cylindrical surfaces requiring considerable accuracy, while other surfaces of not such great importance can be machined by some of the cross-slide tools. In boring holes, cutting recesses, or facing behind shoulders, the slide-tools *E* and *F* will be found useful.

Setting up the Machine

The manner of arranging a machine provided with the tooling shown in Fig. 2 for machining part *A*, Fig. 1, will now be considered. A set of collet jaws of the right diameter is selected, and a bar of stock placed in the jaws, but the latter are not closed tightly on it. The turret is then brought up and the stock pushed back into the collet jaws until only a sufficient length extends. The collet is next locked, and the turret stop set so that other pieces will be made to the same length. The machine is now ready to make the first piece. The operator then brings up the turret, as shown in the first step in Fig. 3, and adjusts the universal turning tool *A* to turn surface *P*, leaving a small amount of stock for the finishing operation. This step is a "cut-and-try" proposition, but after the size has once been determined upon, no further setting is required for the turning tool.

After the distance to the shoulder has been measured and found to be correct, the turret stop is set so that the same surface on other pieces will be cut to the same length. The next step is to bring up the cross-slide toolpost, and by using tool *L*, feed into the work and then longitudinally toward the left along surface *O*. This step must also be done carefully until the correct diameter has been cut, after which the same diameter can be maintained on other work by reading the micrometer dial of the cross-slide. When the correct length has been determined, the longitudinal stop for the turret can be set. Tools *K*, *H*, and *M* are idle in this step. The tools in succeeding illustrations are designated by the same reference letters as are used for the same tools in Fig. 2.

For the second step on this piece, another universal turner *B* is brought up to machine the second cylindrical surface

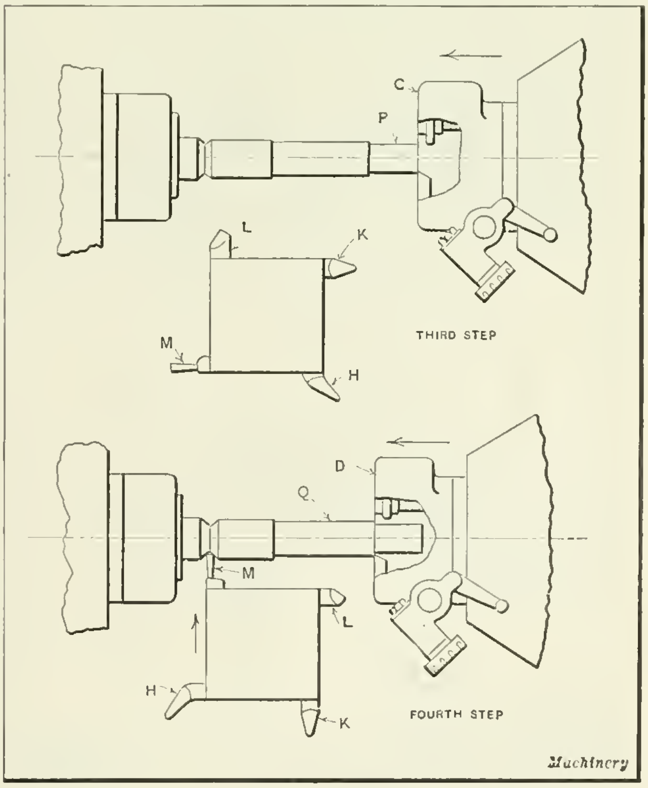


Fig. 4. Two Final Steps in machining Part A, Fig. 1

Q and the procedure followed in setting the tools for surface *P* is repeated. The cross-slide toolpost is then indexed to bring into use the chamfering tool *K*, which cuts a groove *R* at the point where the work is to be cut off, and at the same time chamfers the end of the piece and the end of the stock. The third step consists of finishing the surface *P*, as shown in Fig. 4, the universal turning tool *C* being utilized and the cross-slide toolpost remaining idle.

The fourth step consists of finish-turning surface *Q* with the universal turning tool *D*, after which parting tool *M* can be set for cutting off the work. All the tools should be adjusted and the various stops set before the bar is cut off. The operator can then immediately go ahead and produce the number of pieces required, no further setting of tools being necessary, as the various stops and micrometer dials permit duplication of the work without difficulty.

Turning and Threading a Special Bolt

For the manufacture of bolt *B*, Fig. 1, the tooling equipment in Fig. 2 can again be used, with the addition of a die-head for cutting the thread. Fig. 5 illustrates the tool used in the first and second steps. The collet jaws must also be changed to hold the hexagonal stock from which the work is to be made. In the first step, the turret stop is set to determine the length of work, and after this the universal turning tool *A* is brought up to turn the right-hand end of the part to the outside diameter of the thread. Tool *K* is next set to chamfer the opposite end of the part and the end of the stock, as indicated. The second step, which consists of turning the bolt body, is accomplished by means of turning tool *B*.

Fig. 6 shows the third step, which consists of cutting the threads with a self-opening die-head *X* placed on the turret, after removing slide-tool *E*, Fig. 2. In setting the stop for the "run" of the die, much depends upon the type of die-head used. If it is designed for outside tripping, it requires a special stop set to operate at the proper time, but if it is of the pull-off type, it is only necessary to set the turret stop so that it will function at the proper distance from the end of the part being threaded. The parting tool *M*, Fig. 6, is used to cut off the stock after the work has been completed, but this cut may be started while the die-head is in operation or even a trifle before in some cases. It can readily be seen that work of this nature can be performed in much less time than on an engine lathe, even when only a small number of parts are to be made.

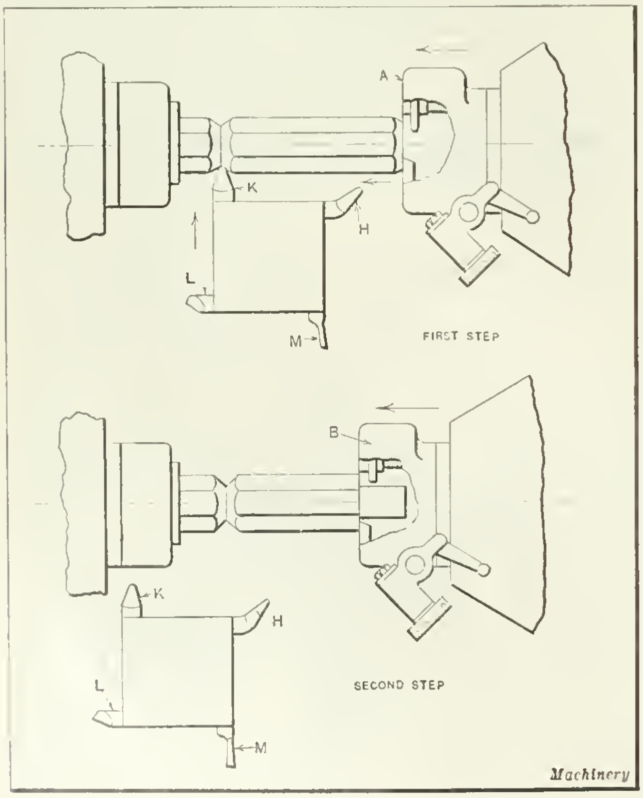


Fig. 5. Tools employed in the First and Second Steps on a Special Bolt

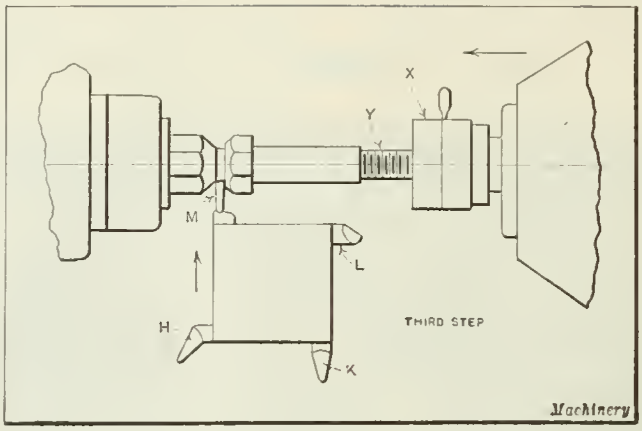


Fig. 6. Cutting the Threads on the Bolt and severing it from the Stock

Method of Handling a Piece of Formed Work

It might appear at first glance that the work shown at *C* in Fig. 1 could not be handled economically in small lots on a turret lathe. However, a careful examination of the tool lay-outs shown in Figs. 7, 8, and 9 will make it evident that only small changes are necessary in the original set-up to handle this piece. Fig. 7 shows the first and second steps. In the first step, the work is held in a collet of suitable size, and the universal turning tool *A* is set to turn the body. A considerable amount of stock is removed, but as the tolerances on the piece are not exacting, a single cut is sufficient to produce the piece within the specified limits.

It would be possible to turn the flange in conjunction with the body, by making certain changes in the set-up of the tooling on the cross-slide, but by using a universal turning tool in a later step, the arrangement of the tools on the cross-slide is not disturbed so much. Tools *L* and *M* remain in the cross-slide turret for this work, the same as in the previous toolings, but two tools *V* and *W* are substituted for *K* and *H*. Tool *V* is used in the second step to cut the groove, the diameter of the work at this point being ascertained by reading the micrometer dial on the cross-slide.

It will be seen that the work is unsupported, and there is therefore a possibility of chatter in taking this grooving cut. In all probability, it would be necessary to feed the cross-slide turret carefully by hand, in order to avoid this contingency, and if it were found that vibration caused trouble, the groove should be finished in another operation on an engine lathe after the holes had been drilled. The work could then be supported on an arbor. The turret is not used in this step, although universal turner *B* can be indexed and brought into position for a succeeding cut.

Fig. 8 shows the third and fourth steps on the same piece. The third step consists of taking a simple cut with tool *W* in the cross-slide turret to form the tapered end of the work. The cross-slide can be fed in the direction indicated by the arrow, but it may be found better to feed it longitudinally to reduce the chance of chatter. This step should not be accomplished by power feed, but rather by hand, using the longitudinal stop of the machine as well as the micrometer dial on the cross-slide to determine the proper sizes. In the fourth step, the universal turning tool *B* is brought up and the flange turned, only one cut being required, as but a small amount of stock is to be removed. For this operation, it is necessary to move the cross-slide along the ways of the machine so that it will not interfere with the turret movement.

The final step on this piece is shown in Fig. 9. Little comment is needed on this operation, because tool *M* is simply used for cutting off the work, the universal turning

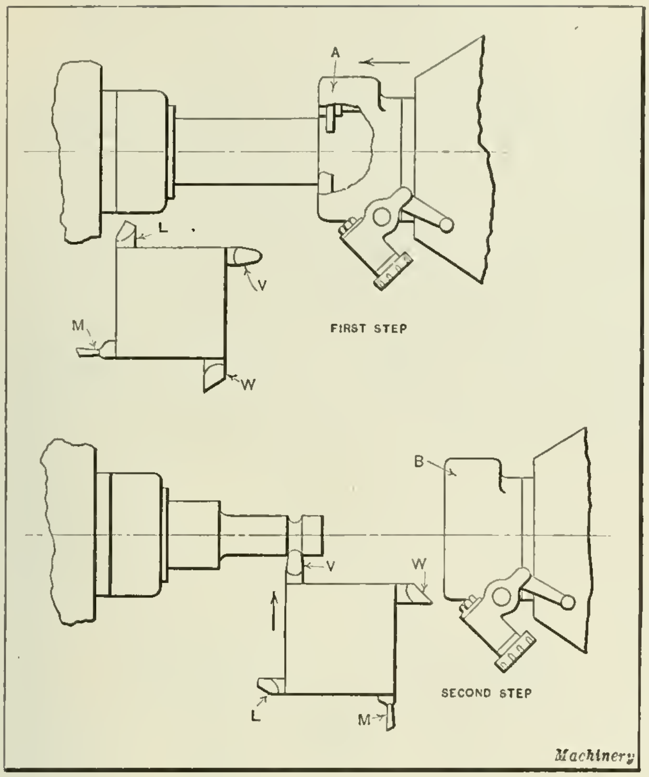


Fig. 7. Turning and Grooving Steps on the Part illustrated at C, Fig. 1

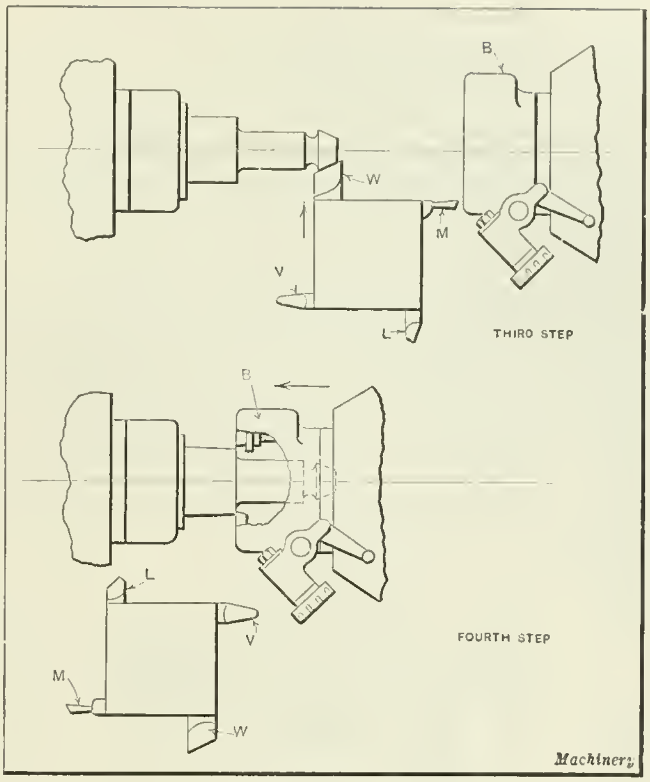


Fig. 8. Tapering the Front End of the Part and turning the Flange

tool *B* being run back out of the way. It should be noted that only two turret tools *A* and *B* are used for machining this piece, so little turret indexing is required during the five steps. It is also possible to use the turret lathe for drilling the holes by substituting collet jaws of the proper size to hold the body of the work and by using two drill-holders in the turret and a reamer for the small hole.

Machining a Bronze Collar

Figs. 10, 11, and 12 illustrate the method followed in machining the bronze collar *E*, Fig. 1. This piece is also machined from bar stock in a single operation, although a final operation on an engine lathe is necessary to make the outside surfaces concentric with the hole. Nevertheless, the piece can be produced by roughing on a turret lathe and finishing on an engine lathe in considerably less time than would be required for machining complete on an engine lathe. The work is held for this operation in the usual manner in collet jaws. In the first step, illustrated in Fig. 10, the universal turning tool *A* is utilized for rough-turning to the small outside diameter. Tool *X* is substituted on the cross-slide for the regular tool *H*, but this tool is not employed until the fourth step.

The universal turning tool *B* is used in the second step, as shown in Fig. 11, to finish the large cylindrical portion of the work. The cross-slide is moved along the ways of the machine a sufficient distance not to interfere with the movement of the turret. For the last three steps on this piece, it is necessary to remove tools *D*, *E*, and *F*, Fig. 2, from the turret and substitute standard drill-holders. This change in setting takes only a short time. In the third step, drill-holder *R* is equipped with a short stubby drill, as shown in the illustration, which is used as a starting tool for the hole which is to be drilled in the next step. It is advisable to have this drill as short as possible in order to obtain accuracy in starting the hole.

After this drill has been removed from the work, the turret is indexed to bring holder *U* in position, as shown in Fig. 12, and a long drill in this holder completes the drilling of the hole. While this drilling is in process, the special tool *X* is used to cut the annular groove, the setting for the cross-slide turret being determined by the adjustment of stops and the micrometer dials. There is an advantage in using the grooving tool while the drilling is in process, as the drill assists in supporting the work and so reduces the likelihood of chatter.

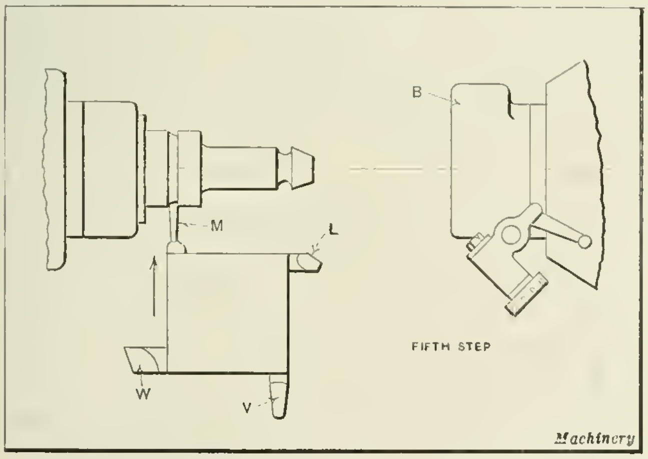


Fig. 9. Cutting off the Part from the Stock by using Tool M in the Square Turret

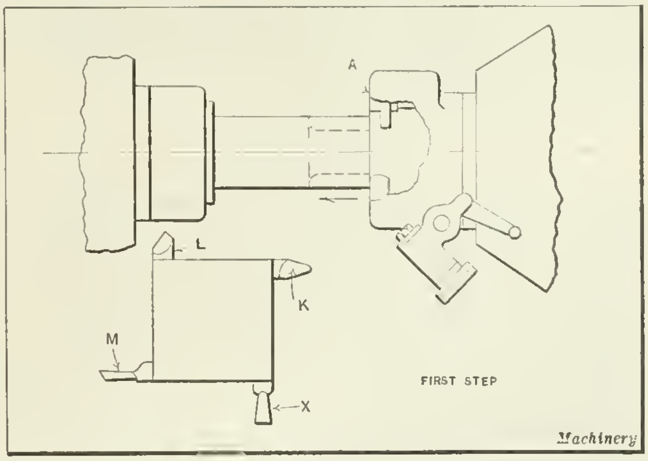


Fig. 10. Preliminary Turning Step on the Bronze Collar illustrated at E, Fig. 1

For the fifth step, the drill-holder *V* is equipped with a floating holder *W* which carries a reamer. The turret is fed by hand while reaming the hole. As it is possible that the hole may be slightly eccentric, it is necessary to place the work on an arbor and refinish the outside diameter on an engine lathe, as previously mentioned, in order to make the outside surfaces true with the hole. Only a very small amount of stock will need to be removed. Parting tool *M* is used to cut off the work while the reaming step is in progress.

No lay-out of tools has been shown for part *D*, Fig. 1, as this part is simple and does not require any different tooling from that shown in Fig. 2. It might be necessary, however, to have a final finishing of the cylindrical surfaces due to a slight eccentricity that may develop during the process of machining. The part should be supported on an arbor for this operation. If the hole were of large diameter, it might be possible to drill it first and then bore it, using a boring-bar on either slide-tool *E* or *F* and thus generating a true hole for the floating reamer to follow. In this case a final operation might not be required.

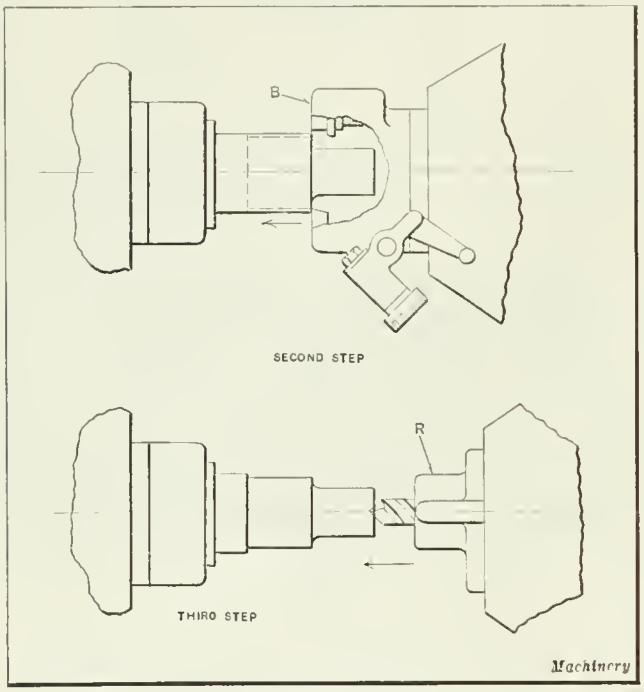


Fig. 11. The Second Turning Step and the Beginning of the Drilling Operation

It will be apparent that many pieces other than those dealt with can be handled equally well with the same kind of equipment, although slight changes in the set-up of the turret and cross-slide toolpost may sometimes be found advantageous. A little care and judgment on the part of the turret lathe operator in selecting the tools will enable him to machine a great deal of work ordinarily manufactured on the engine lathe.

* * *

PLASTIC WOOD

A recent number of *Engineering* states that plastic wood is a name given to a new material manufactured by a British concern. This preparation, which is made from very fine wood meal having the consistency of soft putty, is supplied ready for use. It is expected that this material will become valuable in patternmaking and molding, for it can be used in wood patterns for various purposes, such as for fillets. It adheres firmly to wood, and can be applied and smoothed down with the hand or a tool. It will set quite hard, but can be cut with an ordinary tool like wood and turned in the lathe or finished with sandpaper. The hardened material is not brittle, and nails can be driven firmly into it without causing cracks.

THE GAGE STEEL COMMITTEE

The problem of length changes in master gages, and of wear in working gages is of great importance to all users of gages, while that of dimensional changes in hardening and of machineability are serious problems with the manufacturers of thread gages. In appreciation of this situation, Major J. O. Johnson, chief of the Gage Section of the Army Ordnance, has enlisted the interest of the several groups concerned with these problems, and his efforts have culminated in the formation of a committee on which manufacturers of gages, users of gages, manufacturers of steel, and the Bureau of Standards, are represented. This committee, of which B. H. Blood of the Pratt & Whitney Co. is chairman, and H. W. Bearce of the Bureau of Standards, secretary, has outlined a program of experimental work which is briefly (1) to develop a quick wear test for gage steels; (2) to determine the behavior of a selected series of commercial steels in service; and (3) to determine the best heat treatment for such steels. As this program calls for considerable experimental work, the Bureau of Standards has assigned an investigator, H. Scott, to give full time to these problems. The financial requirements are met in part by a fund of $5000 transferred to the Bureau by the War Department and an equivalent sum given by the Bureau. The steels for this work are being supplied free of charge by steel manufacturers, and the mechanical work and heat-treatment by the gage manufacturers; the Bureau of Standards is conducting length measurements, quick wear tests and laboratory investigations, and it is expected that the users of gages will undertake the service tests.

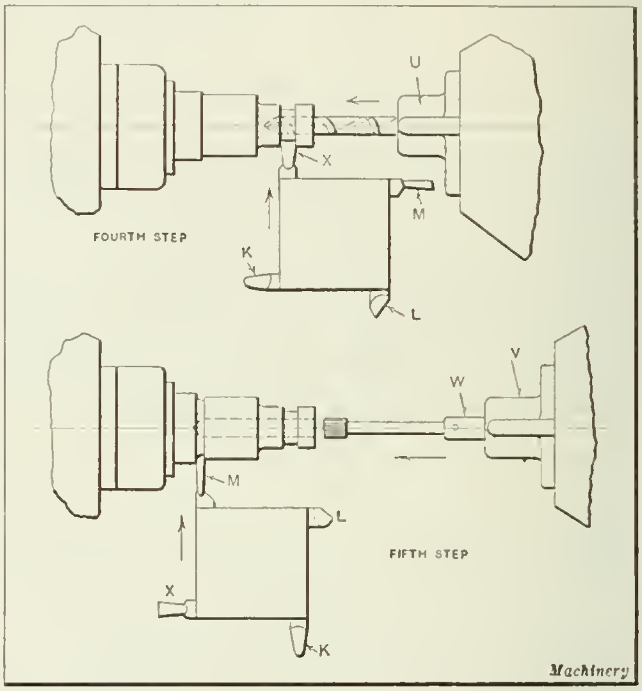


Fig. 12. Completing the Drilling of the Hole, grooving, reaming and cutting off

* * *

EXPOSITION OF ENGINEERING APPARATUS

A national exposition of power and mechanical engineering apparatus will be held at the Grand Central Palace, New York City, beginning December 7, and extending until December 13. It follows the annual meetings of the American Society of Mechanical Engineers, and the American Society of Refrigerating Engineers. The exposition will emphasize the engineering phases of the problems involved in the economical uses of fuel, and a more effective generation and utilization of power. The educational value of such an exposition should be considerable.

METRIC GRADUATIONS ON MACHINE TOOLS FOR FRANCE

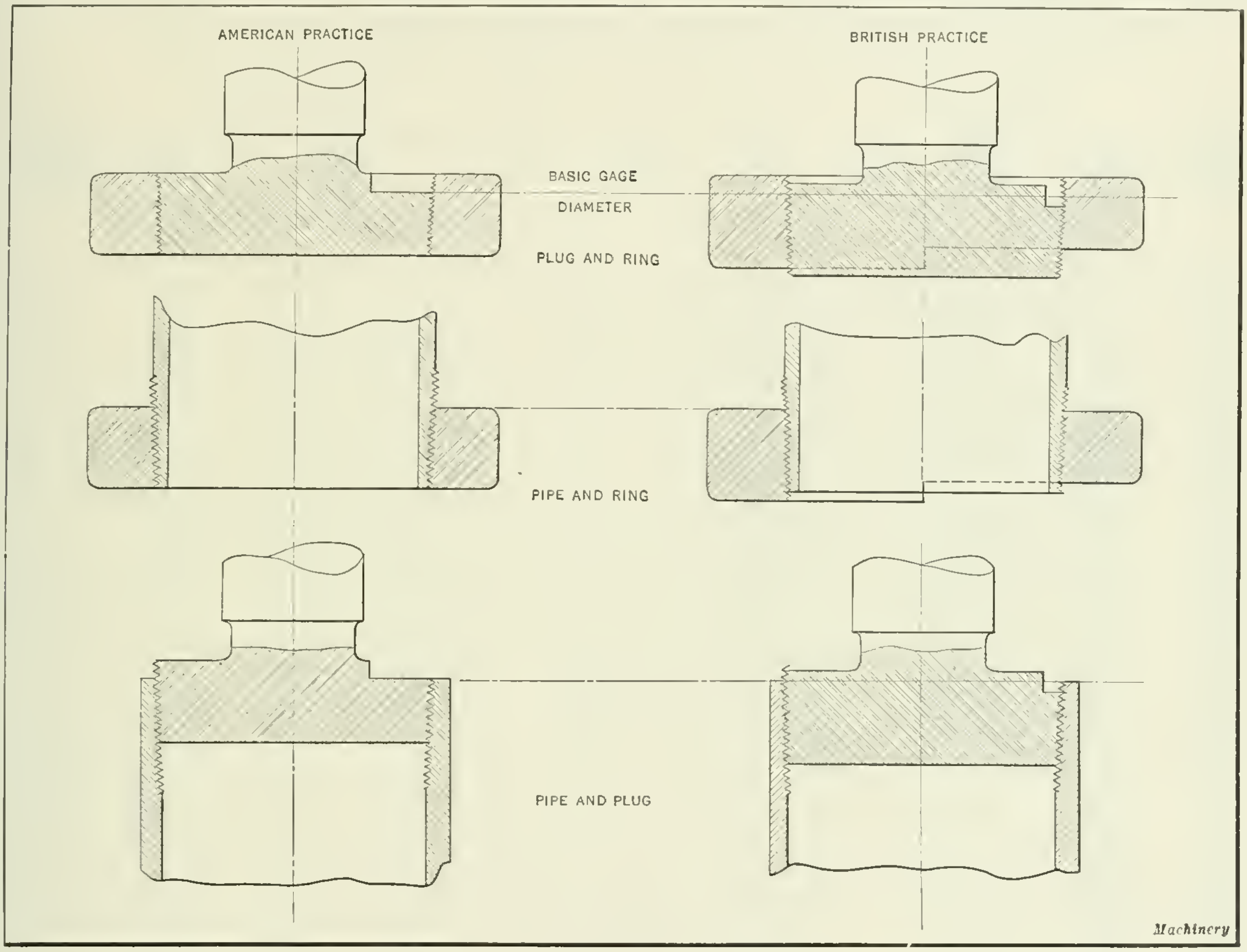
A correspondent in France calls attention to the value of having all graduations on American machine tools sold in France made in the metric measure. Many buyers hesitate to purchase American machine tools of certain types because of the difficulties met with by the workmen in certain lines of work. This is particularly true of lathes and milling machines having graduated collars on carriage or table feed-screws. These collars are usually graduated in thousandths of an inch. It would, of course, be much easier for a French user if these collars were graduated in, say, hundredths of millimeters. In the case of lathes, either metric lead-screws should be supplied, or a translating gear having 127 teeth should always be furnished on any machine sold to France. Graduations in inches, and lead-screws with English pitches, which make it difficult to cut metric threads, without doubt act as a brake on the selling of American machine tools in the countries where the metric system is universally used in machine building shops.

Another thing that must not be forgotten is that previous to 1914, about 65 per cent of the machine tools imported into France came from Germany, and only 10 per cent from America or England. The German manufacturer was well versed in the requirements of the French market, and knew how to introduce his products. Numerous salesmen, generally of French nationality, covered the entire country. Liberal terms of sale were offered by German manufacturers. Thus firms with small capital became strong supporters of the German product. After the war there was at first strong opposition to the buying of German machines, but gradually a large number were imported and sold, and doubtless many of Germany's old customers in France have been regained.

BRITISH STANDARD PIPE THREAD AND GAGE DIMENSIONS

By CHARLES G. SPICE
Research Engineer, Pratt & Whitney Co., Hartford, Conn.

In November, 1909, the British Engineering Standards Committee, supported by various British engineering institutes, published Report No. 21 on British standard pipe threads for iron and steel pipes and tubes. This report also gave a schedule of sizes in which the dimensions given for the various depths of thread were only approximately specified. A recent report issued by the British National Physical Laboratory contains tables in which these approximate dimensions have been corrected to bring the thread to the true Whitworth form, the tables covering all ordinary sizes. Table 1 is based on the original report of 1909, but is corrected throughout to suit the more recent report mentioned. It might be well to call attention to the fact that the British Whitworth standard pipe thread is perpendicular to the conical surface, whereas the Briggs or American standard pipe thread is perpendicular to the axis of the cone.



Diagrams illustrating the Differences between the American and British Methods of gaging British Standard Taper Pipe Threads

At present there are two practices employed for gaging Whitworth taper pipe threads—American and British. This condition is due to the fact that inspectors in America are accustomed to gaging the work as they do American standard taper pipe threads, and therefore consider the tolerances in turns, or fractions of a turn, plus or minus from the basic. The American practice, when the plug gage and its templet are screwed together, is to have the plug flush at the top and bottom with a thick ring, or the bottom and the basic gage diameter notch flush with a thin ring. Furthermore, when using the ring to gage work, the end of the work must not be above or below the small end of the ring a greater amount than the specified tolerance, and likewise, when using a plug to gage a fitting, the notch must not be above or below the end of the fitting a greater amount than the tolerance specified.

With the British practice, however, the plug and ring ends are not flush when the two are screwed together. The plug protrudes slightly beyond the small end of the ring, and the top is a like amount below the face at the large end. Also, British plug and ring gages are each provided with two steps, and the work, either a pipe or fitting as the case may be, must come between the limits indicated by the steps. The British practice is to express the tolerance as the length of thread in inches, whereas with American practice the tolerance is expressed as "turns plus or minus from basic." The accompanying illustration shows diagrammatically the various differences between the two gaging practices. A point worthy of notice, however, is that the final result obtained with the product is identical no matter which practice is followed; this is due to the fact that the location of the basic gage diameter is the same in either case in so far as the end of the pipe itself is concerned.

In the original report of the British Engineering Standards Committee, it is stated that a plain taper ring gage and a threaded plug gage were used. Thus the outside of the pipe only was gaged and not the threads. The report of the National Physical Laboratory (1921) indicates the adoption of the American method of gaging—that is, with threaded ring and plug gages. The actual difference in the dimensions of gages made to each system are presented in Table 2. The Pratt & Whitney Co. has been making gages according to the American system for a number of years, and these have been acceptable to the British authorities.

TABLE 1. BRITISH WHITWORTH TAPER PIPE THREAD DIMENSIONS

Nominal Pipe Size	Outside Diameter of Pipe	Basic Outside Diameter of Gage	Threads per Inch	Single Depth of Thread	Minimum Thread Length on Pipe End	Distance of Basic Gage Diameter from Pipe End				No. of Pipe Turns in Hand Fitting (Approx.)
						American and British (Nominal)	British Practice Limits		American Practice Max. and Min. Limits in No. of Turns from Basic Diam.	
							Maximum	Minimum		
⅛	13/32	0.383	28	0.0229	⅜	5/32	0.1824	0.1303	0.7294	4⅓
¼	17/32	0.518	19	0.0337	7/16	3/16	0.2188	0.1563	0.5937	3½
⅜	11/16	0.656	19	0.0337	½	¼	0.2917	0.2083	0.7923	4¾
½	27/32	0.825	14	0.0457	⅝	¼	0.2917	0.2083	0.5838	3½
⅝	15/16	0.902	14	0.0457	⅝	¼	0.2917	0.2083	0.5838	3½
¾	1 1/16	1.041	14	0.0457	¾	⅜	0.4375	0.3125	0.8750	5¼
⅞	1 7/32	1.189	14	0.0457	¾	⅜	0.4375	0.3125	0.8750	5¼
1	1 11/32	1.309	11	0.0582	⅞	⅜	0.4375	0.3125	0.6875	4¼
1¼	1 11/16	1.650	11	0.0582	1	½	0.5833	0.4167	0.9163	5½
1½	1 29/32	1.882	11	0.0582	1	½	0.5833	0.4167	0.9163	5½
1¾	2 5/32	2.116	11	0.0582	1⅛	⅝	0.7292	0.5208	1.1462	7
2	2⅜	2.347	11	0.0582	1⅛	⅝	0.7292	0.5208	1.1462	7
2¼	2⅝	2.587	11	0.0582	1¼	11/16	0.8021	0.5729	1.2606	7½
2½	3	2.960	11	0.0582	1¼	11/16	0.8021	0.5729	1.2606	7½
2¾	3¼	3.210	11	0.0582	1⅜	13/16	0.9479	0.6771	1.4894	9
3	3½	3.460	11	0.0582	1⅜	13/16	0.9479	0.6771	1.4894	9
3¼	3¾	3.700	11	0.0582	1½	⅞	1.0208	0.7292	1.6038	9½
3½	4	3.950	11	0.0582	1½	⅞	1.0208	0.7292	1.6038	9½
3¾	4¼	4.200	11	0.0582	1½	⅞	1.0208	0.7292	1.6038	9½
4	4½	4.450	11	0.0582	1⅝	1	1.1667	0.8333	1.8337	11
4½	5	4.950	11	0.0582	1⅝	1	1.1667	0.8333	1.8337	11
5	5½	5.450	11	0.0582	1¾	1⅛	1.3125	0.9375	2.0625	12⅓
5½	6	5.950	11	0.0582	1⅞	1¼	1.4583	1.0417	2.2913	12⅓
6	6½	6.450	11	0.0582	2	1⅜	1.6042	1.1458	2.5212	15¼
7	7½	7.450	10	0.0640	2⅛	1⅜	1.6042	1.1458	2.2920	13¾
8	8½	8.450	10	0.0640	2¼	1½	1.7500	1.2500	2.5000	15
9	9½	9.450	10	0.0640	2¼	1½	1.7500	1.2500	2.5000	15
10	10½	10.450	10	0.0640	2⅜	1⅝	1.8958	1.3542	2.7080	16¼
11	11½	11.450	8	0.0800	2½	1⅝	1.8958	1.3542	2.1664	13
12	12½	12.450	8	0.0800	2½	1⅝	1.8958	1.3542	2.1664	13
13	13¾	13.680	8	0.0800	2⅝	1⅝	1.8958	1.3542	2.1664	13
14	14¾	14.680	8	0.0800	2¾	1¾	2.0417	1.4583	2.3336	14
15	15¾	15.680	8	0.0800	2¾	1¾	2.0417	1.4583	2.3336	14
16	16¾	16.680	8	0.0800	2⅞	1⅞	2.1875	1.5625	2.5000	15
17	17¾	17.680	8	0.0800	3	2	2.3333	1.6667	2.6664	16
18	18¾	18.680	8	0.0800	3	2	2.3333	1.6667	2.6664	16

Machinery

GRINDING IN THE MANUFACTURE OF LEAF SPRINGS

Artificial grinding wheels are rapidly displacing natural sandstones in the manufacture of leaf springs. There are three principal grinding operations on springs of this type: (1) Removing the scale from individual leaves; (2) chamfering the edges of the leaves; and (3) squaring the sides of the eyes. Practice varies in different plants, and sometimes these principal operations are supplemented by others. Such exceptions, as well as the regular grinding methods employed, will be described in the following:

This type of grinding is done offhand, using a floor stand equipped with a vitrified aluminous abrasive wheel 24 inches in diameter. Each spring leaf is ground individually by being pressed against the top of the grinding wheel, which revolves in a direction away from the operator. Owing to the fact that the grinding is done on the tops of the wheels, it is impossible to use protection hoods, and therefore wheels having tapered sides are always furnished for this class of work.

Some of the stock used in leaf springs comes with a rounded edge. In such cases very little chamfering of the leaves is necessary, for this operation consists essentially of rounding and cleaning the edges. The work is done offhand on a floor stand, in the same manner as the previous operation and with the same kind of wheels. The operation of chamfering also includes the proper shaping of the ends of the leaves. Sometimes special fixtures for supporting the work are used, into which the spring leaves are inserted, and the support is used to guide the work during the grinding operation.

A Besly or Gardner double-head grinding machine is generally employed for squaring the sides of the eyes. The springs are usually assembled and the eye on each end is ground between the two cylinder wheels. One wheel is mounted on a slide and can be moved toward or away from the other by means of a foot-lever. The movable wheel is traversed toward the stationary head, until both wheels come in contact with the work which is held between them. The same amount of stock is removed from each side of the eye, which is ground to snap gage limits.

The methods of manufacture of leaf springs vary in different shops. The springs for some of the higher grade automobiles are often made as follows:

As the spring leaves come from the forge shop they are temporarily assembled, and all the edges of the leaves of each assembled spring are then ground at one time on the rim of a cylinder wheel mounted in a chuck on a floor stand. In this way a uniform size of leaves is obtained. The springs are then taken apart and the edges of the individual leaves rounded or chamfered. Formerly the chamfering, as well as squaring the sides of the eyes, was done offhand on natural sandstones. Instead of removing the scale and smoothing the leaves on a grinding wheel, polishing wheels set up with No. 46 TJ alundum grain are sometimes used.

Comparative Costs of Artificial and Natural Wheels

As sandstones are used in some cases for grinding leaf springs, it is interesting to compare their cost with that of artificial wheels. From information recently obtained, a natural sandstone wheel 66 to 70 inches in diameter and 7 inches thick lasts from three to six weeks on this type of work. An artificial alundum vitrified wheel has an average life of about eight weeks, all other conditions being the same, and in that time an average of from 120 to 150 tons of springs can be ground. A sandstone wheel of the size mentioned costs slightly over $40, while a vitrified alundum artificial wheel 24 inches in diameter, 3½ inches thick, and with a hole 2½ inches in diameter costs $35. Considering the increased production, longer life, and price of the alundum wheel, the artificial wheel is the more economical.

* * *

ANNUAL MEETING OF MECHANICAL ENGINEERS

The American Society of Mechanical Engineers will hold its annual meeting at the Engineering Societies' Building, 29 W. 39th St., New York City, December 4 to 7. Tuesday, December 5, will be devoted to sessions on management, materials handling, machine shop practice, power test codes, training in the industries, steam table research, and general research. On Wednesday, December 6, there will be a joint session with the Stoker Manufacturers' Association on stokers, and also a session on locomotive design. Thursday, December 7, will be devoted to sessions on power, standardization, aeronautics, ordnance, forest products, and safety codes. Among the papers on machine shop practice that will prove of especial interest are: "Gearing for Planers" by Forrest E. Cardullo; "Testing Involute Spur Gears," by M. Estabrook; "Application of Oilgear Variable-speed Hydraulic Drive to Machine Tools and Manufacturing Processes," by Walter Ferris; "Spherical Gears," by C. H. Logue; and "Power Required for Removing Metal," by F. A. Parsons. In connection with the meeting of the society, there will be an exhibition of power plant equipment at the Grand Central Palace.

TABLE 2. DIMENSIONS OF BRITISH WHITWORTH TAPER PIPE THREAD GAGES

Nominal Pipe Size	Basic Outside Diameter of Gage	British Practice—Distance of Basic Outside Gage Diameter from Small End of Plug	American Practice—Distance of Basic Notch from Small End of Plug	Plug Height		Ring Width		Outside Diameter at Small End of Plug		Root Diameter of Ring at Large End, American and British Practice
				British Practice	American Practice	British Practice	American Practice	British Practice	American Practice	
⅛	0.383	0.3114	0.1563	0.3375	0.3114	0.3375	0.3114	0.3635	0.3732	0.3469
¼	0.518	0.3625	0.1875	0.3938	0.3625	0.3938	0.3625	0.4953	0.5063	0.4616
⅜	0.656	0.4083	0.2500	0.4500	0.4083	0.4500	0.4083	0.6305	0.6404	0.5985
½	0.825	0.5208	0.2500	0.5625	0.5208	0.5625	0.5208	0.7925	0.8094	0.7505
⅝	0.902	0.5208	0.2500	0.5625	0.5208	0.5625	0.5208	0.8695	0.8864	0.8275
¾	1.041	0.6125	0.3750	0.6750	0.6125	0.6750	0.6125	1.0027	1.0176	0.9644
⅞	1.189	0.6125	0.3750	0.6750	0.6125	0.6750	0.6125	1.1507	1.1656	1.1124
1	1.309	0.7250	0.3750	0.7875	0.7250	0.7875	0.7250	1.2637	1.2856	1.2145
1¼	1.650	0.8167	0.5000	0.9000	0.8167	0.9000	0.8167	1.5989	1.6188	1.5534
1½	1.882	0.8167	0.5000	0.9000	0.8167	0.9000	0.8167	1.8310	1.8508	1.7854
1¾	2.116	0.9084	0.6250	1.0125	0.9084	1.0125	0.9084	2.0592	2.0769	2.0173
2	2.347	0.9084	0.6250	1.0125	0.9084	1.0125	0.9084	2.2902	2.3079	2.2483
2¼	2.587	0.9915	0.6875	1.1250	0.9915	1.1250	0.9915	2.5250	2.5440	2.4895
2½	2.960	0.9915	0.6875	1.1250	0.9915	1.1250	0.9915	2.8980	2.9170	2.8625
2¾	3.210	1.1021	0.8125	1.2375	1.1021	1.2375	1.1021	3.1411	3.1592	3.1037
3	3.460	1.1021	0.8125	1.2375	1.1021	1.2375	1.1021	3.3911	3.4092	3.3617
3¼	3.700	1.2042	0.8750	1.3500	1.2042	1.3500	1.2042	3.6247	3.6453	3.6031
3½	3.950	1.2042	0.8750	1.3500	1.2042	1.3500	1.2042	3.8747	3.8953	3.8541
3¾	4.200	1.2042	0.8750	1.3500	1.2042	1.3500	1.2042	4.1247	4.1453	4.1041
4	4.450	1.2958	1.0000	1.4625	1.2958	1.4625	1.2958	4.3690	4.3875	4.3521
4½	4.950	1.2958	1.0000	1.4625	1.2958	1.4625	1.2958	4.8690	4.8875	4.8521
5	5.450	1.3875	1.1250	1.5750	1.3875	1.5750	1.3875	5.3633	5.3797	5.3500
5½	5.950	1.4792	1.2500	1.6875	1.4792	1.6875	1.4792	5.8576	5.8719	5.8479
6	6.450	1.5708	1.3750	1.8000	1.5708	1.8000	1.5708	6.3518	6.3641	6.3458
7	7.450	1.6833	1.3750	1.9125	1.6833	1.9125	1.6833	7.3448	7.3641	7.3411
8	8.450	1.7750	1.5000	2.0250	1.7750	2.0250	1.7750	8.3391	8.3563	8.3392
9	9.450	1.7750	1.5000	2.0250	1.7750	2.0250	1.7750	9.3391	9.3563	9.3392
10	10.450	1.8667	1.6250	2.1375	1.8667	2.1375	1.8667	10.2833	10.3484	10.3370
11	11.450	1.9792	1.6250	2.2500	1.9792	2.2500	1.9792	11.3263	11.3484	11.3120
12	12.450	1.9792	1.6250	2.2500	1.9792	2.2500	1.9792	12.3263	12.3484	12.3120
13	13.680	2.0917	1.6250	2.3625	2.0917	2.3625	2.0917	13.5493	13.5784	13.5490
14	14.680	2.1833	1.7500	2.4750	2.1833	2.4750	2.1833	14.5435	14.5706	14.5470
15	15.680	2.1833	1.7500	2.4750	2.1833	2.4750	2.1833	15.5435	15.5706	15.5470
16	16.680	2.2750	1.8750	2.5875	2.2750	2.5875	2.2750	16.5378	16.5628	16.5450
17	17.680	2.3667	2.0000	2.7000	2.3667	2.7000	2.3667	17.5321	17.5550	17.5428
18	18.680	2.3667	2.0000	2.7000	2.3667	2.7000	2.3667	18.5321	18.5550	18.5428

Machinery

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THE DEMAND FOR DIE-CASTINGS

There has been a remarkable expansion in the die-casting industry during the past ten years, due partly to the increased demand for lighter construction in machinery and mechanical appliances. Die-castings can be produced today of attractive appearance, having sufficient strength for any reasonable use, and considerably cheaper when produced in quantities, particularly for intricate parts, than a forging or casting which must be machined to size. Many parts used in automobile construction and many household articles can be produced more economically by the simplified method of die-casting. Holes can be cast to size, threads can be provided, and even graduations on a flat or curved surface can be cast directly on the part. The accuracy obtainable is sufficient to meet requirements in the construction of ordinary mechanical devices, except those requiring a very high degree of precision.

The demand for die-castings is constantly increasing, and new means are being developed for casting metals that could not be successfully handled in the past. The die-casting process appears to be still in its infancy, and within a few years we doubtless shall see further important developments both in the process itself and in the physical properties of the metals that can be used for die-castings.

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SCOPE OF THE TECHNICAL JOURNAL

It happens occasionally that readers of MACHINERY, deeply interested in some absorbing issue of the day, urge us to take part in the widespread journalistic discussion of the subject they have so much at heart. It may be the tariff, woman suffrage, trade unionism, the right to strike or to lock-out, high rents, the bonus, foreign debts, the league (or association) of nations, prohibition, armaments, nationalization of mines or railways—the range is wide and comprehends about all the passing and perennial questions of national and international interest.

The reason we do not participate is simple enough—MACHINERY sticks to its field. Our function as journalists is to gather for the engineering reader and present as well as we know how, accurate up-to-date information about machine design and machine shop practice. This is stating it simply, but it is a large order and requires all the editorial space MACHINERY has at its disposal. The material gathered for publication constantly presses against the limits, and so great are the industries and developments that keeping up with them demands all the energies of a large and well-trained publishing organization, with no time for other issues however interesting, attractive or important.

The technical, and to an extent the commercial, side of the machine-building industries is our business, and we believe that the great majority of MACHINERY'S readers, even those who sometimes urge us to broaden our sphere, would not thank us for injecting our views on political, economic, scientific or ethical questions—especially when these views would differ from their own, as they surely would sometimes.

Furthermore, hundreds of able writers and scholars are constantly dealing with the big questions of the day; and their data, arguments and conclusions are available to our readers in periodicals whose name is legion. These discussions do not belong in MACHINERY any more than a description of a new lathe, planer, or milling machine belongs in the *Saturday Evening Post;* and just as market prices and reports on paints, oils, drugs, metals, and other commodities would be entirely out of place and wasted in *Harper's Magazine*, so a discussion of bolshevism would be entirely out of place in MACHINERY. Writers able to handle with power and conviction great questions like the League of Nations, or the Einstein theory, would find it wholly beyond their powers to write, for the engineering reader, an intelligible description of a new milling machine. Less than half of one per cent of all the readers of the *Saturday Evening Post* would have an intelligent understanding of the design of a gear shaper, after reading a careful description of one in MACHINERY, simply because the description is for the men who already possess mechanical knowledge.

So, just as those who write for the general reader stick to what they know and understand, we believe that is what MACHINERY'S readers want us to do. "Shoemaker, stick to your last."

* * *

FREE ENGINEERING ADVICE

Consulting engineers do not give advice on the design of shop equipment and on economical production without receiving a reasonable compensation for their work; but when a manufacturer asks a machine tool builder or maker of tooling equipment for advice, he expects to get it free of charge. The builders of machine tools and shop equipment naturally are eager to show prospective customers how their equipment can be used to the best advantage; and frequently the enquirer takes undue advantage of this condition to obtain from several builders of equipment complete layouts and plans for the manufacture of his product. From the layouts thus submitted he selects what appears to be the best, but he does not always place his order with the manufacturer whose engineering advice he has obtained, in this way, free of charge. Sometimes he adapts machinery already in his shop to perform the work in the way described; sometimes he buys equipment from a competitor who may furnish the required machines cheaper, but who lacks the engineering knowledge to work out the manufacturing plan that was adopted.

It has been proposed that the builders of machine tools and tooling equipment make a small charge for such engineering service as they render, whenever equipment is not ordered from them in accordance with the lay-outs, drawings or plans they have submitted for the customer's use. If this were done, machine tool manufacturers would have fewer requests to submit drawings and tool lay-outs when the customer has only a vague intention of buying new equipment.

It is difficult to distinguish between such service as the machine tool builder necessarily must render in order to impress the prospective customer with the value of his machine or equipment, and service of a general nature that can be applied to other machines as well. The builder of shop equipment must decide for himself when he is called upon to render mere consulting engineering service; and in such cases, if machine tool builders make it a rule to state that this service will be rendered free of charge subject to the placing of an order, but that otherwise the service will be charged for, fewer buyers will abuse the privilege of obtaining free engineering advice.

Reducing the Cost of Tooling Equipment

THE distinctive value of the service rendered by the tool and contract shop has repeatedly been pointed out in MACHINERY. The great development that has taken place in this branch of the machine industry was the subject of a full page editorial last April. It is not as well known as it should be that shops equipped for making special tools, jigs, fixtures, dies, gages, and other tooling equipment are in a peculiarly advantageous position for designing and building special tools. Because they are specialists they can do this work cheaper and better than the comparatively small tool-rooms of individual manufacturing plants. A great deal of good money is wasted every day in dozens of places by designers and toolmakers of mediocre ability and limited experience, who undertake to design and build tools for special purposes. Their tools may operate in what appears to be a satisfactory manner, without anywhere nearly realizing what should be the real objective, that is, maximum efficiency. The special tool and contract shop, employing a corps of designers and toolmakers constantly engaged on high-class tooling equipment work, is in a position to produce tools that are not only better, but that can be bought for less than the manufacturer can produce them in his own tool-room.

Before the development of the special shop it was the custom, when a set of tools was required for the manufacture of a new machine or device, for the manufacturer to hire a man who represented himself as a tool designer and to gather in with him a few toolmakers, usually the kind that floated from job to job. It needs no great experience in manufacturing to realize that under these conditions very mediocre tools were produced at excessively high cost. Methods of this kind still prevail in some shops, but they are as inadequate and out of date as the lathes of thirty years ago would be if employed in high production with high-speed steel or stellite tools.

Progressive manufacturers are beginning to realize that the service offered by the tool and contract shop is an economical service. The big automobile companies were among the first of the metal-working manufacturing plants to recognize this fully, and today many of the tool equipment shops are kept busy almost entirely by the automobile industry. Methods that have proved so advantageous and economical in the automobile field would surely prove efficient and economical in other lines of manufacture. Shops making sewing machines, typewriters, hardware, engines, pumps, electric motors, washing machines, or jewelry, can be served as well by the tool and contract shop as the automobile shop has been. In few fields are the requirements for accuracy and economy greater than in the automobile field; and if the tool shop has been able to meet satisfactorily the exacting requirements of this industry, it can meet the requirements in other fields.

The manufacturer who continues to maintain an expensive tool-room of his own, except for emergency purposes, should investigate actual costs and results obtained from his tool-room, as compared with what is offered by the shop that specializes in a product and service that with him is merely a side line. Manufacturers of the hundred and one different products of modern industry know that they cannot afford to build their own machine tools. They have found that it pays to do business with shops specializing in this field. It would pay them equally well to have specialists build the tooling equipment required for the operation of machine tools, and these specialists are seldom found except in shops devoted exclusively to toolmaking. The trend is toward recognition of the definite place and special service of the tool shops. These shops are sure to grow in size and importance until they constitute the main source of manufacturing equipment aside from standard machine tools and accessories.

New Semi-automatic Multi-cut Lathe

By WILLIAM O. STRAUSS, Engineer, R. K. LeBlond Machine Tool Co., Cincinnati, Ohio

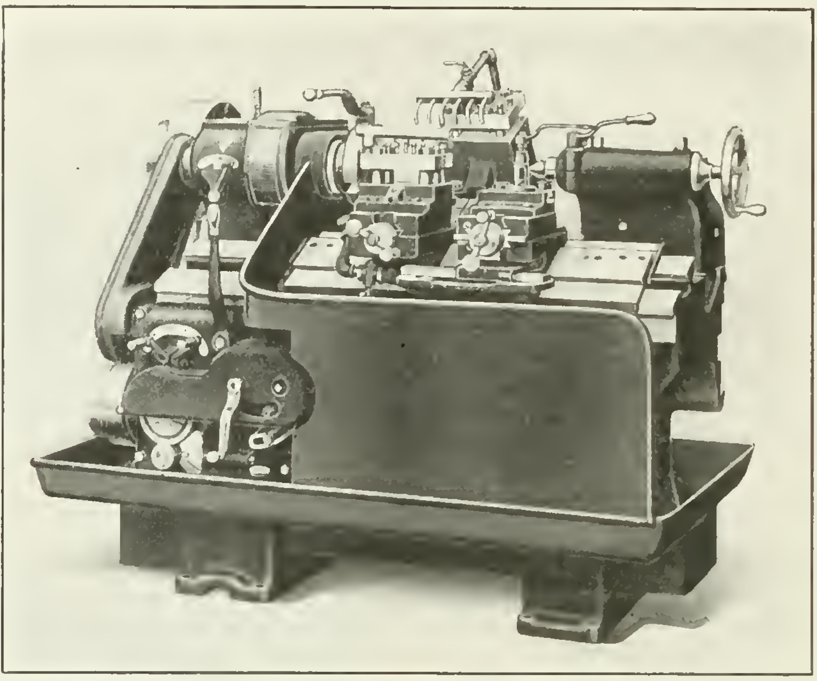


Fig. 1. Improved Heavy No. 12 Multi-cut Lathe for Work up to 12 Inches in Diameter and of Various Lengths, depending on the Length of Bed

Several improvements that increase the productive possibilities and provide greater convenience of operation have been embodied in a new and larger sized semi-automatic multi-cut lathe recently developed by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. The new machine, which is known as the No. 12 heavy multi-cut lathe, turns work up to 12 inches in diameter and is made in various bed lengths giving maximum center distances of 18. 26, 34, or 42 inches.

Among the new features are: (1) A power rapid traverse for the turning carriage and facing slide; (2) an automatic arrangement which stops the spindle when the feed of the tools is stopped; (3) an automatic shutting off of the supply of lubricant to the work simultaneously with the stopping of the spindle rotation; (4) a submerged rotary pump and lubricant distributor lines of ample capacity; and (5) the derivation of all movements from simple slides on broad scraped bearings. Each of these features will be described in detail in the following.

This machine, as its name implies, may be equipped with multiple tools for simultaneously turning and facing such parts as automobile wheel hubs, transmission gears and shafts, flange and stub ends of crankshafts, motor pinions, and cone pulleys. Fig. 4 shows the "multi-cut" lathe set up for turning an alloy steel pinion a job in which four facing and two turning tools are employed to remove about ½ inch of metal from all surfaces, the piece being completely machined to size in one operation. The floor-to-floor time per piece for this job is 4 minutes 45 seconds, and about 10 horsepower is consumed. Many plain turning and facing jobs done in the ordinary machine shop can also be handled profitably on this machine.

The simplicity of the design enables the operator to set up the machine in approximately the same time as is required for setting up a hand screw machine, and because of this, the multi-cut lathe is applicable to lots of only twenty-five or fifty parts. As the machine is essentially a lathe and uses only lathe tools, the average lathe operator can be quickly trained to obtain maximum production with it. All slides are actuated without the use of cams, and so setting up for a given job simply requires the selection of the proper change-gears. These may be quickly determined from a chart.

When the volume of work is sufficient to justify it, one operator can readily take care of two machines. The turning carriage at the front of the machine and the facing slide at the rear are automatically tripped by limit stops at both ends of their travel. The feeding movements of the carriage and slide are so arranged that the time required for a job is that necessary for taking the longest single cut. Both the feeding and rapid traverse movements of the carriage and slide are controlled by means of the upright hand-lever of the feed-box at the head end of the machine (see Fig. 1). This control is so interlocked that the feed and rapid traverse cannot both be engaged at once. The machine is heavily constructed in order that it may utilize the unusual amount of power supplied it; although it is only rated to swing 12 inches in diameter, a motor of from 7½ to 15 horsepower, depending upon the nature of the work that is to be handled, is recommended for driving it.

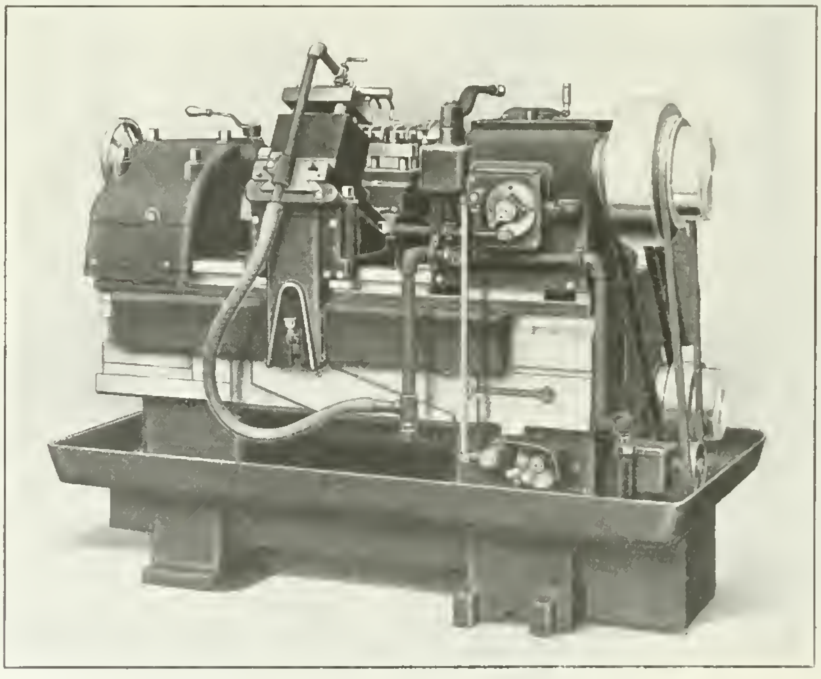


Fig. 2. Rear View, showing the Arrangement of the Facing Slide and the Profile Plate from which it receives Movement

Selective Speed Headstock

Six speed changes for the headstock spindle are obtainable from the constant-speed driving pulley by the manipulation of two levers. The lever on top of the headstock gives the faster speeds, and that at the front of the headstock, the slower speeds. The horizontal lever projecting to the front of the machine at the right-hand end of the headstock is used for starting the spindle. The driving pulley is equipped with a multiple-disk clutch, which runs continuously in oil. All the headstock gears are made of nickel-steel and heat-treated, and have stub teeth to increase their strength. These teeth are rounded to permit the gears to be easily slid into engagement. The gears are mounted on short high-carbon steel shafts which have four keyways, the corresponding keys being broached in the gears from the solid.

The automatic stopping feature of the spindle, previously mentioned, is so designed that when the feed of the turning carriage and facing slide is tripped, the spindle is instantly stopped or makes a predetermined number of revolutions before stopping. The spindle boxes are adjustable for wear, and the spindle is provided with ball thrust bearings. The entire headstock mechanism is enclosed in an oil-tight casting in which every gear and bearing is constantly flooded with oil. The spindle is provided with a hole for the application of draw-in or air chucks.

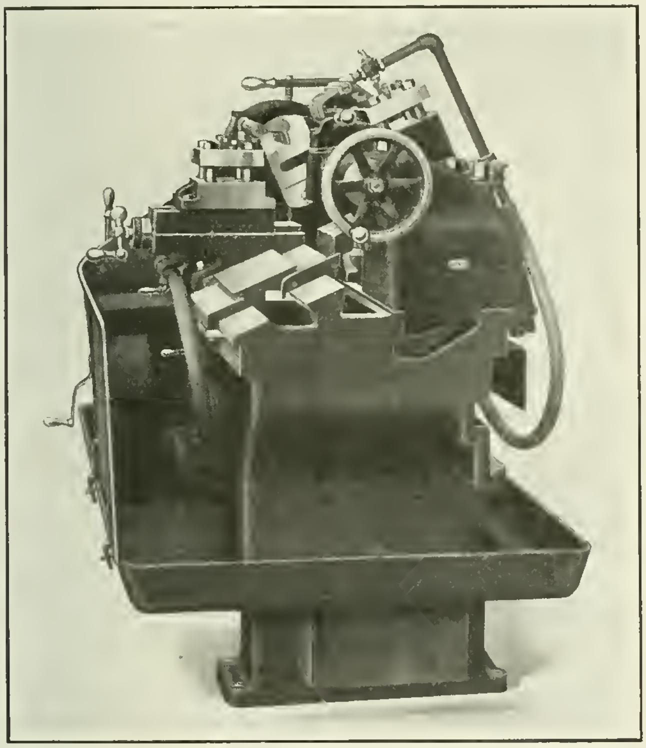


Fig. 3. Tailstock End of Multi-cut Lathe, which clearly shows the Design of the Bed Shears

The Bed and Tailstock

One of the noticeable points in which the construction of this machine differs from the smaller sizes is in the arrangement of the shears on the bed. The front shear on which the turning carriage is mounted is at an angle, whereas the rear shear on which the facing slide operates, and on which the headstock and tailstock are mounted, is in a horizontal plane. On the smaller machines this shear is at an opposing angle to the front shear.

The turning carriage is free to travel past both the headstock and the tailstock, and because the shear is at an angle, it is claimed that the pressure of the cut serves to keep the carriage closer to the bed; thus all tendency to climb the shears and strain the gibs is eliminated. The bed is mounted on cast iron legs which are designed to receive a pressed-steel pan, tank, and settling basin for the cutting compound. Ample space between the shears of the bed allows the chips to pass through. The tailstock is of the quick-acting screw type, and has four bolts for clamping it to the bed. The spindle of the tailstock is made from 0.45 carbon steel.

The Turning Carriage and Facing Slide

The turning carriage is scraped to the shears for its full length and is double-gibbed to the bed. The top of the carriage is provided with a broad dovetail to which the turning tool-rest is applied. One or more standard rests can be mounted on the carriage and spaced along it to suit the work. Two tool-rests are shown mounted on the carriage in Fig. 1. Any of the rests may be equipped with a taper-turning attachment so that straight and taper surfaces can be turned simultaneously. The carriage is fed along the bed by means of a steel bull gear and a rack which is placed in the center of the shears to provide a balanced drive.

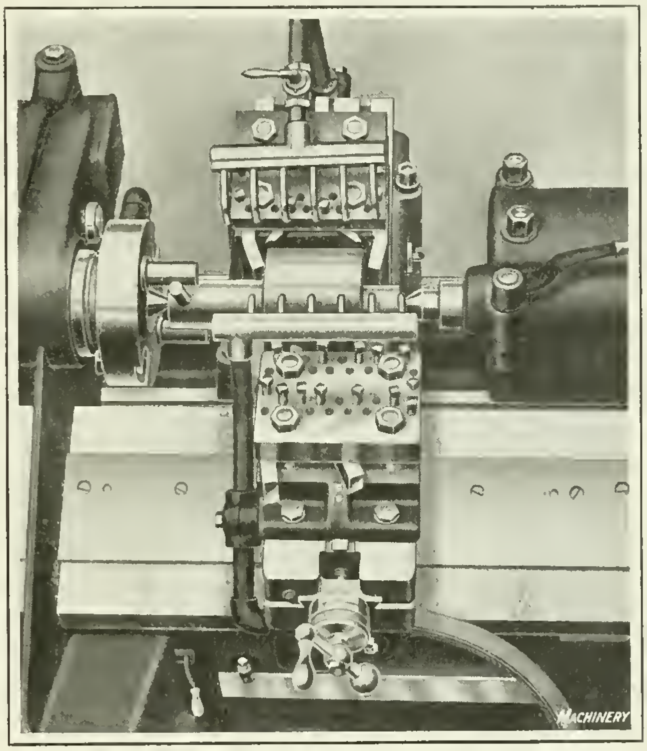


Fig. 4. Tooling of the Turning Carriage and Facing Slide for a Typical Job

The slide on which the facing tools are held is mounted on an angular bracket on the shear at the rear of the machine. This slide receives its motion from the profile plate in the planed way on the rear of the bed, as shown in Fig. 2. A hardened roller attached to the facing slide is confined in the channel of the profile plate, and as the profile plate is fed along the bed, this roller, through a rack and pinion, operates the facing slide at right angles to the horizontal center line of the lathe. The contour of this profile plate is selective, so that the facing tools may be made to dwell at the end of their cut while the turning tools continue, or the profile plate may be of a shape that gradually slows up the feeding rate of the facing tools as they approach the end of their cut. This would allow for forming operations or for sizing heavy fillets.

The Feed and Rapid Traverse Movements

Power for the feeding movements of the turning carriage and facing slide is transmitted from the headstock spindle, by means of sprockets and a chain, to the feed-box at the head of the machine. Nine basic feed changes are obtained by manipulating the two short levers on the front of this box, which operate chrome-nickel steel sliding gears. The relative feeds of the turning carriage and facing slide are variable through change-gears which are located on the outside of the feed-box. Then, after the ratio is determined, the feeds may be increased or decreased at will by the manipulation of either feed-change lever.

The feed movement of both the carriage and slide is tripped by means of adjustable dogs on a revolving disk, which disengage a positive clutch. The disk makes one complete revolution per maximum travel of the carriage, and the latter may be tripped at any desired point by simply setting one of the tripping dogs. The operation of this dog also actuates the automatic spindle stopping arrangement incorporated in the headstock. All gears and bearings in the feed-box are constantly flooded with clean lubricant, which is supplied by a pump provided exclusively for this unit. Power for the rapid traverse movement is transmitted through a light belt from the main driving pulley to the pulley at the left-hand end of the feed-box. This pulley is connected to the rapid traverse driving shaft by means of a multiple disk clutch which runs in oil.

Lubricating Provisions and Motor Drive

As all important units are oiled by flooded lubrication, hand-oiling is so reduced as to be an almost negligible factor. Indicators on the headstock and feed-box show the levels to which these units should be kept filled with oil. The submerged centrifugal pump is of ample capacity and does not require priming. It delivers about 15 gallons of fluid per minute under sufficient pressure to wash away all chips and cool the tools properly.

Either an alternating- or a direct-current motor can be furnished for driving the machine. The motor is mounted on a hinged plate, which is attached to the rear of the headstock cabinet leg and drives the machine through a belt connecting it to the headstock pulley. A tightener pulley mounted on roller bearings is also furnished. A constant-speed type motor of from 7½ to 15 horsepower capacity and running at 1750 revolutions per minute is recommended.

Taper-turning Attachment

The taper-turning attachment previously mentioned consists of a heavy bracket which is bolted to a planed pad on the front of the machine. This bracket carries a swiveling guide bar, which may be clamped in any selected position by means of T slot bolts. A sliding shoe is also attached to the cross-slide to impart an in and out movement to the cross-slide which bears a definite relation to the angular setting of the guide bar. The guide bar and the sliding shoe may be replaced by a form plate and a roller for the duplication of irregular shapes. The bed is provided with a series of holes to receive the clamping screws of the taper attachment bracket, so that the taper attachment may be moved along the bed as desired.

Some of the important specifications of this multi-cut lathe are as follows: Maximum turning capacity, 12 inches diameter; maximum facing capacity, 10½ inches diameter; maximum travel of carriage (all bed lengths), 20 inches; range of spindle speeds, from 50 to 250 revolutions per minute; range of turning carriage and facing slide feeds, from 0.002 to 0.203 inch per spindle revolution; rapid traverse of turning carriage and facing slide, 128 inches per minute; maximum travel of facing slide, 5¼ inches; and maximum travel of turning tool-rest, 5½ inches.

* * *

The annual meeting of the Taylor Society was held in the Engineering Societies' Building, November 22 to 24. A number of papers covering broadly important phases in management were read, the subjects dealt with including the organization and management of a medium-sized plant; statistical compilation; shaping management to meet developing industrial conditions; master budgets of sales and production; reduction of waste through research studies; and supervision of personnel.

GERMAN INDUSTRIAL CONDITIONS

From MACHINERY'S Special Correspondent

Berlin, November 7

The tremendous drop in the exchange value of the mark during October has necessitated larger working capital for industrial plants, increased the scarcity of money, and made it more difficult to obtain credit for filling orders on hand. The present conditions have also caused uneasiness among the workers, and it is necessary to revise wages as well as prices of goods at very short intervals. There are many indications of a cessation of the industrial boom and of a coming crisis. This is evidenced by the fact that new orders in general are placed at much lower actual prices than in the past, and it is easier to obtain raw materials; in addition, the scarcity of labor is diminishing, and in some localities there is even a slight surplus of labor. Also the drop in the value of the mark did not increase German exports to such an extent as formerly.

Difficulties in Obtaining Credit

The need of large working capital seems to be the dominating factor of the situation, and it is the opinion in all industrial centers that the present boom must collapse, due to a lack of working capital and credit. The scarcity of money became so serious during the past month, that many plants could not pay their employes. Some firms issued bank notes of their own for their payroll, by permission of the Reichsbank. The Krupp Aktien-Gesellschaft issued bank notes of 200- and 1000-mark denominations, and the Thyssen Aktien-Gesellschaft of Mülheim issued notes of the same denominations, and 100- and 500-mark notes in addition. These bank notes, even at this early date, are no longer valid. Practically every firm has tried to solve the problem in some way, but without success. One expedient, the issue of new shares, has failed because the bank cannot be persuaded to lend the large sums of money required.

Changes in Prices of Machine Tools

Naturally the collapse of the mark created a complete alteration of the prices of machine tools. They are now offered at fixed prices only in instances where the machines are actually in stock. A payment on account is required when an order is placed, and it is no wonder that the amount of new orders placed is small. Employment in the machine tool industry continues to be good on account of the number of orders on hand, the filling of which will presumably take some months. Many orders were received at the Leipzig fair, and on the whole, the fair has been more successful than was expected.

Any business contract is a speculation of the worst kind, the risk of which increases according to the degree in which the manufacturer depends on foreign markets for the supply of raw materials. A new feature of the market is the basing of prices on the value of the American dollar. As a result of this practice, it frequently happens that the prices asked for almost identical machines differ greatly.

Prospects of better conditions seem poorer than ever, and the political situation appears to be hopeless. The iron industry has been a leader in setting the prices of its products according to the American dollar, and price changes in this industry now take place four times a month. Machine tool builders are careful in ordering raw materials. One large concern recently cancelled as far as possible all previous orders for raw materials. Invoicing in foreign currency, of products made from home materials as well as from foreign materials and intended for home or foreign consumption, is now being practiced for the first time by the Association of German Machine Tool Builders. This method has been adopted by the manufacturers in an attempt to keep pace with the drop in the value of the mark in relation to the dollar.

Machine Tool Investments

By a Machine Tool Sales Manager

THE usual method of determining whether a new machine tool should be purchased or not, is to investigate the effect that it will have on the cost per piece produced. In many cases, machine tool buyers expect to reduce the cost of their product sufficiently to cover the purchase price of the machine in a single year. In other words, they expect a return of 100 per cent on the investment. From the buyer's standpoint, an investment yielding 100 per cent is ideal, and if machine tools are developed fast enough to make it possible continuously to offer investments of this type, it would be very valuable in the reduction of costs in the industries. But while such returns can be recorded for several machine tools now on the market, it is doubtful if a rate of development can be maintained that will make it possible always to offer 100 per cent investments to machine tool buyers. Of course, an automatic screw machine of today can easily show a 100 per cent return on the investment, when its production is compared with the engine lathe of twenty years ago. But it is not likely that the automatic screw machine of tomorrow will be sufficiently superior to that of today to make it possible to offer it as another 100 per cent investment. In other words, machine tool buyers must begin to consider machine tools as a good investment even if they do not give such excessively high returns.

Reducing the Payroll by Improved Equipment

There are some advantages to be gained from the purchase of machine tools besides the actual reduction in the cost of manufacture per piece. When a machine is purchased and put to work, it is expected to earn a profit on the investment and to cover its own overhead. It is exactly the same when a machinist is added to the payroll. He is expected to earn a profit on the wages paid to him, and to cover the cost of the overhead expense added by his employment Now, suppose that a certain amount of work is to be done, and that it may be done either by using the present machinery with additional employes, or by using the same number of employes and installing new machinery. Further, assume that the actual cost per piece will be the same in either case. Which is then the better solution of the production problem?

In one case, the shop would pay out more money in wages, but the assets of the company would remain the same. If new equipment were purchased, money would also be paid out, but the company would have added to its assets. The assets would be increased to the extent of the purchase price of the machinery, less depreciation.

If anyone is in doubt as to which is the better procedure, ask a banker. It is much easier for a concern to do business with a bank when it can show that it has growing assets than when it can merely point to a growing payroll —assuming that the profit is the same in both cases. Suppose, for example, that a shop with 200 employes does $800,000 worth of business. This is $4000 per employe, which includes all expenses, wages cost of materials, insurance, rent, selling expense, taxes, and the hundred and one other items that make up manufacturing costs. Assume that by investing a large amount in modern machinery, the same output is obtained with 150 employes. Assume, further, that $2000 per year is the average cost of wages and supervision per man; then $100,000 a year has been saved in wages. If the interest and the depreciation on the machinery bought amounts to $100,000, the actual profit remains the same; nevertheless, the company is in a better financial position. The new machinery has not increased the profits, but it has increased the assets of the company. Instead of paying out wages that constitute no asset, it has turned the saving into an asset. In times of stress, the borrowing capacity of this company is greater, and it can weather business depressions and financial storms more easily.

Reasonable Returns on Machine Tool Investments

The remarkable improvements in machine tools during recent years have led buyers of machine tools to expect unreasonably high returns on machine tool purchases. Compare the investment in machine tools with the investments made in starting a public service corporation. In the case of public utilities—railroads, electric light and power stations, gas works, and water works—large investments are made before any revenue whatever is derived, and if the return is sufficient to cover depreciation and operating expenses, and yield a profit anywhere from 6 to 10 per cent on the capital invested, the corporation is rated as a sound business.

Now the purchase of a machine tool is a sound investment on exactly the same basis. It is unreasonable to expect a 100 per cent return on the purchase price of a machine tool when a public utility that yields 10 per cent is exceptional. If a machine tool can show an actual annual saving of 20 per cent of its purchase price—10 per cent being allowed for depreciation and 10 per cent as interest on the investment—it should be considered a very good proposition. If the machine is used in an industry that has extremes of prosperous and lean years, an average of a number of years could be used, and if the average equals the figures mentioned, the investment is a sound one. A depreciation of 10 per cent wipes out the cost of the investment in ten years. Many machine tools have a longer life than that, and in any case, at the end of ten years there is a certain scrap value in the machine, and nearly always a second-hand value.,

As a matter of fact, there is probably no other industrial product that gives as high a return on the investment as machine tools. The mere fact that there are buyers in the machine tool field who today expect 100 per cent returns on their investment indicates that machine tool builders are selling their inventive ability and skill very cheaply. It also indicates that those who use machine tools get proportionately a much higher price for their product than the machine tool builder; otherwise, they could not expect a 100 per cent return on their investment. When competition becomes as keen in some of the fields where machine tools are used as it is now between machine tool builders, some buyers of machine tools will be satisfied with as low as 10 per cent return on their investments.

What the Machine Tool Salesman can do to Correct Erroneous Impressions

One factor that has contributed to the demands for a high rate of return on machine tool investments has been that the salesman of machine tools has lacked the financial aspect. He may have been an excellent salesman and a good mechanic and demonstrator of his machine, but he has not made the financial side of the transaction one of the main items of his proposition. There is great room for improvement in the line of attack of the machine tool salesmen.

The machine tool buyer must be educated to look on a machine tool investment much in the same light as investments in other industrial fields. In order to teach him to do this, the machine tool salesman must learn to figure the return from new equipment by an accurate accounting method. If he can offer a net return of 10 per cent or more, he has an investment proposition worthy of consideration and one that will receive attention in a period when the buyers of machine tools are engaged in an active competitive business.

Machine tool salesmen devote a great deal of time in devising methods for going around, over or under, the purchasing agent. To some extent this is necessary, because the salesman must become familiar with the shop conditions, and the purchasing agent, as a rule, can give him only second-hand information on shop subjects. At the same time it should be remembered that the qualifications of purchasing agents as a whole have been raised very much faster than the qualifications of men in many other lines of endeavor. The purchasing agents today are selected because of their ability to earn money for their companies by making investments that will return profits. It will help the cause of the machine tool salesman if he is able to explain clearly to the purchasing agent that the buying of his machine tool is a real investment. The purchasing agent is looking for good investments; it is the salesman's business to show him where he can invest his company's money to good advantage.

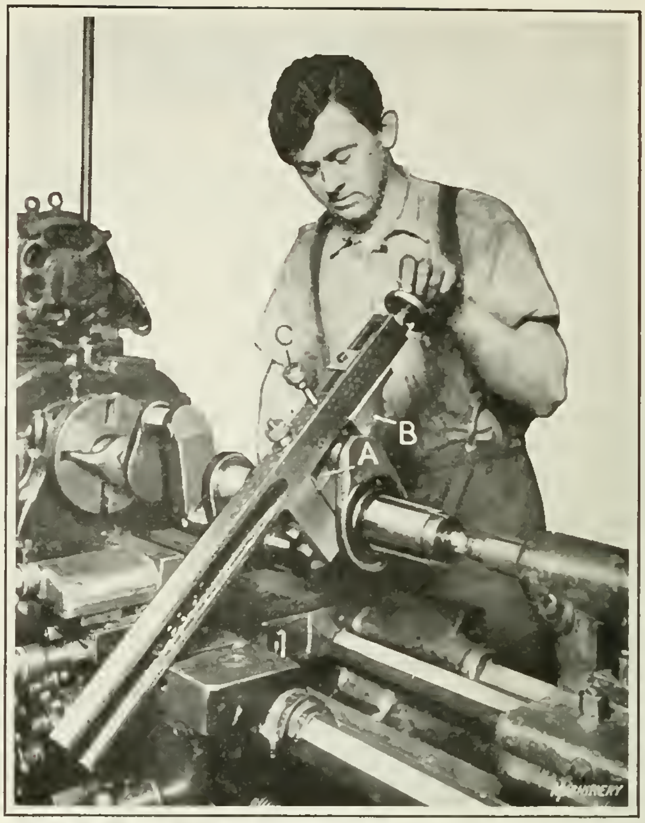
* * *

RE-TURNING CRANKPINS IN AN AUTOMOBILE SERVICE STATION

In repairing automobile crankshafts, it is quite common practice to regrind the crankpins and main bearings, but the repair shops of all service stations do not have sufficient use for a crankshaft grinding machine or a specially arranged cylindrical grinder to employ this method of refinishing worn crankshaft bearings. At the service station of the White Co., Long Island City, crankpins are re-turned on a Greaves-Klusman lathe in which a Sawyer-Weber returning tool is used, as illustrated. The crankshaft is chucked at one end or driven by a lathe dog and supported at the tailstock end in the regular way. The diameter of the pin to be turned is first determined, and then the 90-degree V-block *A* is adjusted to suit this diameter. For convenience in making this adjustment, a scale is provided on the opposite side. It is necessary that this V-block be adjusted for varying diameters of crankpins so that the turning tool will be located diametrically opposite the center of the pin.

The blade that does the turning is the full width of the wrist-pin and is fastened in the slide block *B*, which has suitable adjustment for diameter. A bronze shoe is brought to bear against the crankpin, the correct bearing pressure being produced by the knurled screw *C*. Then the crankshaft is revolved slowly to the front, the best results in turning being obtained if the speed of rotation is not over ten revolutions per minute. The extending bar of the tool bears against the carriage of the lathe as the shaft revolves, and the operator, standing at the rear of the machine, can then conveniently feed the tool by means of the handwheel, as shown in the illustration.

To obtain the best results with this tool, certain points must be observed, as outlined in the following: It is necessary that the cutters have a keen edge and that they be kept sharp. Low rotative speeds are productive of the best results, and the feed should not be more than 0.0005 inch per revolution of the crankshaft. Cutting compound, consisting of 50 per cent lard oil and 50 per cent turpentine should be used in copious quantities. As the cutter is gradually fed in, it is necessary to maintain a proper amount of tension of the bronze shoe against the reduced diameter of the crankpin; hence as the work is being performed the knurled screw *C* is tightened slightly from time to time.



Use of Crankpin Turning Tool for repairing Automobile Crankshafts

This tool has been found entirely suitable for re-turning crankpins that are scored or worn out of round. In the case of a pin that is worn tapered, the revolving crankshaft will cause the end of the bar to sway considerably, and if this is not prevented by bringing the carriage against the side of the bar, the crankpin will be turned tapered. Reference has been made to the necessity of maintaining a keen cutting edge on the turning tool; to aid in maintaining this edge, it is good practice to clean the crankpins before turning with a piece of aloxite cloth to remove rust or glaze, which is destructive to the cutting edge of the tool. At the completion of the returning operation the turned surfaces may be smoothed by means of aloxite cloth held in a wood clamp or in any other suitable way, and this completes the finishing of the pins.

* * *

DEMAND FOR MACHINE TOOLS IN JAPAN

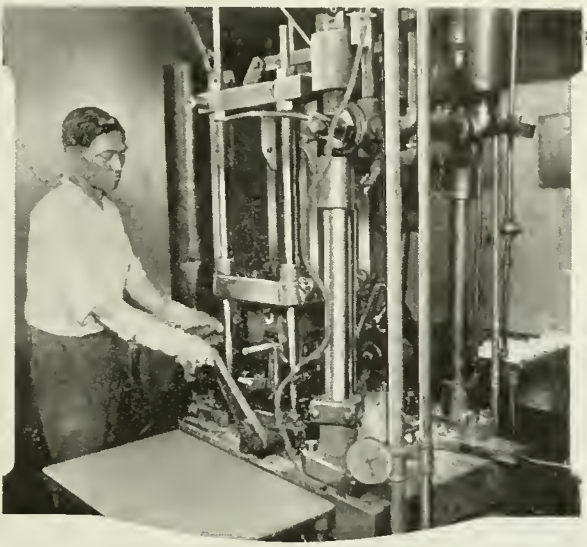
The types of machine tools chiefly in demand in Japan are given in the following information received from Mitsui Bussan Kaisha, Ltd., Tokyo, Japan dealers in machine tools and general machinery. The kinds, types, and sizes of machine tools most in demand are as follows: Lathes, 12- to 24-inch swing; upright drilling machines, from 24 to 36-inch sizes; horizontal boring machines, from 3- to 6-inch sizes; milling machines, Nos. 2 and 3; gear-cutting machines, from 24- to 48-inch sizes; plain and universal grinding machines; and roll grinders.

In viewing the entire machinery field, it is found that the demand for machinery for different industrial uses comes somewhat in the following order: Electrical machinery, excavators, rolling mill machinery, printing machinery, and machine tools. In the machine tool class, the order of demand is about as follows: Milling machines, lathes, grinders, drilling machines, and gear-cutting machines.

Paper mill, sugar mill, and flour mill machinery are also in demand, as well as ice-making machinery. Generally speaking, machinery from the United States is preferred, English machinery comes next, and German and French machinery follow.

Developments in Die-casting Practice

By CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



PERHAPS the greatest advance in the die-casting industry within the last eight or ten years has been the development of the aluminum die-casting process. The use of a lighter die-casting alloy than the original white metals consisting of zinc-, lead-, and tin-base alloys, has made it possible to extend the field of application to a greater degree than formerly. Many articles in common use are now being regularly made by die-casting. In the manufacture of automobile steering apparatus, magneto and ignition systems, carburetors and pumps, player pianos and phonographs, calculating machines, vacuum sweepers, etc., aluminum and zinc die-castings are extensively used.

Examples of some of these aluminum products are shown in Figs. 1 and 2. Fig. 1 is a complete set of die-cast parts for a well-known make of vacuum sweeper. The parts shown are of widely differing designs and involve many special applications of die-casting. Fig. 2 shows adding machine and calculating machine castings and gives a good idea of what can be done with this process in producing castings of large size and thin wall sections.

With the greater field of application afforded by the use of aluminum alloys, there necessarily has been an attendant development in the manufacture of suitable die steels because the casting temperature of aluminum is much higher than that of other white metals. There has also been a development in the types of die-casting machines used to meet the more varied application, although there still remains considerable opportunity for development in machines. Die-casting alloys have been fairly well standardized among the manufacturers of die-castings, and a great deal has already been published regarding the composition of these alloys.

Die-casting Dies

Die-castings may be defined as castings made in metallic dies, or molds, under pressure. Die-casting dies consist of two main metallic members analogous to the cope and drag of a sand mold. For zinc-, tin-, and lead-base alloys, these die members are usually made of low-carbon machine steel, while for aluminum castings, heat-treated chrome-vanadium steel is generally used. Each half of the die can be made of a great many component parts, but when assembled the dies must open and close in two sections. The cavities, holes, and other irregularities on the casting are produced by steel cores, which are usually made of the same kind of steel as the dies. The cores are operated by pinions that engage rack teeth cut on the cores, or in some cases by levers. Usually the cores are located in the die that is drawn away from the melting pot.

The most descriptive names for the two die members are "ejector-die" for the movable member, and "cover-die" for the stationary one through which the metal is admitted to the die cavity. As a general rule, it is advisable to place the cores in the ejector-die, although conditions affecting the parting sometimes make it preferable to place them in the cover-die. In back of the ejector-die there is an ejector-plate in which pins are carried for removing the casting from the die impression. These pins pass through the die-block to the cavity in the ejector-die. The sprue-cutter is a steel stud projecting from the ejector-die far enough to enter the bushing in the cover-die. The cover-die is usually of simple construction containing merely an impression and the bushing through which the metal enters the die.

It is advisable to design the dies so that the casting will remain in the ejector-die when the two are open. The ejector-plate carrying the pins can then be advanced to cause the pins to extend slightly into the die cavity and eject the casting. Sometimes the die cavity will not be irregular enough to cause the casting to remain in the ejector-die of itself, and in such cases the sprue-cutter may be employed to hold the casting in until the dies have been opened. In such a die, the sprue-cutter is made tapered, and after the casting has been made, the sprue shrinks around the sprue-cutter, causing the casting to remain in the ejector member.

The function of the sprue-cutter is to distribute the liquid metal, not to actually sever the metal. It furnishes enough displacement in the bushing leading to the nozzle to insure that the die cavity will be completely filled. It is usually necessary to remove the sprue from the casting in a separate operation. The sprue-cutter may be stationary or movable; if it is movable, it is operated by a lever or pinion. For aluminum work, it is quite likely to be made movable, although it is not generally necessary to move it when other white metals are being cast.

The ejector-pins must fit accurately in the holes in which they operate, and yet must be capable of moving freely. They leave their impression on the casting, because it is practically impossible to have the ends of the ejector-pins project to exactly the same plane as the surface of the die impression. As a consequence, marks will be left on the casting in every case, either in the form of slight projections or depressions. Where the part is such as to re[illegible] finishing, it will be readily appreciated that a depression will be objectionable, whereas if the part is to bear upon another part in service a projection on the surface of the casting would be objectionable, while a depression would not be. From this it will be appreciated that the designer should know the service to which the part is to be put.

Location of Parting Line

The location of the parting line of the two die members is of paramount importance, and to determine where the best place for this line is, requires a knowledge of the art of casting production. There is likely to be a greater variation in the casting dimension at the parting than at any other point. This is so because it is not always certain that the two die members will be completely closed, for if they are left open only a few thousandths of an inch by some slight particle on the face of the dies, an opportunity for variations is afforded. Sometimes it is necessary to employ a great deal of ingenuity to make it possible for the part to be removed from the die, in which case no matter where the parting line is, special means are necessary to free the casting. For this purpose section core pieces are often used, which are removed from the casting after it is ejected from the die.

Running a line of cold water through the dies prolongs their life. Dies for castings of considerable mass, that is, bulky designs, require water-cooling, although for castings of thin wall section it is not necessary to cool the dies in this way. This is true whether the metal is aluminum or one of the other white metals of lower melting temperature. If the cores are of large diameter, it is often necessary to water-cool them as well, by running a pipe or tube into the die or core, directing it to the place that is subjected to the greatest degree of heat. A suitable drain pipe should, of course, be provided for carrying off the cooling water.

In designing die-casting dies, much depends upon the design of the part to be cast. When a drawing of a part is received by the Doehler Die-Casting Co., the engineering department determines what changes in design are necessary, if any, to cast the part satisfactorily. A drawing is then made on which the recommended changes are indicated, and the casting limits specified. Other suggestions regarding allowances for finish, casting material, etc., are also noted on this drawing. An attempt is made to keep the sections of the casting as uniform as possible. Large fillets and thin sections are most desirable, and undercuts are avoided wherever possible, because they involve complicated construction.

A blueprint of this drawing is forwarded to the customer for his approval, and if the limitations set down by the engineering department meet the requirements of service satisfactorily, and the design is approved by the customer, the actual designing of the dies is undertaken. In designing the die, draft must be provided for the interior walls and holes. The outer walls can sometimes be made without draft by using slides which move away from the casting before it is ejected. The use of slides also makes it possible to cast under-cuts on the sides of the part.

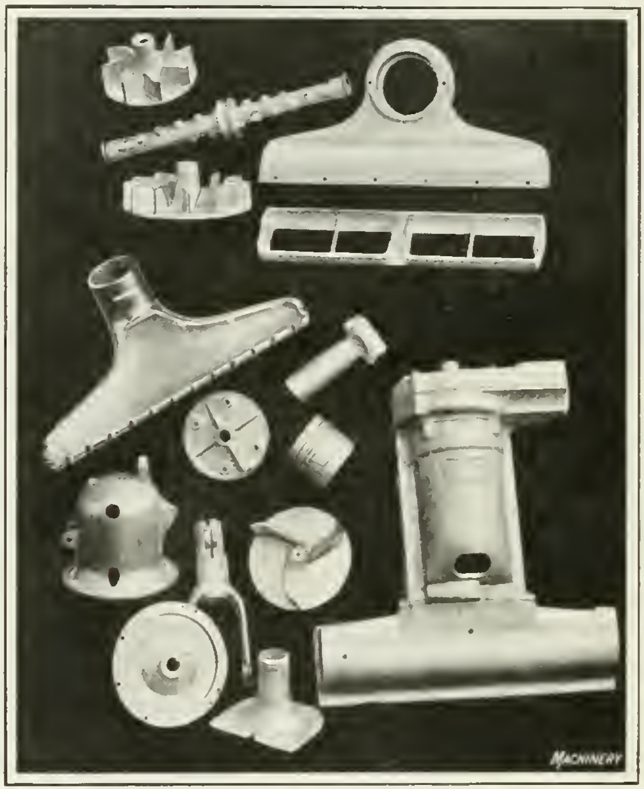


Fig. 1. Die-cast Parts for a Vacuum Sweeper

Draft Required in Dies for Castings Made from Different Alloys

The amount of draft commonly used for each of the alloys is approximately as follows: For zinc-base alloys, 0.001 inch per inch on both the cores and walls; for tin- and lead-base alloys, 0.0005 inch per inch for the cores, and 0.001 inch per inch for the walls; for aluminum, 0.015 inch per inch for cores 1/4 inch or more in diameter, and 0.005 inch per inch for cores less than 1/4 inch in diameter, and for the walls 0.005 inch per inch; for copper-base alloys (brasses and bronzes), 0.005 to 0.010 inch per inch for the cores, and 0.002 inch per inch for the walls.

Accuracy and uniformity are important factors in die-casting production. Calculation for shrinkage and careful construction of the die are vital considerations in obtaining accuracy and uniformity. For casting aluminum, a shrinkage allowance of 0.004 inch per inch is made; for zinc-base alloys, the shrinkage allowance is 0.0025 inch per inch, and for tin- and lead-base alloys, 0.001 inch per inch.

It is of great importance that all these factors entering into the die design be taken into consideration because errors necessitate changes involving a heavy expense, due to the high cost of die-casting dies. It is well for the designer to bear in mind that it is comparatively easy to add stock to the outside of the casting, since that involves only enlargement of the die, but it is extremely difficult, and often impossible, to reduce the outside dimensions of the die-casting, as this means reducing the size of the impression. To guard against this, and also to facilitate the machining of the die members, the cavities themselves are often made in sections, although in any event changes should be guarded against.

As previously stated, the alloys commonly used for die-casting are fairly well standardized. The composition and properties of some of the alloys which the Doehler Die-Casting Co. has adopted as standards were presented in an article published on page 282 of November, 1920, MACHINERY.

Zinc-base alloys consisting mainly of zinc and tin or zinc and aluminum have a specific gravity of 7.20. The heaviest casting recommended to be made from these alloys is 8 pounds, the thinnest wall section, 1/16 inch, and the tolerance that can be maintained per inch, ± 0.001 inch. External threads as fine as 24 per inch can be cast, and also internal threads under certain conditions. The minimum hole diameter that can be cast with zinc alloys is 1/32 inch, although this size is influenced somewhat by the length and thickness of the casting wall.

Tin-base alloys, which include the babbitts, consist mainly of tin, lead, and antimony. The specific gravity of these alloys is 7.40, the maximum recommended weight of a die-casting made from them, 10 pounds, and the minimum wall thickness, 1/32 inch. The castings can be held to a tolerance of ± 0.0005 inch per inch. External threads as fine as 27 per inch can be cast, as well as internal threads in some cases. The minimum diameter of hole that can be cast is 1/32 inch, but this size is also influenced by the length and thickness of the casting wall.

For the lead-base alloys, which consist of lead, tin, and antimony, the specific gravity is 10.03 and the maximum weight recommended for castings made from these alloys is 12 pounds. The minimum wall thickness is 1/32 inch, and the tolerances are ±0.001 inch per inch. External threads can be cast as fine as 24 per inch, and internal threads can also be cast under some conditions. The smallest diameter of hole that can be cast is 1/32 inch, but this size is governed somewhat by the thickness of the casting wall.

Aluminum alloys consist of aluminum and copper principally, or aluminum, copper, and nickel, and their specific gravity is about 3.003. The maximum recommended weight of an aluminum casting is 5 pounds. The thinnest wall section that can be successfully cast is 1/16 inch for small castings, and 1/8 inch for large castings. Aluminum castings

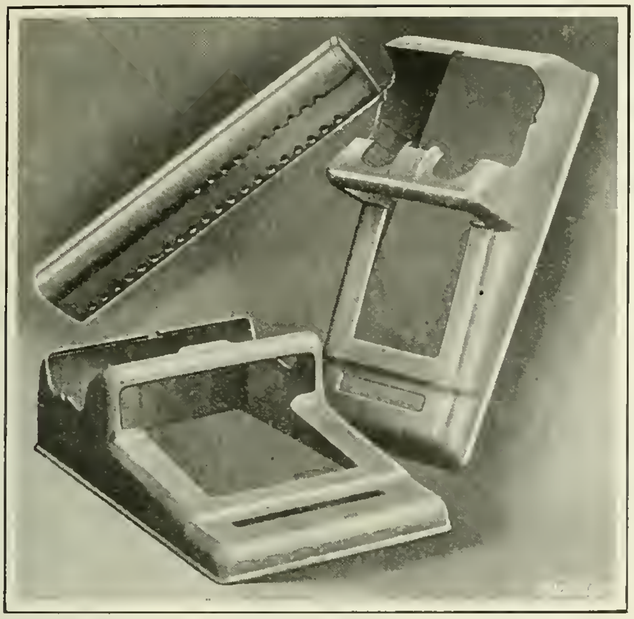


Fig. 2. Die-castings used in Adding Machines and Calculating Machines

can be held to a tolerance of ± 0.0025 inch per inch. External threads can be cast, but they must be cast 0.010 inch over size and then chased to size. The finest external thread that is recommended for aluminum castings is 20 per inch. Internal threads cannot be cast. The minimum size of holes for aluminum castings is 3/32 inch on holes not deeper than 1 inch; for holes smaller than this, it is customary to spot the casting to facilitate subsequent drilling.

For the copper-base alloys consisting of copper and zinc (manganese bronze), 14 pounds is the maximum weight recommended for die-castings. The minimum wall thickness is 3/64 inch, and the tolerances ± 0.005 inch per inch. It is not possible to die-cast threads from copper-base alloys. The smallest diameter of hole that can be cast is ½ inch, smaller holes being spotted to facilitate drilling.

The figures given in the foregoing are, of course, only approximate, since some dimensions on a given casting can always be held closer than others. For example, at the parting line there is a greater variation than elsewhere on the casting. Alloys having a lower melting point can be held within closer limits than those having a higher melting point, so that aluminum with its higher melting point cannot be held as close to a specified dimension as the other white metals.

Subsequent articles will deal with types of die-casting machines, methods of designing die-castings, and the means by which difficulties met with in the die casting process are overcome.

* * *

EFFECT OF CERIUM AS AN ALLOY METAL

The study of cerium as an alloying element in steel, conducted at the Ithaca, N. Y., field station of the United States Bureau of Mines, has been finished. The attempt to utilize the cerium group of metals, made from by-products of the gas mantle industry, in metal alloys gave only negative results. In aluminum alloys, the cerium group of metals had no useful effect either as alloying materials or as scavengers. In steel, the desulphurization effected by the cerium metals was accompanied by the retention in the steel of inclusions due to the cerium metals. The harmful effect of the inclusions overbalanced any good effect due to desulphurization or to the presence of cerium metals as alloying elements. Neither plain carbon steel nor various alloy steels to which cerium was added were improved. Collected data showed cerium to have no marked effect as a true alloying element in steel, and to be harmful rather than helpful when used as a scavenger.

MAKING A MOLD FOR A LARGE BRACKET

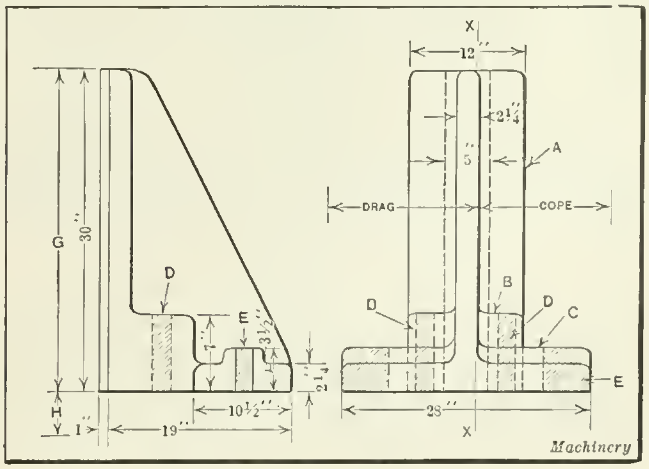
By M. E. DUGGAN

The majority of patternmakers would doubtless construct a pattern such as the one shown in the illustration with a parting line at *X–X*. The original pattern was made in this way, and was intended to be molded on its side, with the left-hand section of the pattern in the drag and the right-hand section in the cope, as indicated. The pieces *A*, *B*, and *C* on the cope side were loosely fastened to the pattern, while the corresponding pieces on the drag side were securely fastened in place. Core-prints and special core-boxes were made to form the bolt holes at *D*. The bolt slots *E* were cut into the pattern and were intended to be molded in green sand.

However, when the pattern reached the foundry, the loose pieces on the cope side were securely nailed to the pattern by the molder. Then, instead of making the mold in the manner intended by the patternmaker, the pattern was molded on end entirely within the drag flask. The section *G*, as indicated in the illustration, represents the drag, and the section *H* the cope. The cope was therefore flat, and of the type commonly referred to as a "flat back" cope. The slots at *E* and the holes at *D* in this case were formed by dry sand cores rammed up with the pattern. These cores, usually called "ram-up" cores, were shaped from slab cores such as are kept on hand in nearly all foundries.

When patterns, such as the one described, are returned from the foundry with the loose pieces fastened to the pattern and the cope and drag sections securely fastened together, it is evident that the molder prefers to mold the pattern on end in the drag flask. In so doing, the chance of damaging the mold when locking or closing it is greatly lessened. Then, again, instead of having to draw a fairly deep pattern from the cope as well as from the drag, only one (the drag) pattern is required to be drawn. Also, if the two-part pattern is used, wooden sand bars shaped to conform to the outline of the pattern are required to support the sand in the cope. In addition it might also be necessary to drive nails into the sand bars and provide gaggers dipped in clay and laid around the mold above the pattern to give the cope mold additional support.

From the foregoing it will be evident that the molder prefers to mold the whole pattern in the drag. This, however, is not always possible, as certain conditions make it necessary to employ a split pattern designed to be molded on its side. Needless to say, the best results in patternmaking will be obtained only when the patternmaker keeps in close touch with the foundry work. By making personal visits to the foundry and by reading articles on molding and foundry practice in technical journals, it is possible for the patternmaker to obtain a better understanding of how patterns should be constructed so as best to meet the molder's requirements.



Pattern used in producing Cast-iron Bracket

Designing Power Press Crankshafts

By P. A. FRIEDELL, Chief Engineer, D. H. Stoll Co., Buffalo, N. Y.

VARIOUS methods of calculating the strength of crankshafts and eccentric shafts for power presses are used by different designers. These methods give different results for presses of the same tonnage capacity, and consequently a designer has difficulty in deciding which is best. In this article is described a method which has been used by the writer for a number of years and has been found to be very reliable. Crankshafts are made from steel of various compositions, but a steel having a carbon content lower than 0.25 per cent or higher than 0.50 per cent should not be used. Steels of the lower carbon content "set" too readily under load, and cause misalignment of the bearings and consequent cutting and heating. The higher carbon steels will not withstand the constant severe stresses produced by shocks, as in blanking and piercing. Open-hearth steel having a carbon content of from 0.40 to 0.50 per cent is most satisfactory for crankshafts.

Designing the Crankshaft for a Single-crank Press

The tonnage capacity is the main consideration in designing a crankshaft. Other items that affect the dimensions are number of cranks; distance between cranks; method of driving crankshaft—at one end, at both ends, or between the cranks; length of stroke; and percentage of stroke during which the crankpin carries the full load. As a first problem a crankshaft will be calculated for a single-crank press intended for blanking and piercing operations and having a capacity of 200 tons. Allowable stresses of 10,000 pounds per square inch for shearing and bending will be used in all computations. A trial value for the crankshaft diameter d, Fig. 1, may be obtained by dividing the tonnage by 3, and extracting the square root of the quotient. This gives a diameter of approximately 8 inches. For the trial crankpin diameter D select a value which will give an area 50 per cent greater than the area of a shaft of diameter d. Then the trial value of diameter D will be found to be approximately 10 inches. To obtain the length E of the crankpin bearing, divide the tonnage by twice diameter D, and add 0.2 D for radii R. Thus,

$$E = (200 \div 20) + 2 = 12 \text{ inches}$$

This length will be satisfactory so far as the bearing area is concerned. However, when the design incorporates a connection screw for adjustment, the following formula, in which P equals the total load in tons, should be used:

$$E = \sqrt{2\left(\sqrt{\frac{P}{5}} + \tfrac{1}{4}\right)^2} + \tfrac{3}{4} + 2R$$

Substituting the known values,

$$E = \sqrt{2\left(\sqrt{\frac{200}{5}} + \tfrac{1}{4}\right)^2} + \tfrac{3}{4} + 2 \times 1 = 12.04 \text{ or } 12 \text{ inches}$$

The greater of the values found for E by the two formulas should be taken as the true length of the crankpin. Although both formulas give the same value in this instance, there is sometimes a considerable variance in the results. The crank cheek widths C should be made approximately 0.6d, or, in this case, 4.8 inches. Radius F should equal 0.1d or about ¾ inch. Adding the various values, length B will be found to equal about 21½ inches, and length L, 23 inches.

Calculating Bending and Twisting Moments and Shearing Force

With the liberally proportioned crankpin and crank cheeks which the trial formulas give, the crankshaft may be considered as a beam on which the load is evenly distributed over distance B and which is supported at points N. Then the approximate bending moment M may be found from the following formula, in which W equals the total load on the beam in pounds:

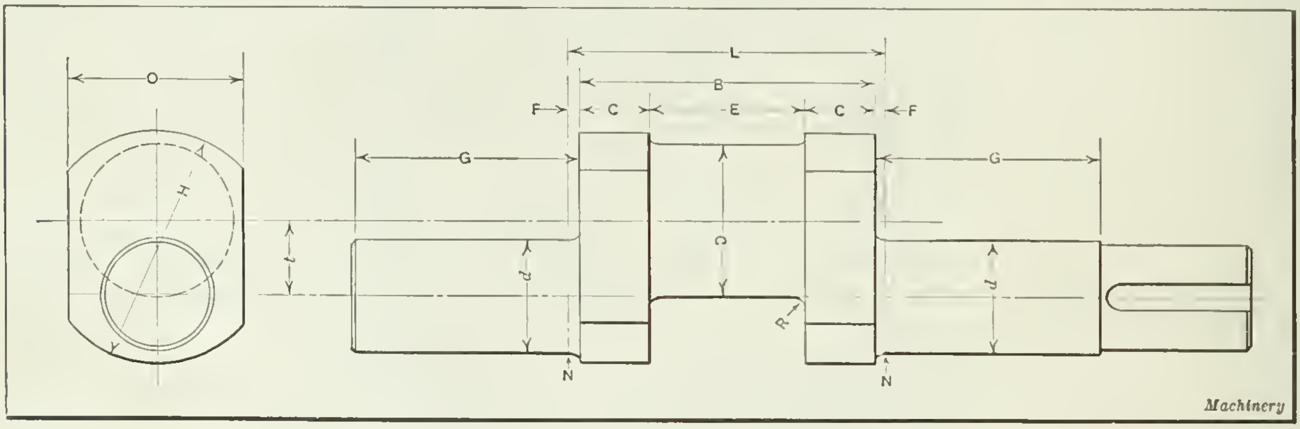


Fig. 1. Single Crankshaft for which Dimensions are computed

$$M = \frac{W}{4}\left(L - \frac{B}{2}\right) \qquad (1)$$

Substituting the known values,

$$M = \frac{400{,}000 \times 12.25}{4} = 1{,}225{,}000 \text{ inch-pounds}$$

Crankshafts are generally designed to receive the maximum load when the axis of the crankpin is not more than one inch from the vertical center line of the crankshaft bearings. Consequently, the twisting moment equals the press capacity, in pounds, multiplied by one inch, or in this case 400,000 inch-pounds.

The stroke should be as short as is practicable, considering the work to be done, because if the crankshaft is designed to receive the maximum load with the crankpin one inch from the axis of the crankshaft bearings, a press with a 2-inch stroke is able to withstand its maximum load throughout the entire stroke, whereas with a press having a 4-inch stroke and a 15-inch connection, the maximum capacity is utilized only through a distance X, which may be determined by the following formula:

$$X = a + c - \sqrt{(\sqrt{c^2 - 1} + a)^2 - 1}$$

in which a = length of connection and c = throw.

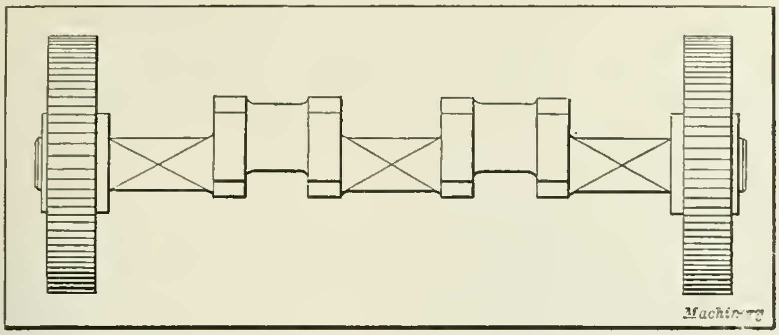


Fig. 2. Typical Double Crankshaft driven at Both Ends

Substituting the known values,

$$X = 17 - \sqrt{(\sqrt{4-1} + 15)^2 - 1} = 0.3 \text{ inch}$$

This indicates that value X drops off rapidly for increased length of stroke. It will be noted from Fig. 1 that the crankshaft is subjected to shear at points N, which equals 100 tons or 200,000 pounds at each point.

Determining the True Crankshaft and Crankpin Diameters

The following formula for diameter d, in inches, may be used for a crankshaft made of open-hearth steel having the carbon content recommended in the foregoing:

$$d = \sqrt{\left(1.72 \sqrt[3]{\frac{T}{10{,}000}}\right)^2 + \frac{Q}{10{,}000}} \qquad (2)$$

in which T equals the twisting moment, in inch-pounds, and Q equals the shear at either of points N. Substituting the known values in this formula,

$$d = \sqrt{\left(1.72 \sqrt[3]{\frac{400{,}000}{10{,}000}}\right)^2 + \frac{200{,}000}{10{,}000}} = 7\tfrac{1}{2} \text{ inches}$$

As the crankpin is subjected to bending stresses, other stresses on a single crankshaft are insignificant. Therefore the crankpin diameter D may be found by the following formula,

$$D = \sqrt[3]{\frac{32\,M}{\pi S}} \qquad (3)$$

in which S equals the allowable stress in pounds per square inch. Taking 10,000 pounds per square inch as the allowable stress and substituting the other known values,

$$D = \sqrt[3]{\frac{32 \times 1{,}225{,}000}{3.1416 \times 10{,}000}} = 10.76 \text{ or } 10\tfrac{3}{4} \text{ inches}$$

Thus a crankshaft in which d equals $7\frac{1}{2}$ inches and D equals $10\frac{3}{4}$ inches will safely deliver a load of 200 tons at a point 0.3 inch from the bottom of the stroke on a 4-inch stroke press, and through the entire stroke of a 2-inch stroke press. Knowing the true values of D and d, dimensions O and H can be determined for a 2-inch stroke press as follows:

$$O = D + 2R = 10.75 + 2 = 12.75 \text{ inches}$$

$$H = \frac{D + d + 2t}{2} + 2R = \frac{10.75 + 7.5 + 2}{2} + 2 =$$
12.125 inches

Lengths G of the main bearings should be not less than 1.75 times the true diameter d. In this case, $G = 1.75 \times 7.5 = 13.125$ inches. It is often necessary to make these lengths greater than 1.75 d due to the design of other parts. The bearing pressure V, in pounds per square inch, may be computed from the formula:

$$V = \frac{W}{2\,Gd}$$

or, for a bearing equal to 1.75 d,

$$V = \frac{W}{3.5d^2}$$

For the crankshaft under consideration,

$$V = \frac{400{,}000}{3.5 \times 7.5 \times 7.5} = 2030 \text{ pounds per sq. in.}$$

This value for main bearings, should not greatly exceed 2000 pounds.

If it were desired to design a crankshaft for a 10-inch stroke, say for drawing a shell 5 inches deep, the capacity at a point 5 inches from the bottom of the stroke would equal

$$\frac{1960d^3}{5} = \frac{1960 \times 7.5^3}{5} = 165{,}400 \text{ pounds or 82 tons}$$

The capacity would increase in value until the bottom of the stroke was reached, at which point the maximum load of 200 tons could be applied.

Should a crankshaft of 10-inch stroke be desired to transmit a load of 200 tons throughout its entire stroke, it would be unnecessary to change the diameter of the crankpin. However, the diameter of the crankshaft would need to be increased to compensate for the greater twisting moment, which would equal $400{,}000 \times 5$ or 2,000,000 inch-pounds. Then the crankshaft diameter d would be as follows:

$$d = \sqrt{\left(1.72 \sqrt[3]{\frac{2{,}000{,}000}{10{,}000}}\right)^2 + \frac{200{,}000}{10{,}000}} = 11 \text{ inches}$$

A crankshaft in which the diameter d equals 11 inches, diameter D, $10\frac{3}{4}$ inches, and the other dimensions are as calculated, would be capable of exerting a pressure of 200 tons throughout its entire stroke, but not more than this pressure, because, while the crankshaft is sufficiently large at its bearings to withstand the maximum twisting moment obtained with a 200-ton load at a radius of 5 inches, the crankpin would be designed only for the bending stress caused by a load of 200 tons.

Crankshafts Having More than One Crank

Little advantage is gained by providing a crankshaft with more than two cranks unless it is desired to keep the slide or ram as light as possible, in which case the extra weight would be placed in the crown of the press. In increasing the number of cranks, the capacity of the crankshaft is increased only when each crank is driven separately. For instance, if the crankshaft previously considered were designed with two crank and driven from one end only, the capacity would still be 200 tons. However, if this double crankshaft were driven from both ends, as shown in Fig. 2, or between the cranks, as shown in Fig. 3, its tonnage capacity would be double, or 400 tons.

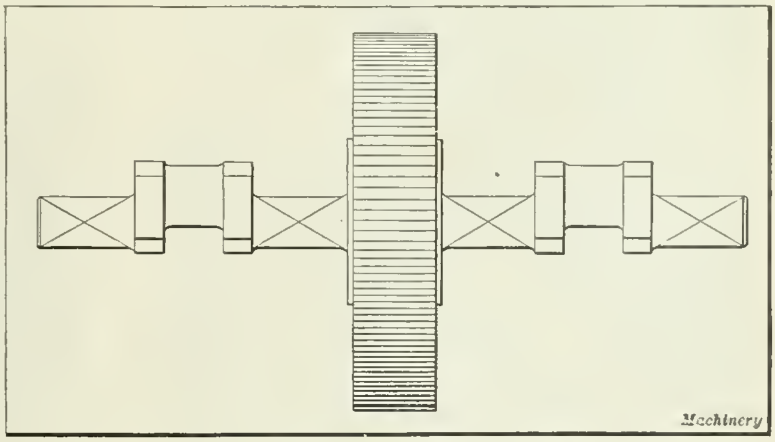


Fig. 3. Double Crankshaft driven between the Two Cranks

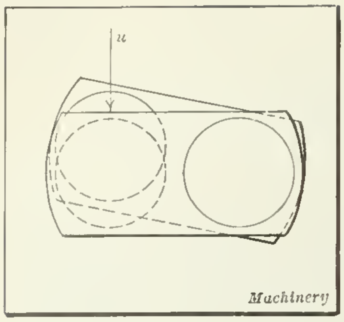


Fig. 4. Application of Force u

When a crankshaft is driven at one end only, power is transmitted through the shaft to the first crank, which performs one-half the work. This crank, in turn, transmits power to the second crank for doing the remainder of the work. The first crank receives only half the direct bending moment; however, there is still another bending moment or effort to be considered, which is similar to that of a cantilever loaded at the end. This moment u also tends to twist the first crankpin, as shown on an exaggerated scale in Fig. 4, in the transmission of power to the second crank. From this it will be inferred that with a double crankshaft driven from one end, the crank at the driving end must be doubly strong to carry half the load on the ram and also to drive the second crank.

Value u changes under different conditions of stroke, crankpin diameter, etc., and is only equivalent to the twisting moment of an eccentric shaft. It may be determined by means of the formula $u = \frac{WE}{4t}$. With a double crankshaft driven at one end, and having a stroke of 20 inches and the other conditions the same as in the previous problem,

$$u = \frac{400{,}000 \times 12}{4 \times 10} = 120{,}000 \text{ inch-pounds}$$

In transmitting the load through the second crank cheek of the first crank, back to the crankshaft, the twisting moment is again 200,000 inch-pounds. Then, from Formula (2) the crankshaft diameter beyond the first crankshaft should be

$$d = \sqrt{\left(1.72\sqrt[3]{\frac{200{,}000}{10{,}000}}\right)^2 + \frac{100{,}000}{10{,}000}} = 5.639 \text{ or } 5\tfrac{3}{4} \text{ inches}$$

Assuming diameter D of the crankpin to be 7 inches, the various values can be found by the same method as was used for the single crankshaft. Thus,

$E = 100 \div 14 + 1.4 = 8.5$ inches
$C = 0.6 \times 5.75 = 3.45$ or $3\tfrac{1}{2}$ inches
$B = 8.5 + 7 = 15\tfrac{1}{2}$ inches
$F = 0.1 \times 5.75 = 0.575$ or $\tfrac{1}{2}$ inch
$L = 15.5 + 1 = 16.5$ inches

Then the bending moment M may be found by substituting known values in Formula (1), W in this case equaling one-half the total load, or 200,000 pounds.

$$M = \frac{200{,}000 \times 8.75}{4} = 437{,}500 \text{ inch-pounds}$$

Then, using Formula (3)

$$D = \sqrt[3]{\frac{32 \times 437{,}500}{3.1416 \times 10{,}000}} = 7.64 \text{ or } 7\tfrac{5}{8} \text{ inches}$$

While a crankshaft of the dimensions given would withstand all stresses imposed upon it, its design would be impracticable. It is thus customary to make the dimensions of the second crank identical with those of the first, and the dimensions of the second and third bearings the same as in the first.

Crankshafts for operation at medium or low speeds, and transmitting heavy loads, should preferably be mounted in fine-grained cast-iron bearings scraped to a good running fit. The crankshafts should be run under moderately high loads at first. After cast-iron bearings have been properly run in, plenty of oil being used, they become most durable and satisfactory for high and medium loads transmitted at low or medium speeds, and are superior to most bronzes.

NEW PRESIDENT OF A. S. M. E.

The new president of the American Society of Mechanical Engineers, John Lyle Harrington, was born at Lawrence, Kans., December, 1868. After a brief business experience, he entered the University of Kansas in 1891 and graduated in 1895 with the degrees of A.B., B.S., and C.E. Later he received the degree of M.S. from McGill University, Montreal.

His first six years after graduation were devoted to bridge, structural and mechanical work with J. A. L. Waddell, consulting engineer, Kansas City, Mo.; with the Elmira Bridge Co., Elmira, N. Y.; with the Pencoyd Iron Works, Philadelphia, Pa.; with the Keystone Bridge Works of the Carnegie Steel Co., Pittsburg, Pa.; with the Cambria Steel Co., Johnstown, Pa., for whom he designed and supervised the construction and equipment of the bridge and structural shops; with the Bucyrus Co., South Milwaukee, Wis., as assistant chief engineer; with the Northwestern Elevated Railway Co. of Chicago, as assistant chief engineer in charge of the detailing and fabrication of the metal work in the shops; with the Berlin Iron Bridge Co., East Berlin, Conn., as designer; and with the Baltimore & Ohio Railroad Co. as assistant engineer of bridges and buildings.

From 1901 to 1905 he served as executive engineer and manager of the C. W. Hunt Co., New York City, and during 1905 and 1906 as chief engineer and manager of the Locomotive Machine Co. of Montreal, a subsidiary of the American Locomotive Co. From 1907 to 1914 he was a member of the firm of Waddell & Harrington, consulting engineers, Kansas City, and from 1914 up to the present he has been the senior partner of the firm of Harrington, Howard & Ash, consulting engineers, Kansas City. During his work as a consulting engineer, which has been devoted largely to the design and supervision of construction of large bridges, he has developed the vertical lift bridge and a variation of it, the movable deck, and has made a specialty of large movable structures of all kinds.

Mr. Harrington became a member of the American Society of Mechanical Engineers in 1902. He is also a member of the American Society of Civil Engineers, the Engineering Institute of Canada, the Institution of Civil Engineers of Great Britain, the American Railway Engineering Association and the American Society for Testing Materials.

* * *

The use of gas, either illuminating or natural, for preheating in thermit welding should be discouraged, because with this fuel the preheating gate in the mold may become badly burned. In order to pre-heat a section to be welded by the thermit process, it is better to use gasoline or kerosene as a fuel. The flame of these fuels can be regulated so that the preheating gate will be dried out by the heat, but not burned. A rich flame may be used during the early part of the preheating operation without harm, but toward the end care should be taken to see that no excess fuel is used.

Roughing Bevel Gears and Pinions

By FRANKLIN D. JONES

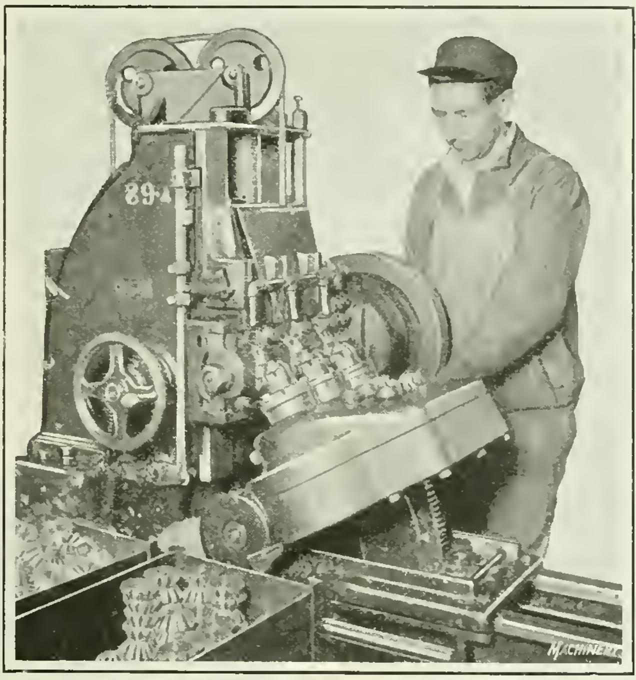


Fig. 1. Roughing Bevel Pinions on a Vertical-cutting Type of Machine equipped with Three Cutters

When bevel gears are required in large numbers, as in the automotive industry, the general practice is to rough out the gears on a machine designed especially for rapid cutting, and then finish these roughly formed teeth on a machine constructed primarily for generating accurate teeth. This practice has two advantages: It increases production because the stocking cuts are made on machines that are very efficient for such work; and the machines used for finishing are not subjected to the strains produced by heavy roughing cuts; consequently, their accuracy is maintained. Several types of Gould & Eberhardt machines designed especially for roughing out bevel gears and pinions are illustrated in Figs. 1 to 6 and in Fig. 8.

Roughing Bevel Gear Pinions on a Multiple Shaper

A multiple type of shaper designed especially for roughing small bevel pinions in large quantities is shown in Fig. 2. This particular machine is used for roughing out the bevel pinions of automobile differentials. Six pinions are cut at a time, the shaper being equipped with six tools and six work-holding spindles, as shown in Fig. 3. The roughing out is done at the rate of fifty-six pinions per hour. The pinions are made of open-hearth steel, and they have twelve teeth and a face width of 13/16 inch. They are indexed after each cutting stroke, and the work-spindles are locked while the tools are at work. The shaft that transmits motion for indexing the work-spindles may be seen in Fig. 2. The tool head is fed downward automatically by a cam designed to vary the feed according to the position of the tools relative to the blanks. Thus, when the tools are entering blanks, the feeding movement is comparatively rapid, and as the full depth of the cut is approached, the feed is reduced. The work-spindles of this machine are in a fixed position and remain at the same angle, since this is a single purpose machine designed for use on pinions of one size.

Multiple-spindle Bevel Gear Roughing Machine

One of the multiple-spindle machines for roughing bevel gears and pinions is shown in Fig. 1. This particular design has an adjustable work-head to permit gears of different sizes and angles to be cut. The machine is a vertical-cutting type using formed cutters, and it is of a triplex design, three pinions being cut at one time. Since the work-table has angular adjustment and is carried by a slide, adjustable along the horizontal ways of the bed, this machine may be adapted to a variety of gear sizes and is recommended in preference to the non-adjustable design for use where the production of duplicate gears is not on a large enough scale to warrant installing a more special machine.

Fig. 4 shows a machine for cutting four bevel pinions at a time. The work-spindles in this case are located at a fixed angle, since the machine is intended for exclusive use on one angle only. This machine is of the type having

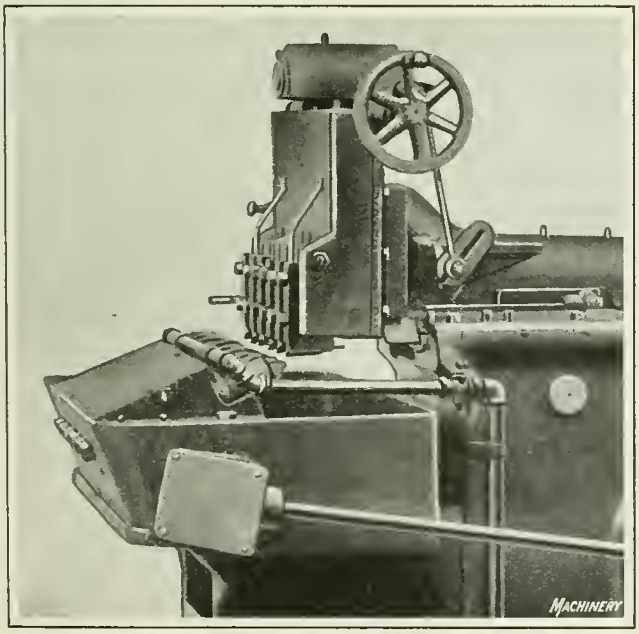


Fig. 2. Multiple Type of Shaper for roughing Bevel Pinions

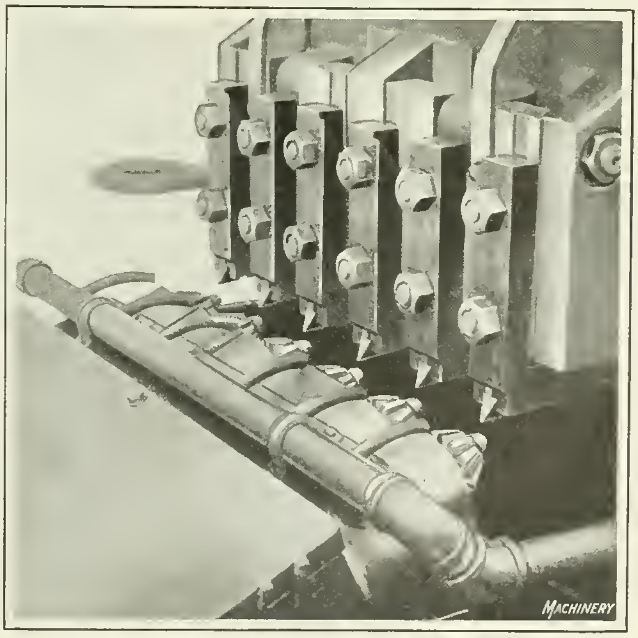


Fig. 3. Detail View of the Six Cutting Tools and Pinions

a revolvable turret, which permits the operator to reload blanks while the four pinions on the opposite side of the turret are being cut. The particular machine illustrated is being used for finishing pinions not requiring the accuracy obtained on a generating type of machine. This fixed-angle turret head type, however, is intended primarily for roughing out bevel pinions.

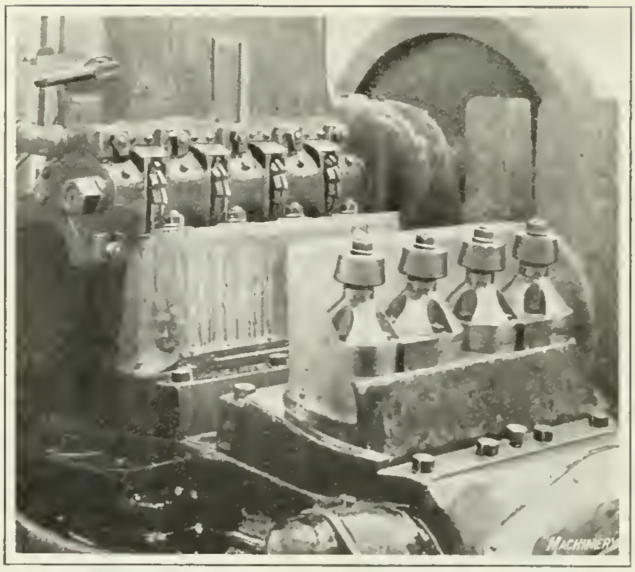


Fig. 4. Machine with Turret and Fixed-angle Work-spindles

Another bevel gear roughing machine of the vertical-cutting turret type is shown in Fig. 8. The work-spindles are held at a fixed angle, but point downward, because, in this case the gears have projecting hubs, which prevent their being cut while held in the usual way. Two bevel gears are cut at a time, and the two additional work-spindles on the opposite side of the turret provide a loading position. These gears have twenty-eight teeth of 4 diametral pitch, and are made of 3½ per cent nickel steel. The rate of feed is 6.6 inches per minute, and the production obtained is sixty-one gears in eight hours.

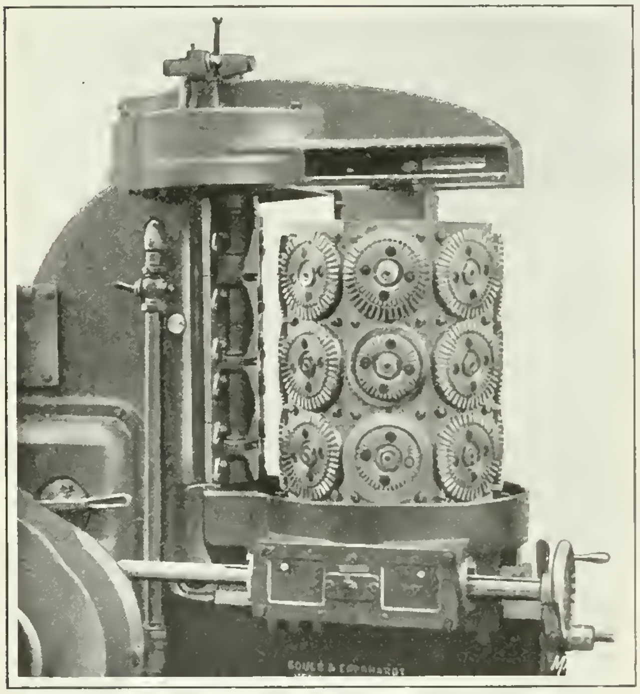


Fig. 5. Special Design of Ring Gear Roughing Machine

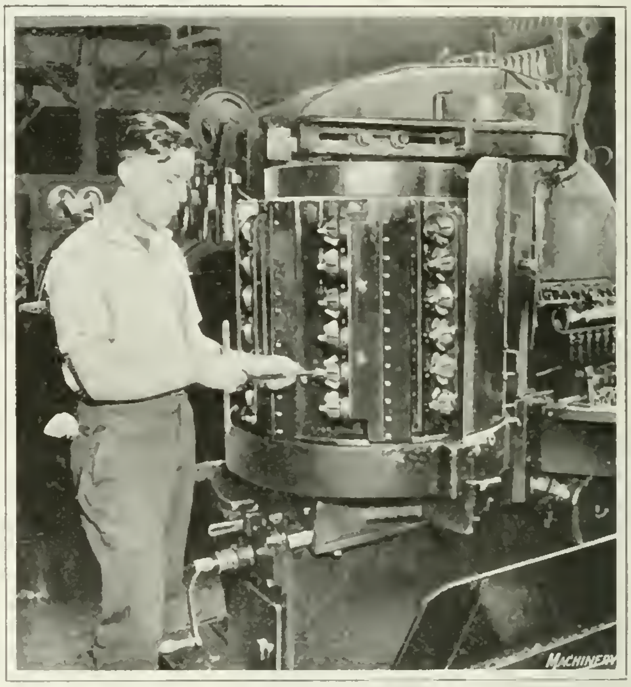


Fig. 6. Another Special Machine for roughing Differential Pinions

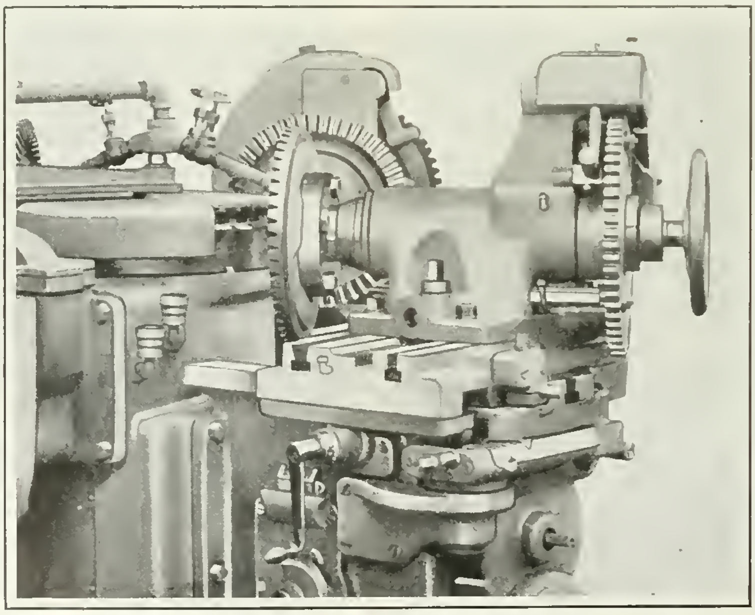


Fig. 7. Roughing Bevel Gears of 4 Diametral Pitch on Triplex Type of Machine

Roughing Bevel Gears on Turret Type Machines

Bevel gear roughing machines of the highly specialized design shown in Fig. 5 were designed and built by Gould & Eberhardt for the Ford Motor Co. to give the extremely large production required in roughing out the ring gears of the differential mechanism. The gear blanks are held on an octagonal shaped turret, and three cutters are at work simultaneously, each cutter being in a central position relative to three groups of blanks. These ring gears, for which this machine is used exclusively, have an even number of teeth (forty teeth of 5 pitch) so that each cutter passes from one gear to the next, thus cutting tooth spaces across successive gears as the turret revolves continuously. A slow feeding movement is employed while the gears are being cut, and a much faster movement when the cutters are passing the spaces between the gears.

The turret holds twenty-four gears when fully loaded and they are roughed out at the rate of thirty per hour, or two minutes per gear. The cutters have a speed of 140 feet per minute. The feeding movement of the turret is from 15 to 16 inches per minute, and the rotary motion is increased to about 112 inches per minute when the cutters are passing across the spaces between the rims. The gear blanks are indexed one tooth after each complete revolution of the turret. When starting the machine, the turret is not fully loaded; the operator first places one gear blank in position, the blank being held by a single nut and plate washer. Then, as the turret swings around and one of the cutters starts working on the first blank, another one is placed on the turret, and this loading is continued until the turret is completely filled. By this time the first gear is, as a rule, finished, and it is replaced by an uncut blank. The operator then continues to remove the roughed out gears, and replaces them with plain blanks as the turret revolves continuously.

Another turret type of roughing machine is shown in Fig. 6. This machine is used for roughing the steel differential pinions of Ford tractors. There are six cutters for milling tooth spaces across each blank in whatever vertical row of blanks is in the cutting position. The relatively slow feeding movement of the turret is then accelerated to bring the next vertical row of pinion blanks opposite the cutters. All the spindles are indexed for the next tooth once during each revolution of the turret. As the illustration indicates, the operator removes the roughed out pinions and places new blanks on the work-spindles, so that there is very little idle time. A projecting arm above the turret provides a rigid support for the upper end, which is also true of the machine shown in Fig. 5.

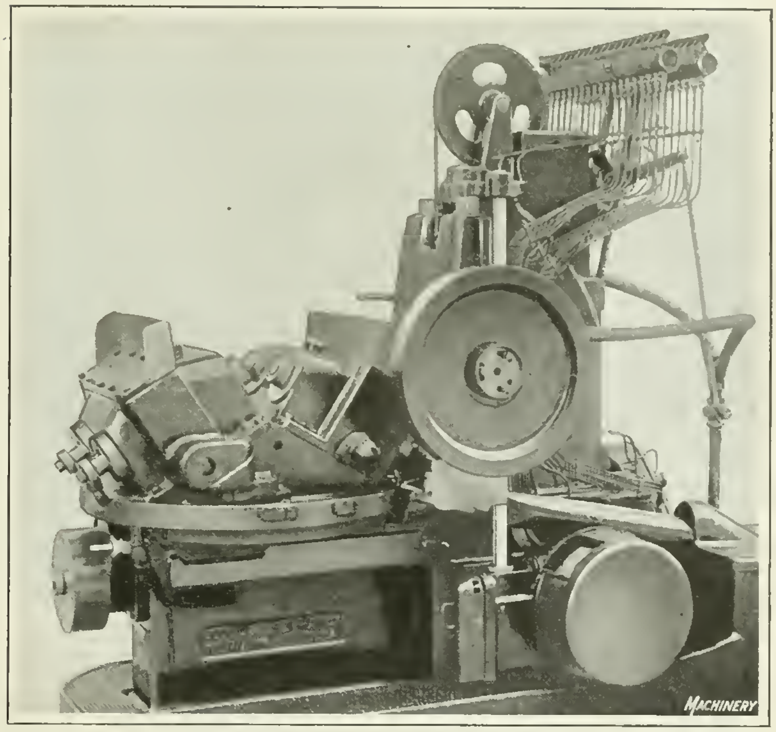


Fig. 8. Bevel Gear Roughing Machine having Special Fixed-angle Turret

Triplex Type of Bevel Gear Roughing Machine

A special design of bevel gear roughing machine intended for production on a very large scale is shown in Figs. 7 and 9. This machine is a Gleason design, a circular type of cutter head, 20½ inches in diameter, is located centrally relative to the three work-holding spindles. These spindles are mounted on slides providing lateral adjustment and radial feeding movements.

When the machine is at work, each head operates independently. The main slide feeds inward radially until the tooth space is roughed out to the required depth. Then the slide and work-spindle move back far enough for the gear to clear the cutter during the indexing movement. The indexing of each spindle is controlled by a notched plate at the outer end of the spindle. The feeding motion is obtained from a cam which acts through an adjustable cam-lever by means of which the stroke is varied as required by the tooth depth. Graduations on the adjustable cam-lever indicate the length of stroke for different adjustments. After all the teeth have been roughed out, the feeding movement for that particular head is automatically disengaged. The operator then replaces the roughed out gear with an uncut blank, while the blanks mounted on the other work-spindles are being cut.

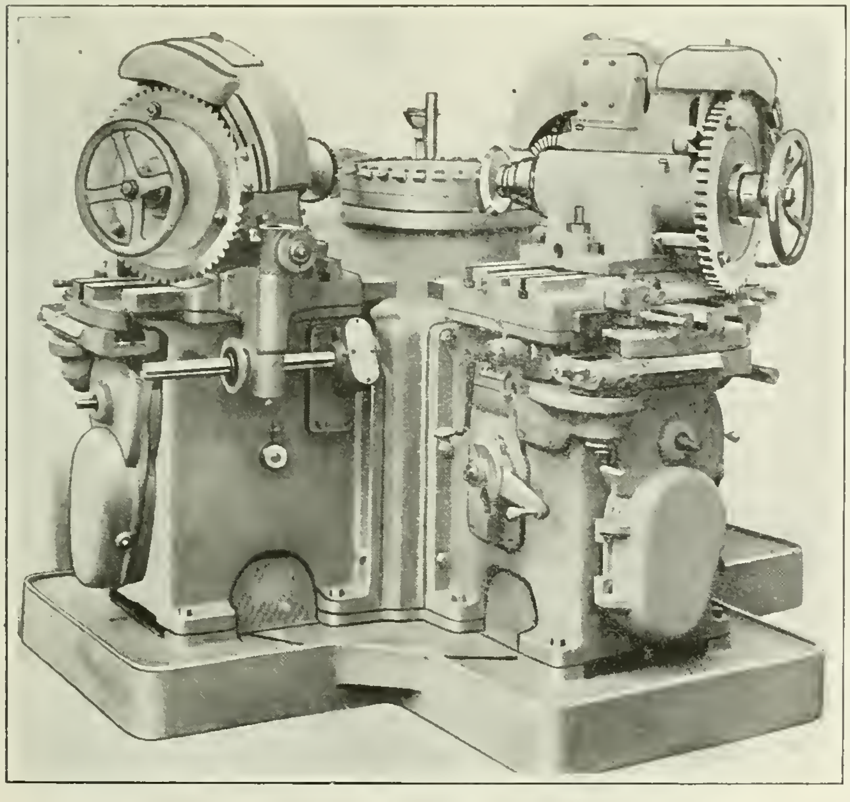


Fig. 9. Triplex Type of Bevel Gear Roughing Machine—Cutter Guard removed

This machine may be used for roughing out gear and pinion blanks simultaneously. The heads for holding pinions incline more from a radial position than the heads for holding gears, in order to allow for the relatively small pitch cone angles of the pinions and enable both gears and pinions to be held in the proper positions relative to the cutter-head. The angular position of each work-spindle is fixed, all the adjustments being obtained by the radial and lateral slides previously referred to.

When the machine is first set up, the blank is located relative to the cutter-head by means of a gage, the base of which fits into a recess in the center of the cutter-head. This gage is located by the engagement of a tongue with a cross-slot at the center of the cutter-head. Three sets of zero marks are provided for locating this cross-slot and the gage for any one of the three work-spindles. For example, if the No. 3 work-head is being adjusted, the No. 3 graduation on the periphery of the cutter-head is set opposite the No. 3 pointer below the cutter-head. The cutter-spindle is driven through spiral bevel gearing, the gear being bolted just beneath the flange of the main spindle on which the cutter-head is mounted. At the lower end of this

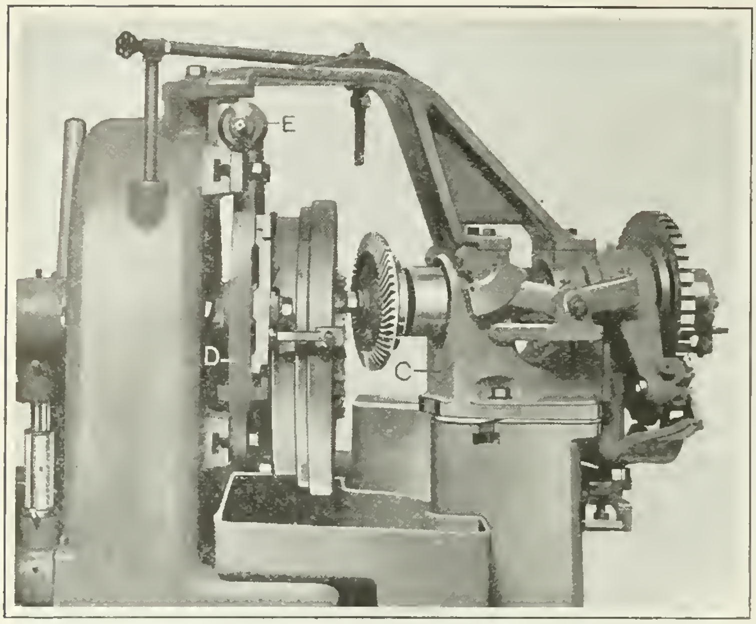


Fig. 10. Machine for roughing Spiral Bevel Gears

main spindle, motion is transmitted to each of the work-heads through bevel gearing and three horizontal shafts connected with the feeding and indexing mechanism by additional shafts and gearing.

This machine may be used for roughing out gears having pitch diameters up to 16 inches and a maximum diametral pitch of 3. The cutter-head operates at a speed of 100 feet per minute. The feeding movement of the work-slide may be varied from 0.200 inch for the fine pitches to 0.950 inch for the coarse pitches. The rate of feed may be varied from five to forty-five seconds per tooth. A general idea as to the rate of production on this machine may be obtained from the following example. When roughing out differential pinions and gears having twelve and twenty-four teeth, respectively, of 5–7 pitch and made of 3½ per cent nickel steel, the work was done at the rate of eight seconds per tooth. In this instance two work-heads were used for the gears and one for the pinions, since the latter require a much shorter time for roughing.

Roughing Spiral Bevel Gears

Spiral bevel gears can be roughed out on the same generator that is used for finishing, but it is advisable to do the roughing or stocking out on a machine designed especially for that purpose, assuming that gear-cutting is done on a scale large enough to warrant employing a special roughing machine. Very small spiral bevel gears, such, for example, as are cut on the Gleason 4-inch machine, are finished direct from the solid, because a preliminary roughing operation is unnecessary for these small pitches. Opposite sides of one of the Gleason spiral bevel gear roughing machines are shown in Figs. 10 and 11.

This machine does not require a generating motion like the machine for roughing spiral bevel pinions. The cutter-spindle receives an endwise feeding movement, as the cutter-head mills tooth spaces of the required depth. After each tooth space is roughed out, the cutter withdraws to clear the work for indexing. The endwise motion of the cutter-spindle is derived from a cam on the cutter-spindle sleeve. This cam is driven through change-gears, which regulate the rate of feed according to the material and pitch. The cutter-head is of circular form, and is similar to the type used on the finishing machine. The machine is automatic, and it may be used for roughing either right- or left-hand gears. When a left-hand gear is being roughed, the center of the cutter is below the center of the work, as shown in the illustrations, whereas for a right-hand gear the center of the cutter is above that of the work.

The arrangement of the indexing mechanism is shown quite clearly in Fig. 11. The motion is transmitted from a cam enclosed within the main housing, which actuates the segment shaped slide *A*, through a lever and connecting link. As this slide moves in its supports, a segment gear, through a pinion and vertical shaft, transmits motion to the indexing mechanism. The plate *B*, which has as many notches as there are teeth in the gear to be cut, is engaged by a locating pawl. When this pawl is withdrawn for indexing, the locating plate is acted upon by another pawl, which shifts the work spindle the required amount.

Selection of Cutter-head and Adjustment of Cutter-spindle and Work-holding Head

The cutter used for roughing should preferably be of the same hand as the gear to be cut. For instance, the machine shown in Figs. 10 and 11 is set up for cutting a left-hand gear and the cutter is also left hand, since it rotates to the left or counter-clockwise, as seen from the rear side. The cutting blades conform to the pressure angle of the gear (14½ or 20 degrees).

What is known as the "point width" must also be considered in selecting a cutter. The point width depends upon the pitch, face, cone distance, thickness of tooth, and spiral angle. It is obtained by calculating the normal width at the bottom of the tooth space at the small end and subtracting from this an allowance for the finishing cut. The nearest standard point width is then selected. When a left-hand cutter is used, an intermediate gear is employed so that the feed works will rotate in the same direction as when a right-hand cutter is used.

Before adjusting the cutter-spindle endwise, the feed-cam is set so that the cutter spindle is in its extreme outer position, as determined by means of a gage. Another gage which rests on two blades on both sides of the cutter-head, is then used to determine the endwise adjustment, which is made by shifting the position of the roller that engages the cam on the work-spindle sleeve.

The work-holding head *C* is set to the root angle of the gear by means of graduations on the edge of the base. Before adjusting the work-spindle longitudinally, it is

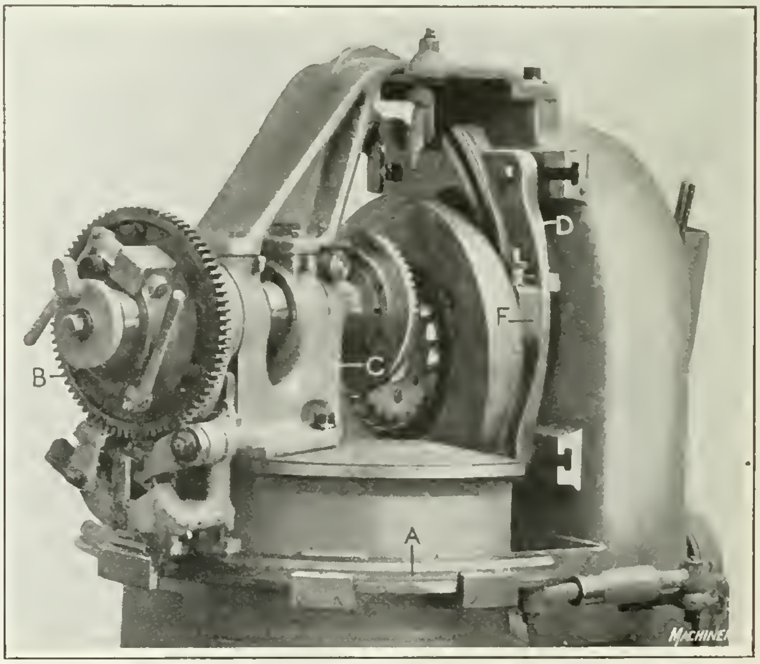


Fig. 11. Another View of the Spiral Bevel Gear Rougher

necessary to rotate the feed-cam until the cutter-spindle is in its extreme backward position. The work-spindle is then adjusted until the distance from the crown (extreme outer edge) of the gear blank to the plane in which the points of the cutter blades lie is equal to the throw of the feed-cam which gives the cutter-spindle its endwise movement. The work-spindle is next moved forward an additional amount equal to the full depth of the tooth, divided by the sine of the root angle of the gear to be cut. A rack and pinion at the outer end of the work-spindle is used for making these adjustments. The second adjustment is regulated by first setting a stop-screw the same distance from a lug as the gear is to be moved forward. This stop is then used for setting the work-spindle for all succeeding gears of the same kind.

Setting the Cutter-spindle Carriage and Cross-slide

The cutter is supported by a carriage which may be swiveled about an axis coinciding with the horizontal center line of the machine (as indicated in the diagram, Fig. 14). The swiveling carriage and the cutter-head are supported by a slide *D* (see also Figs. 10 and 11) which may be adjusted laterally for varying the distance between the center of the cutter and the vertical center line of the machine. These angular and lateral adjustments determine the angle of spiral cut on the gear, which must be the same as the angle decided upon for finish-cutting. The adjustments are not the same as on the finishing machine, but they should give the same angle. The crosswise adjustment of slide *D* is obtained by means of a screw in conjunction with a scale and graduated dial *E* (Fig. 10) reading to 0.001 inch. A worm at *F* (Fig. 11) and a segment provide for the angular adjustment, one turn of the worm being equal to one degree, and one division on the worm collar equaling one minute. The crosswise adjustment equals the sum of dimensions x and y, Fig. 14.

$$x = \text{Cone distance} - (\text{Face} \div 2) - (6 \times \text{spiral angle})$$

$$y = 13 \times (1 - \cos a)$$

The angular position of the cutter carriage is determined as follows:

$$\text{Sin } a = \frac{6 \times \cos \text{spiral angle}}{13}$$

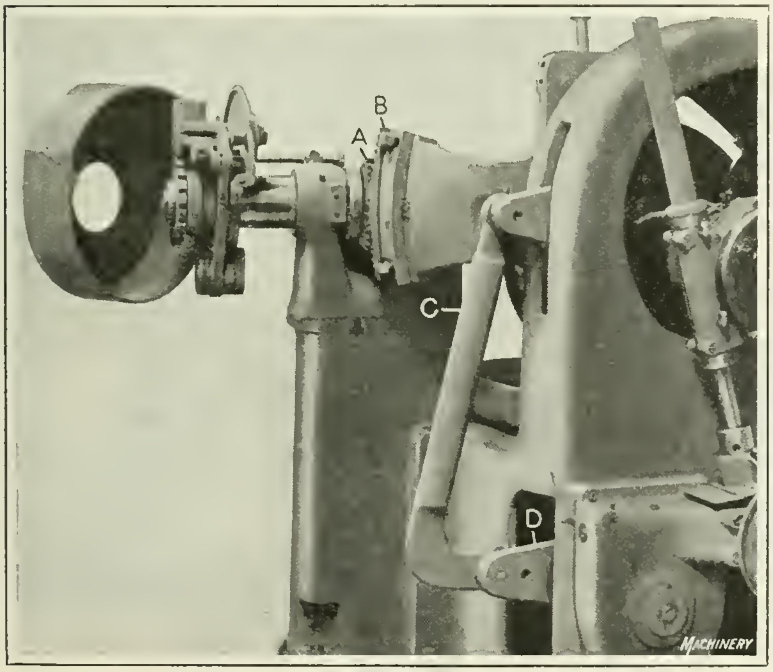


Fig. 13. Rear View of Spiral Pinion Rougher

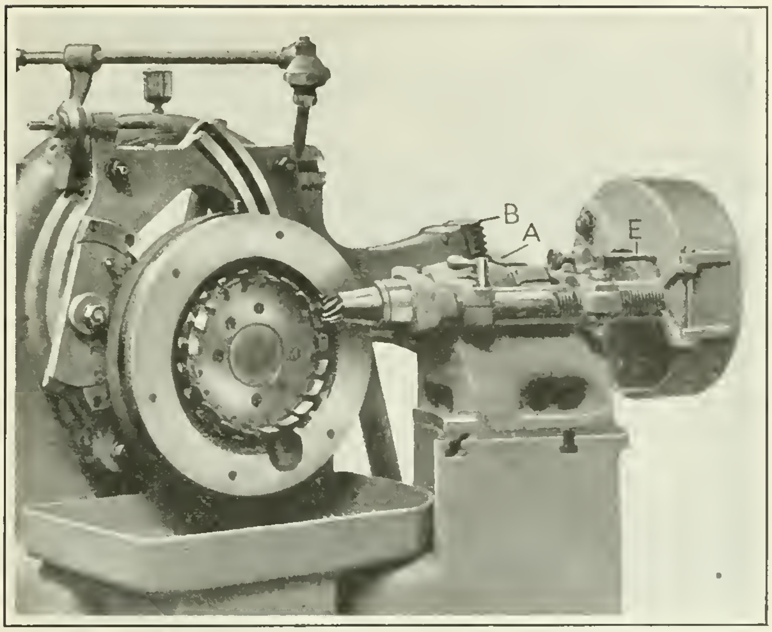


Fig. 12. Machine used for roughing Spiral Bevel Pinions

When the cutter-spindle carriage is shifted from the upper position for cutting right-hand gears, to the lower position for left-hand gears, or vice versa, the relation between the cam controlling the indexing movement and the feed-cam for the cutter-spindle must be changed, it being necessary to re-time the action of the cams. Cutter-spindle feed-cams are made with different amounts of throw to suit the tooth depth of the gears to be cut.

Roughing Spiral Bevel Pinions

The machine used for roughing spiral bevel pinions is similar in some respects to the gear rougher, the chief difference being that the former operates with a generating motion. This is required for pinions, because the teeth are not nearly so straight lengthwise as gear teeth, owing to the fact that they are formed around a much smaller pitch cone as compared with the gear, and consequently have much more twist or curvature. For this reason the pinion and cutter must be rolled together to obtain roughed out teeth conforming more closely to the final shape required, than would be possible without a generating motion. In Figs. 12 and 13 are shown front and rear views, respectively, of a Gleason machine for roughing spiral bevel pinions.

Generating and Indexing Movements

The generating movement is applied to both the cutter-head and the work. The relative movements of the work-spindle and the cutter head are controlled by a gear segment *A* attached to the work-spindle sleeve and meshing with a crown gear segment *B*. Segment *A* has the same pitch cone angle as the gear to be cut. The crown gear segment is secured to an arm projecting from the frame or drum supporting the cutter-spindle carriage and cross-slide. This frame, which is enclosed within the upper part of the machine column, is given an oscillating movement by a cam located within the base of the machine. Connection with the cam is made through link *C* and lever *D* (Fig. 13), and provision is made for shifting the link connection at the lower end for varying the amount of rolling or generating motion. The extent of this generating movement depends upon the ratio of the gear and pinion to be cut, the movement decreasing as the ratio increases. The approximate rolling motion for different gear ratios is as follows: For ratios from 6 : 1 to

4 : 1, 15 degrees; from 4 : 1 to 3 : 1, 20 degrees; and from 3 : 1 to 1 : 1, 25 degrees.

One tooth space is roughed out during the upward rolling motion, and the pinion is indexed for cutting the next tooth space during the downward movement. This indexing motion is derived from the generating motion of the work-spindle. The indexing mechanism is located at the outer end of the work-spindle and may be seen in Fig. 13; in this illustration the hinged cover has been swung outward to expose the indexing mechanism. The index-plate which is engaged by the locating pawl, has as many notches as there are teeth to be cut.

Adjustments of Cutter and Work

The cutter should preferably be of the same hand as the spiral on the gear; consequently, it will be opposite that of the pinion. Although a cutter of the same hand can be used for both gear and pinion, it is usually necessary to have separate cutters, as a greater point width of cutter is required for the gear than for the pinion. A cam mounted on the cutter-spindle sleeve gives the cutter a positive feeding movement, the same as on the gear rougher, and a feed-cam is used having a throw corresponding to the tooth depth. The cutter-spindle must be adjusted endwise, so that the points of the cutter blades are in the same plane as the apex of the pitch cone of the pinion. This adjustment is made by means of a screw controlling the position of a feed-cam roller, and it is regulated by means of a gage. The formulas for determining the angular position of the cutter-spindle carriage and the lateral position of the cross-slide are the same as those used for the gear rougher. The angular adjustment is also made by means of a worm and segment, and the cross adjustment by means of a screw in conjunction with a scale and a graduated dial, which is similar to the arrangement on the gear rougher.

The keyways in the pinion blanks should be cut before the roughing operation, and an arbor having a key should be used. By also using a keyed arbor when the pinions are finished on another machine, all pinions will be held in the same position relative to the cutter, and it will not be necessary to set each pinion to divide the stock left for finishing. The head carrying the work-spindle is set in accordance with the root angle of the pinion. The pinion blank is set at the right distance from the center of the machine by means of a scale and stop screw *E*, Fig. 12. The graduations represent distances from the nose of the spindle to the center of the machine. The time required for roughing out a tooth space may vary from a minimum of 18 seconds to a maximum of 72 seconds. The cutting speed is 106 feet per minute.

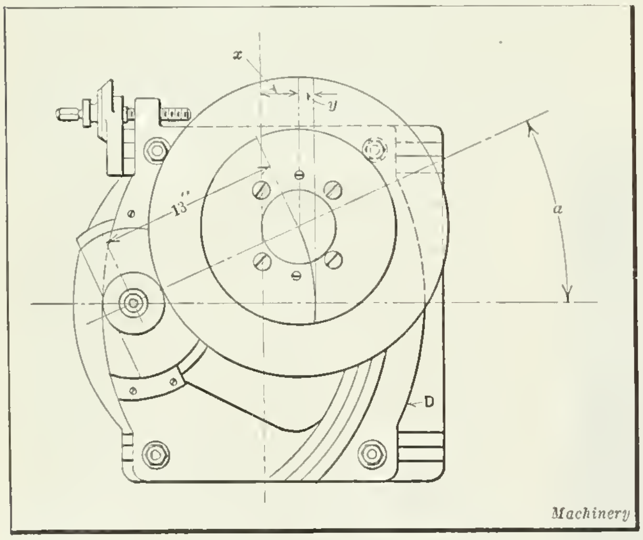


Fig. 14. Diagram showing Angular and Lateral Adjustments of Cutter-head on Spiral Bevel Gear Rougher

A GAGE-MAKER'S PROBLEM

By W. G. HOLMES

The problem dealt with in this article was encountered in the production of a certain gage. As the solution given is applicable to problems that occasionally arise in gage work, it should be of interest to gage designers and gage-makers. In the problem we have an arc of radius r, which cuts the corner of a right angle UVW in such a manner that the vertical line WV is cut at point H, and the horizontal line UV at point G, dimensions A and B being known.

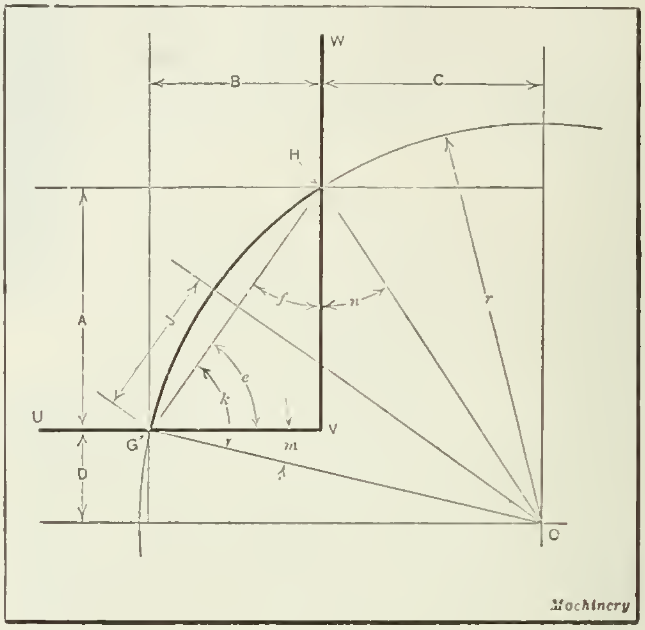


Diagram used in solving Gage-making Problem

In order to determine the location of center O with respect to the sides of right angle UVW, it is necessary to find dimensions D and C.

The given dimensions are as follows:

A = amount cut off by arc on vertical line WV;
B = amount cut off by arc on the horizontal line UV; and
r = radius of arc.

With these dimensions given it is desired to find the horizontal distance C from point H to the center line passing through point O, and the vertical distance D from point G to the horizontal center line passing through point O.

By trigonometry

$$\text{Tan } e = \frac{A}{B} \text{ and } \cot f = \frac{A}{B}$$

and by geometry

$$e + f = 90 \text{ degrees and } J = \tfrac{1}{2}\sqrt{A^2 + B^2}$$

Now

$$\cos k = \frac{J}{r};\quad m = k - e;\ \text{ and }\ n = k - f$$

Then

$$D = r \sin m \quad \text{and} \quad C = r \sin n$$

* * *

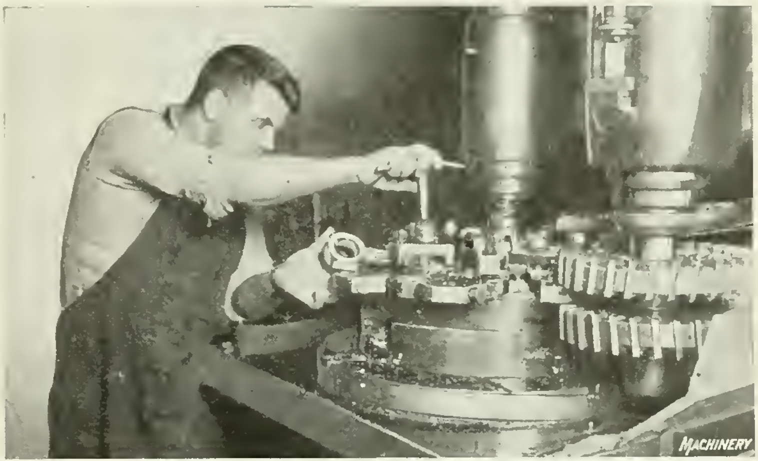
ENFORCEMENT OF SAFETY CODES

The American Engineering Standards Committee, 29 W. 39th St., New York City, has decided that clauses relating to legal penalties or to methods of enforcement will not be included in the safety codes approved by the committee. It is the opinion, both of the men engaged in the standardization of safety appliances in the industry and of officials having to do with the laws of enforcement of safety requirements, that legal penalties for failure to conform with established state safety codes and methods of enforcement can best be decided by each state for itself.

Making Wills Sainte Claire Connecting-rods

Methods Employed in the Plant of the Taft-Peirce Manufacturing Company, Woonsocket, R. I., for Machining High-grade Automobile Connecting-rods—Second of Two Articles

By FRED R. DANIELS



IN the first installment of this article, published in November MACHINERY, a number of milling operations employed in machining Wills Sainte Claire connecting-rods were described, together with the special equipment used. In the present article the manufacturing procedure will be continued, and all important information concerning the machining operations required in completing the manufacturing process will be given.

Machining the Cap-screw Holes

The set-up of the machine used for drilling and reaming the cap-screw holes in the forked style of connecting-rods is illustrated in Fig. 11 and the set-up for the plain style of connecting-rod is shown in Fig. 12, the equipment used in each case being a Pratt & Whitney multiple-spindle drilling machine and indexing fixtures. The fixture illustrated in Fig. 11 holds six forked rods, arranged in three pairs. Four 15-64-inch drills and four 0.247-inch reamers are at work on one pair while a similar group of tools is working on a second pair. The arrangement is such that with each indexing movement two finished rods are produced, which are replaced with two fresh rods at the loading position. The corresponding operation on the plain rods, shown in Fig. 12, is performed on a machine that has been partially redesigned to suit the requirements. The arrangement shown is the result of an effort to increase production by the use of two indexing fixtures, permanently attached to the table of this machine. Each of these fixtures has provision for three connecting-rods, so that by using two at a time, practically the same production is realized as with the equipment used for the forked rods.

Fig. 13 shows the method of mounting these fixtures on the drilling machine table. Two bridge irons are bolted to the base on which the fixtures are attached; these provide a support for the upper end of each fixture and also carry the drill and reamer bushings. Each fixture is operated independently, the index-pin being moved upward by a handle. This handle operates a stud in hole *A* at the base of the fixture to withdraw the index-pin *B* from the bushing in the turret and permit the fixture to be indexed through 120 degrees. During this movement a coil spring forces the end of the index-pin against the under side of the fixture until it snaps into the next indexing hole. The position of the work and the elongated locating pin *C* for the piston-pin hole, which has been used in previously mentioned fixtures, are also shown in this illustration.

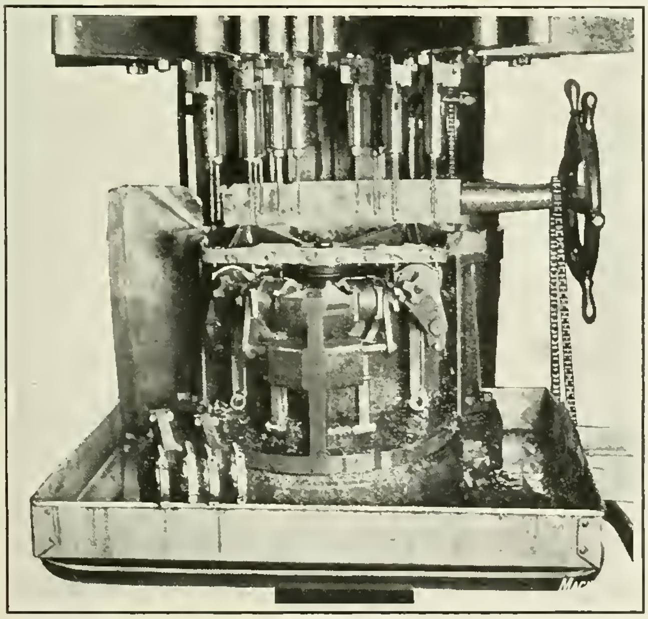


Fig. 11. Multiple-spindle Drilling Machine set up for drilling and reaming Bolt Holes in Forked Rods

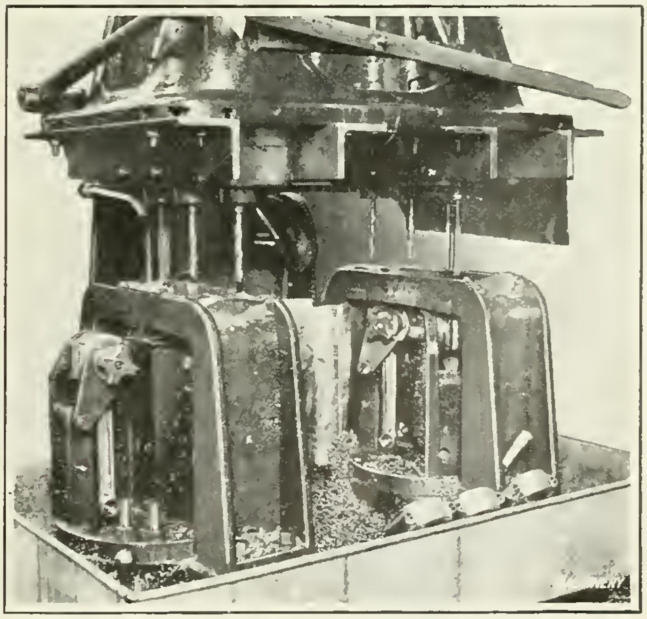


Fig. 12. Machine and Fixtures used for drilling and reaming Bolt Holes in Plain Connecting-rods

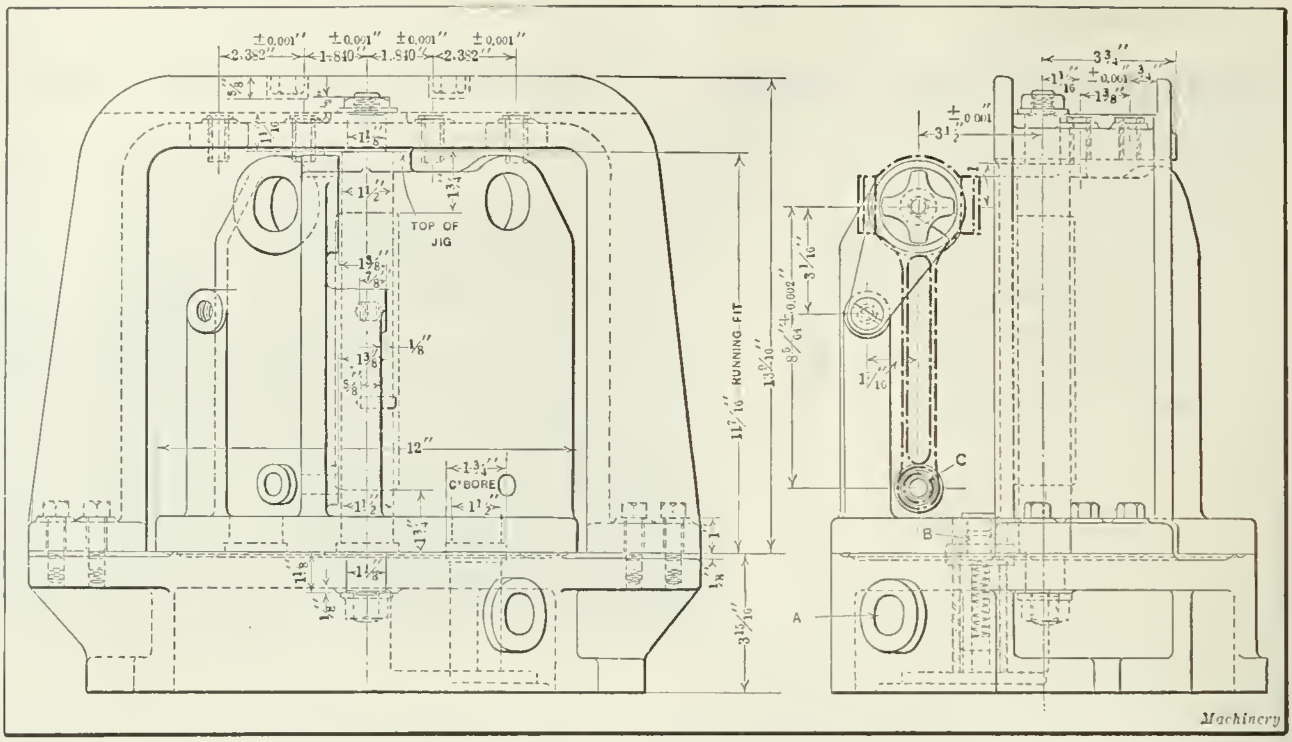


Fig. 13. Method of attaching Two Indexing Fixtures to Drilling Machine Table

In order to establish an unchangeable position for the drill and reamer spindles, it has been found advantageous to equip the machine with two special four spindle multiple heads. The method of attaching these to the under side of the spindle housing is indicated in Fig. 12, and the heads are shown in detail in Fig. 14. Two angle-irons are bolted to the under side of the spindle housing of the machine to form bolting surfaces for attaching these special heads, one being located in the correct position for each indexing fixture. The tendency of the drills to change their center distance slightly during a prolonged run has been entirely eliminated by this arrangement of the drilling machine. When it is realized that the maximum amount of run-out permissible on these cap-screw holes in 0.008 inch, it will be seen that absolutely accurate center location must be maintained and a substantial work-holding medium provided.

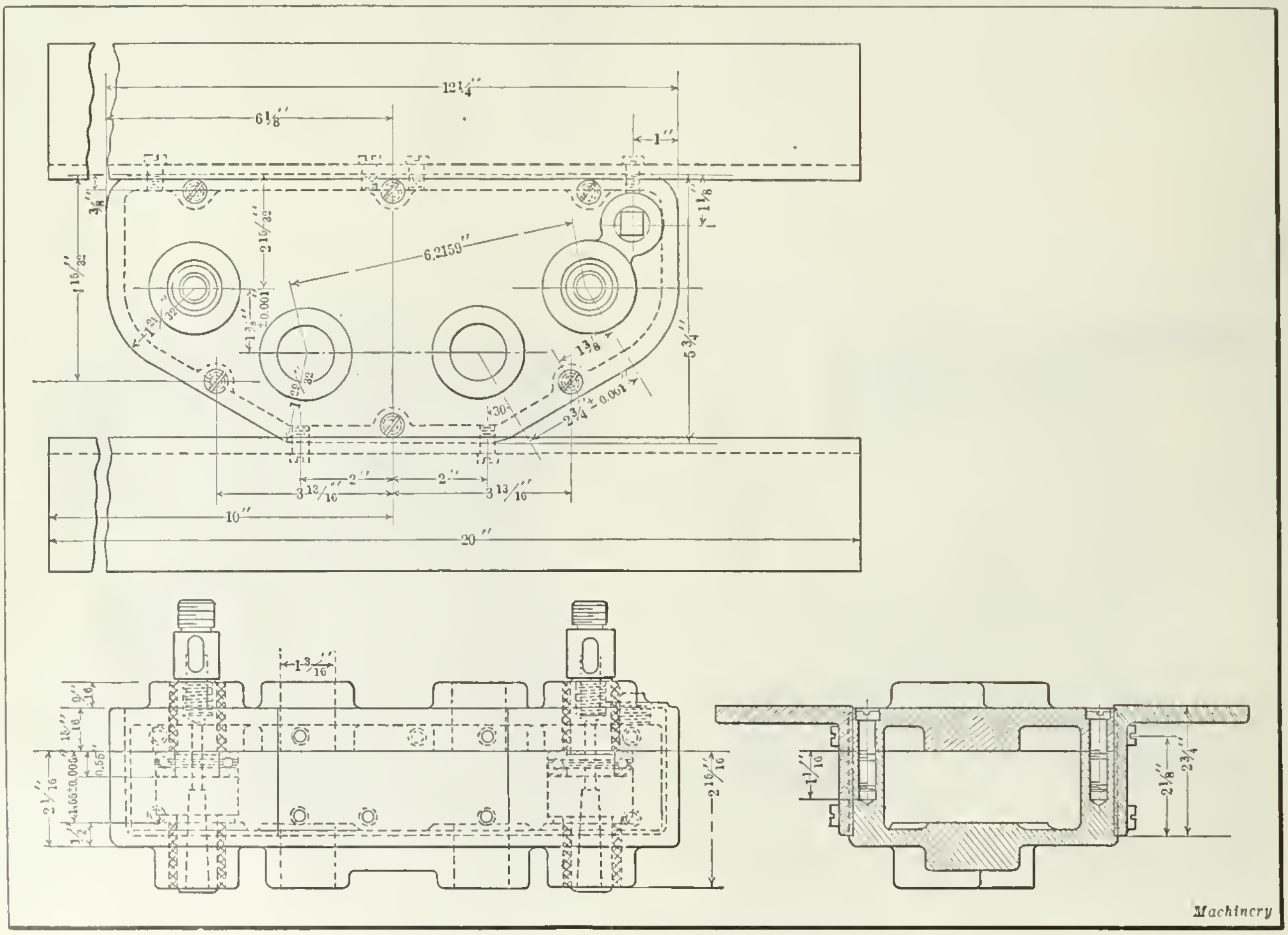


Fig. 14. Design of Multiple-spindle Heads and Method of mounting on Machine Frame

Grinding the Fitting Surfaces of the Cap and the Rod

After the bolt holes have been drilled and reamed on the machines described, they are hand-reamed to size, and the cap part and rod are then marked in pairs preparatory to being cut apart. A saw 1/8 inch wide, which is used for the latter operation, is mounted on an arbor with two straddle milling cutters, separated by collars of proper width so as to simultaneously mill seats for the bolt heads. This is done on a No. 1 1/2 Brown & Sharpe milling machine.

A Pratt & Whitney vertical surface grinding machine is employed for grinding the fitting surfaces of the cap and bearing for both styles of rods. A Norton 38-30 grade H wheel and a multiple fixture for holding eight rods and their caps are used. The work is so arranged in the fixture as to keep the cap or caps of each rod with that rod and grind them together in one clamping unit of the fixture. The obvious advantage of this is to maintain the alignment of bolt holes and finished boss faces so carefully obtained in the earlier machine work. The grinding wheel speed is 1100 revolutions per minute. After grinding, the caps and rods are assembled, and are kept together throughout the concluding operations.

The fixture used for grinding the forked rods is illustrated in Fig. 15, two clamping units only being shown. The position of the caps and rods is indicated by heavy dot-and-dash lines. The equalizing clamping medium is worthy of special mention, principally because it is controlled entirely by the operation of one knob secured to stud *A*. Turning this knob forces bar *B* forward and causes the two clamps *C* to hold the four caps (two for each rod) firmly against the steel strips that are set into the upright part of the cast-iron base. The clamps each have a round-point steel insert against which bar *B* is forced, and the yoke part of the clamps has lugs to engage the caps, so that they may be held with equalized pressure. By this arrangement the rods are quickly clamped.

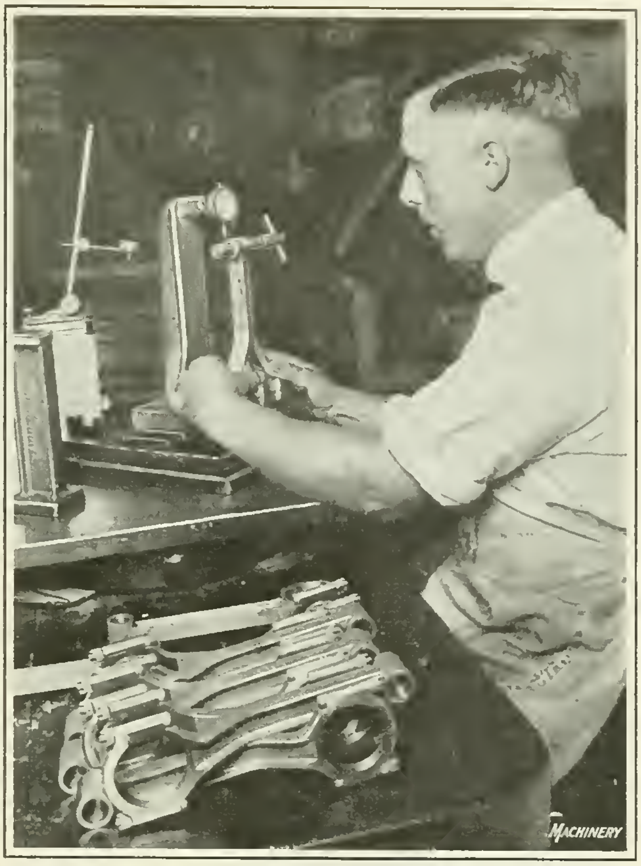


Fig. 16. Inspecting the Parallelism of the Piston-pin Hole with the Cap Bearing Surfaces

Continued turning of the knob causes the hinged link *D* to draw bar *E* toward it, carrying the two tie-rods *F*, thus causing heads *G* to seat against the inside of one prong of each fork and clamp the fork to the steel face on this side of the fixture. The tie-rods are drilled at the end for a spring pin. After the connecting-rods have been clamped in the manner described, the spring pins may be released by means of thumb screws *H*, to allow the floating clamps *J* which they carry, to engage the inside of the other prong. When this has occurred, the thumb-screws are tightened to hold the clamps in place during the grinding operation, thus preventing the fork from springing out of parallel under the pressure of the grinding wheel. There are two pins in each clamp *J*, which engage the bore of the connecting-rod bearing and locate these floating clamps relative to the bore. Heads *G* are movable, as they must be swung through 180 degrees in order to permit the rods to pass by them when removing the work after grinding. It is also necessary to depress clamps *J* and lock them in this position with the thumb-screws before the rods can be removed. The entire arrangement constitutes a flexible mechanism by means of which an even clamping tension can be secured on two rods and four caps with a minimum of effort and time.

A micrometer gage is used to check the work while it is in the fixture, gaging from the

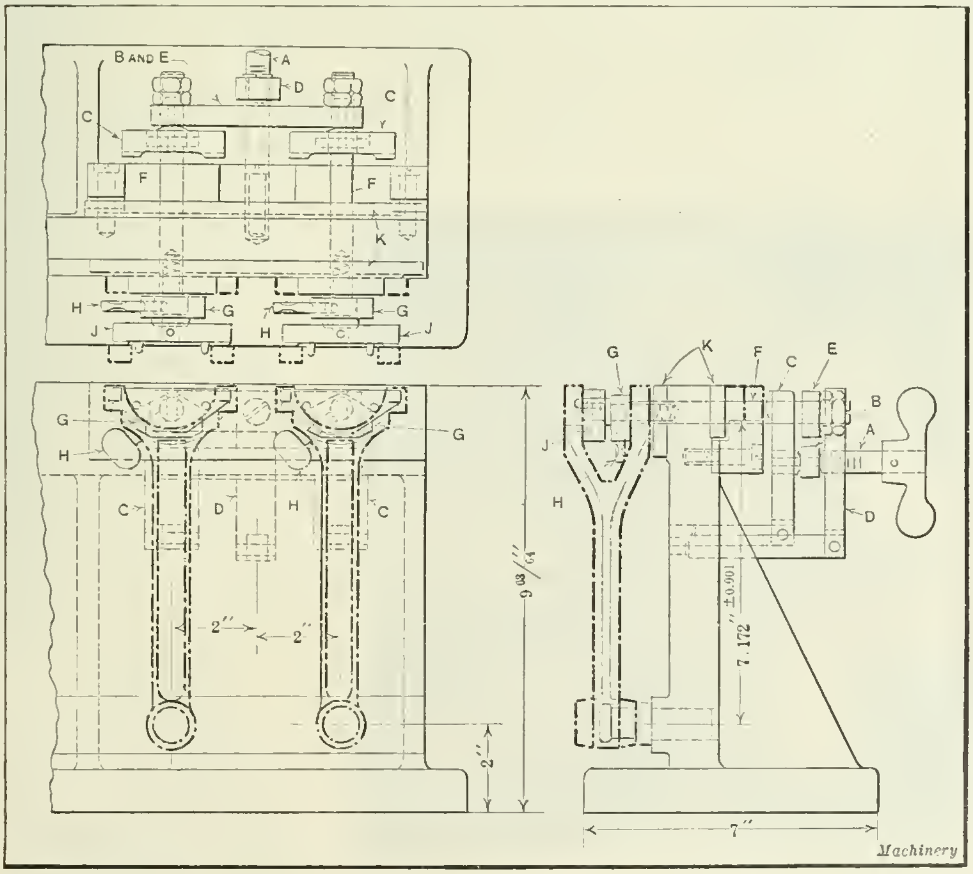


Fig. 15. Fixture used in grinding Bearing Surfaces of Caps and Forked Rods

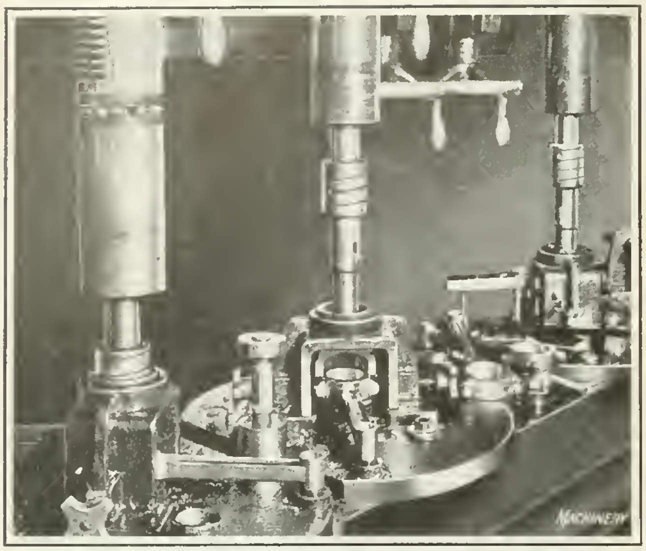


Fig. 17. Boring Crankpin Holes after assembling Caps

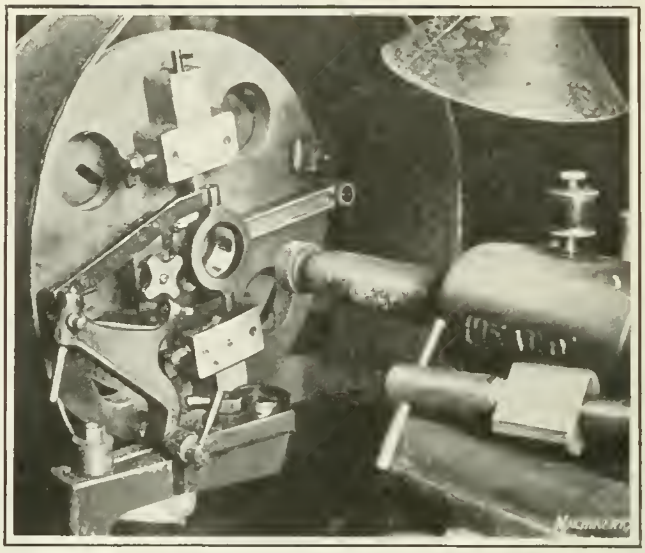


Fig. 18. Grinding Crankpin Holes in Forked Rods

steel strips or parallels *K*. The distance from the piston-pin hole to the ground surfaces at the cap joint, on which there is a tolerance of but 0.004 inch, is also gaged and the parallelism checked, by the use of a surface plate, indicator gage, and a test block. This inspecting operation is illustrated in Fig. 16 which shows the equipment mentioned and the method of using the indicator, with the ground surfaces of the cap bearings resting on the surface plate and a plug inserted in the piston-pin hole.

Major Operations after Assembling Caps

The rods, with the caps assembled, are then ground on the parallel surfaces of the crankpin bearing bosses. One cut is taken on each side of the plain rods, but two cuts are necessary on the forked rods to compensate for their tendency to spring. For this work a Blanchard surface grinder is used. When grinding plain rods, the magnetic chuck is provided with an annular plate equal in thickness to one-half the difference in width of the plain and forked rod crankpin bosses. This plate is used under the crankpin end of the plain rods. In other respects, the set-up for both rods is the same.

Sixteen rods are arranged radially on the grinder chuck at one time. A Norton 38-30 grade H wheel is used, running at 850 revolutions per minute. For the plain rods, the wheel feed is 0.0004 inch per revolution; for the forked rods, 0.0005 inch for roughing, and 0.0002 inch for finishing. It should be stated that the second or finish-grinding operation on the forked rod bosses does not occur until after the gap has been semi-finish-milled (as described in detail in the first installment), and in finish-milling the gap which follows the finish-grinding of the sides, the work is located from these ground surfaces.

The grinding of the crankpin boss on the plain rod, and the corresponding rough-grinding operation on the forked rod are followed by boring the large hole to correct the elliptic shape caused by cutting off the caps. For the forked rods, this occurs before either the gap is finished or the faces of the large boss are finish-ground, although these two operations were mentioned in conjunction with the grinding of the bosses on the plain rods.

Fig. 17 illustrates the type of equipment used in boring both rods. This is a Foote-Burt multiple-spindle drilling machine, on the table of which special boring fixtures are permanently attached. Davis piloted boring-bars are used. In locating the connecting-rods for boring, a bushing having external lugs to fit the major diameter of the elliptical hole, is first placed in the hole. The boring-bar pilot is then employed to position the crankpin end of the rod correctly, the rod itself being free to swing on a stud at the piston-pin end. When thus located, the capstan wheels on each side of the fixture are turned to retain this setting, and the bushing is removed. A spacing collar is interposed between the prongs when boring the forked rods. The cutting speed of the boring-bar is 80 feet per minute, and the feed is 0.005 inch per revolution.

The plain rod is next hollow-milled on each side of the large boss to produce the 10-degree taper. (See Fig. 1 of the first installment in November MACHINERY.) This operation also removes a small irregular projection left at the junction of the H-section and the boss. The work is done on a Defiance drilling machine. At intervals during the various machining operations, it is necessary to burr, straighten, or sand-blast the rods. These operations do not require description, but they are of vital importance in the manufacturing procedure. In sand-blasting, the finish-bored holes are protected by wooden covers, and a Pangborn sand-blasting machine is employed.

Grinding the Holes, and Final Operations

The grinding of the crankpin and piston-pin holes in the forked rods are illustrated in Figs. 18 and 19, respectively. For the large hole, a No. 2 Brown & Sharpe cylindrical grinding machine

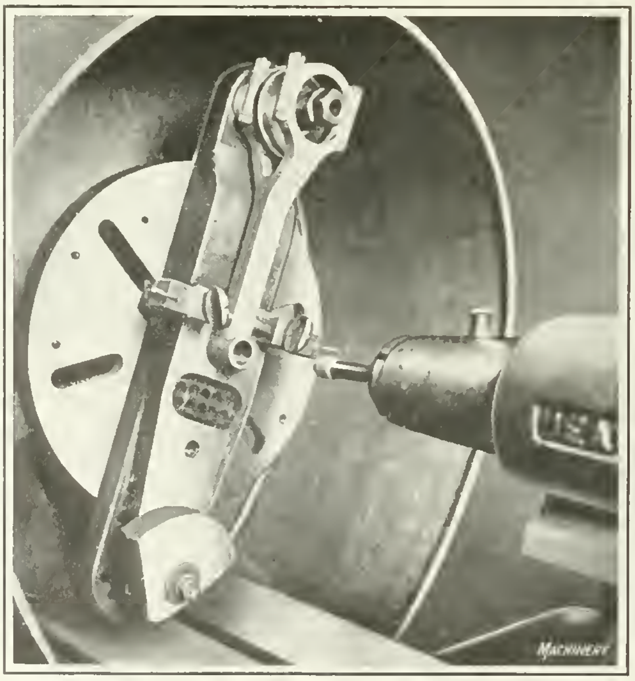


Fig. 19. Grinding Piston-pin Holes in Forked Rods

equipped with a Heald grinding head, is used, on the work-head of which is mounted an aluminum faceplate to which the clamping arrangement is attached. The boss is centered by a special plug shown lying on the wheel-head base, and two spring pins, carried in blocks opposite the bolt-hole bosses. It is secured by turning a knob which forces a circular clamp against the outer finished face of the large boss. This ring-shaped clamp is free to seat itself evenly on the work because of its trunnion-bearing mounting. The diameter of this hole is held to a tolerance of 0.0005 inch, and limit plug gages are used for checking the work. A 38-60 grade K Norton wheel, revolving at 8000 revolutions per minute is employed. The feed is 0.00025 inch per revolution of the spindle.

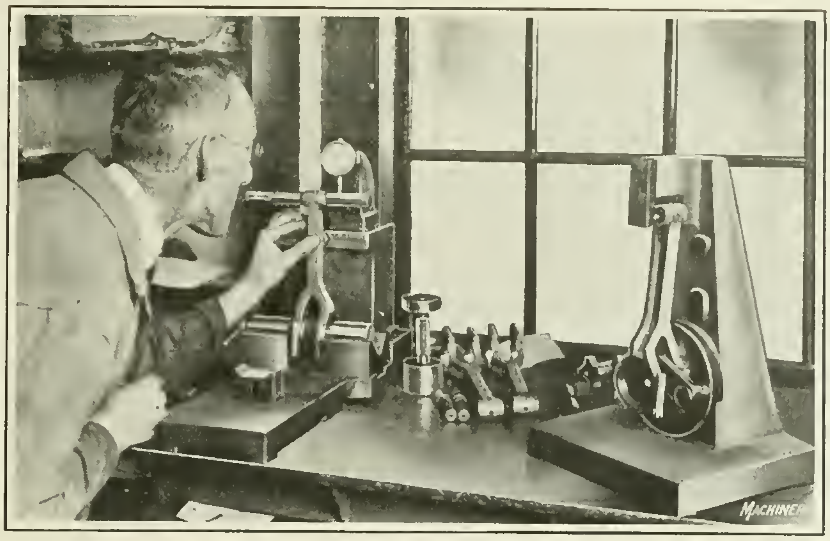


Fig. 20. Final Inspection of Forked Rods

In locating the work for grinding the piston-pin hole (Fig. 19), the ground crankpin hole is placed over a ground steel plug, and clamped by a screw and large washer which engages the inner prong. The fixture also has two side clamps to hold the rod after it has been positioned radially by means of a plug which fits the bored piston-pin hole and enters a bushing in the fixture. The fixture is counterbalanced to take care of the weight of the overhanging rod. The wheel used is a Norton 38-60 grade K. The wheel speed is 12,000 revolutions per minute and the feed 0.00025 inch per revolution. The data for grinding the plain rods are substantially the same as just described.

At this stage of manufacture, the forked rod caps are disassembled and two 3/16-inch pin holes drilled and reamed in the rod bearing. (See Fig. 2 of first installment.) The caps are replaced after dutch-pins are driven in these holes, and then both sides of each prong are counterbored on a Prentice drilling machine, using a bridge-iron fixture. A fly cutter is used in the boring-bar for the inside counterbored holes so that it can be passed through the crankpin hole and then fed first up for one counterbore and then down for the other. The main object of this operation is to remove any bulge caused by driving in the 3/16-inch pins, which are rather close to the edge of the hole. Stops under the bridge-iron limit the feeding movement. A two-bladed bar is used for machining the outer counterbores.

The piston-pin bushings are then assembled on a Greenerd arbor press, and broached with standard Lapointe machine equipment, this operation being tested by limit plug gages. The large hole in the plain rod has one extra operation to complete the manufacture, namely lapping the crankpin bearing hole to remove about 0.0002 inch of stock. A cast-iron expanding lap and a special lapping compound are used for this operation.

C. H. Wills & Co., manufacturers of the Wills Sainte Claire car, maintain a final inspection department in the Taft-Peirce plant. One corner of this department is illustrated in Fig. 20, where a forked rod is shown being tested for parallelism of the piston-pin and crankpin bearings. At the right is shown another gaging fixture used to inspect the relation of the ends of the piston-pin boss with the finished faces of the crankpin boss.

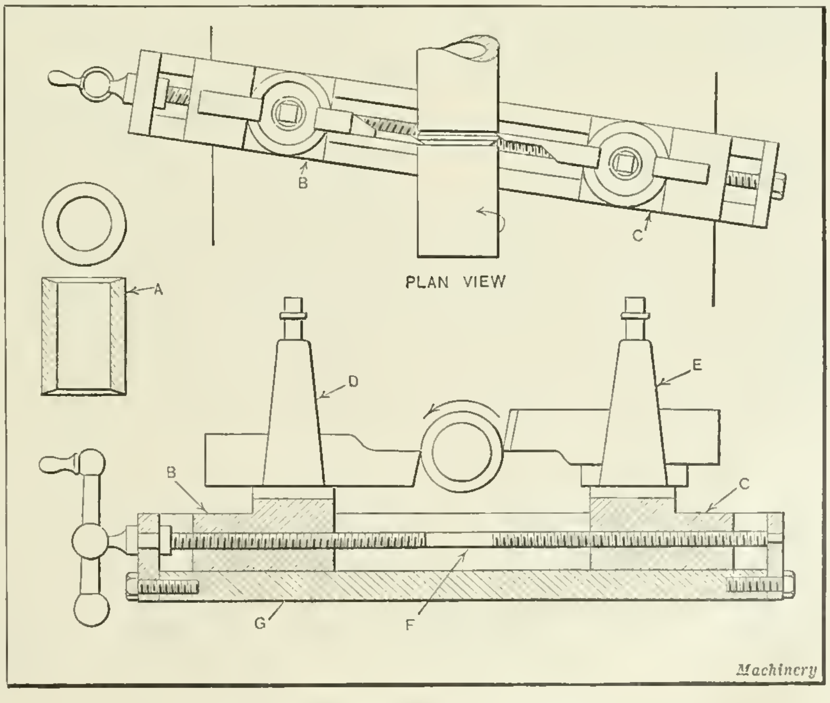
* * *

CUTTING-OFF TOOL FOR TUBING

By R. H. KASPER

A large number of bushings like the one shown at *A* in the accompanying illustration were to be made from tubing. The ends of the bushings were required to be cut or faced off at an angle as shown. The usual method of cutting off the tubing to length and facing each end of the cut-off piece separately consumed considerable time. A cutting-off tool which would speed up production was therefore designed. The improved tool consists essentially of two slides *B* and *C*, toolposts *D* and *E*, and a feed-screw *F*. The slides *B* and *C* operate in a dovetail groove in base *G*. One slide has a right-hand thread and the other has a left-hand thread, so that when the feed-screw is turned the slides will move toward or away from each other. The tool in post *D* is held in the usual manner, while the tool in post *E* is turned upside down so that the cutting edge is on the under side.

The base of the tool is clamped on the vees of the lathe at an angle corresponding to the angle required on the ends of the bushings. The tool in post *D* faces the end of the bushing being cut off, and is set slightly ahead of the tool in post *E* so that separation takes place at the back end of the finished bushing; this arrangement prevents a heavy fin from being formed at that end.



Tool for cutting off Tubing to make Bushings

Bearings and Bearing Metals

By CHRISTOPHER H. BIERBAUM, Vice-president and Consulting Engineer, Lumen Bearing Co., Buffalo, N. Y.

BEARINGS may be divided into two classes: Those having two elements—sliding surface bearings; and those having three elements—rolling surface bearings. The first class only (sliding bearings) will be considered in this article. In discussing the design, construction, and lubrication of bearings, the fundamental laws relating to them, as discovered by a number of investigators in the past, should be taken into consideration. In the light of these laws, the ten principles following may be considered as definitely established for the operation of a properly designed, constructed, and lubricated bearing.

1. The bearing surfaces are completely separated by a supporting film of oil.
2. The friction of operation is the fluid friction in the oil film, and adequate thickness of film is essential.
3. During construction, proper clearance or space should be provided for the normal thickness of the oil film.
4. The advance edge of a bearing surface must be rounded off or chamfered in order to permit a supporting film of oil to form.
5. The oil film forms most effectively upon a bearing surface whose advance edge is at right angles to the direction of motion.
6. An increase of speed increases the thickness of film, all other conditions remaining constant and clearance permitting.
7. An increase in the viscosity of the oil increases the thickness of film, other conditions remaining constant and clearance permitting.
8. The larger the unbroken area of oil film, the greater will be the average pressure-supporting capacity per unit area, other conditions remaining constant.

The author of this article has devoted many years to the study of bearings and bearing metals, and the results of his investigations have been presented from time to time in the technical press and in reports before the American Society of Mechanical Engineers. In the present article, a summary of the practical conclusions that the author has drawn from his experience is given. An original analysis of the action of a journal in a bearing, and information on the hardening and grinding of journals are also presented, and are here published for the first time. This material will form one chapter in a forthcoming handbook to be published by the Lumen Bearing Co. on the subject of bearings and bearing metals.

9. Every unnecessary oil-groove or interruption in the continuity of the oil film reduces the supporting capacity of the film.
10. For every bearing condition there is a film thickness corresponding to maximum lubrication efficiency.

The Action of a Journal in a Bearing

Let us assume that we have a journal 3 inches in diameter, with a clearance of 0.004 inch. The center of the journal will then be able to describe a circle 0.004 inch in diameter, and will also be able to assume any position within the circle. Now, let the diameter of the outer circle of Fig. 1 be equal to 0.004 inch; it will then be possible to plot all the movements of the center of the journal within the circle. After lubrication, set the journal in motion in the direction of the curved arrow, without having any load on it (not even its own weight); the center of the journal will then assume a position in the center of the circle with an oil film of even thickness throughout. Now, maintaining the rotation of the journal and gradually applying a load in the direction of the vertical arrow, it will be found that the center point of the journal will move along a line making an angle of 72 degrees with the vertical, as the load gradually increases. This may be called the load line, which is followed a distance equal to one fourth the amount of clearance, or, in this case, 0.001 inch. Here the oil film is ruptured and the maximum carrying capacity of the bearing will have been reached.

When a bearing is at rest, the loaded journal will be in metallic contact with the bearing at the lower point of its vertical diameter. As rotation begins, rolling of the journal upon the bearing occurs and continues to a point called the angle of repose, where slipping commences and the oil film begins to form. From here it follows the curved line and then assumes a position upon the load line corresponding to the amount of load that it carries.

Arcs of Maximum and Minimum Pressure

The location of the arcs where the maximum and minimum pressure on the oil film occur is of commanding interest. In the foregoing illustration, as the load is being gradually applied, a maximum pressure begins to develop at a point 10 degrees from the foot of the vertical diameter (measuring all degrees in a counter-clockwise direction), and as the load is increased this point gradually shifts to 45 degrees, while the intensity of the pressure increases from zero to the point of rupture of the oil film. In the same manner, a minimum pressure begins to develop at 184 degrees, and as the load is increased it gradually shifts to 125 degrees as the minimum at rupture, and its value changes from atmospheric pressure to a distinct suction.

The law governing the proper thickness of oil film has not yet been investigated to the extent that the importance of the subject demands. In modern machinery the average thickness of film varies from 0.0002 to 0.006 inch.

An Example of Proper Supply of Oil

Specific examples will best illustrate the application of the known laws of lubrication. Fig. 2 shows what may be considered ideal conditions, indicating a practical and efficient method of lubricating a crankpin bearing where the journal receives oil through the crankpin. The rotation of the crankshaft is indicated by the upper arrow, and in the position shown the engine is on a dead center, at a point of reversal of pressure. The direction of relative motion of the rubbing surfaces is shown by the two arrows at the right of the figure. The oil film enveloping the right half of the crankpin has been completely restored during the stroke just finished, since the oil-groove passed over this half of the bearing while no pressure was being exerted on it. After the dead center has been passed, the entire pressure is exerted on the crankpin with its fully restored oil film, and at the same time the oil-groove wipes over the other half of the bearing and restores its oil film while no pressure is being exerted on it, after which it, in turn, is ready to receive a reversal of pressure on a fully restored oil film. Thus both halves of this bearing present alternately, for the maximum pressure of each stroke, a complete and uninterrupted surface for maintaining the film on an area equal to the projected area of the crankpin; but it is impossible to obtain so perfect a condition of lubrication in a bearing having the old-fashioned cross oil-grooves, which are still too often found.

In case the direction of rotation of the engine is to be reversed, the oil-groove in Fig. 2 should be placed diametrically opposite its present position. The function of the oil-grooves is to supply oil; in many cases they are necessary evils which should be minimized as much as possible by avoiding a useless excess of grooves, especially in the arcs of maximum pressure as shown in Fig. 1. Unless good and sufficient reason exists to the contrary, oil-grooves should be cut parallel with the journal.

Objections to Excessively Tight Bushings

The method by which bearing bushings are driven in is of great importance. Either because of neglect, or because the subject is not properly understood bushings are sometimes driven in too tightly. All bearing alloys have a temperature coefficient of expansion higher than that of cast iron. The bearing bushing is also directly subjected to the friction of the journal, and hence its temperature is higher than that of the cast-iron housing surrounding it. For this reason, all bearing bushings must be allowed an opportunity for an appreciable outward expansion when in operation, and they should be driven in place with just enough pressure on the outside of the bushing to prevent it from coming loose while in operation.

The practice of driving in bushings so tightly that they must be reamed before they can be put into service is very objectionable. Subsequent reaming does not remedy the evil, because a bushing driven in so tightly will continue to contract inwardly when it expands in operation, since the pressure on the outside prevents it from expanding in that direction. If a bushing is driven in too tightly, the amount of clearance between the bearing and the journal becomes a matter of guesswork, and the oil film space provided is uncertain. This is true even though the bushing has been reamed before being placed in service, and is a frequent cause of heating and bearing troubles. Any provision made for fastening the bushing in place should be such that it will not bind or clamp the bushing against outward expansion. If a set-screw is used, for example, it should be provided with a turned down cylindrical end, engaging a hole in the bushing, but it should not bind or bottom in the hole.

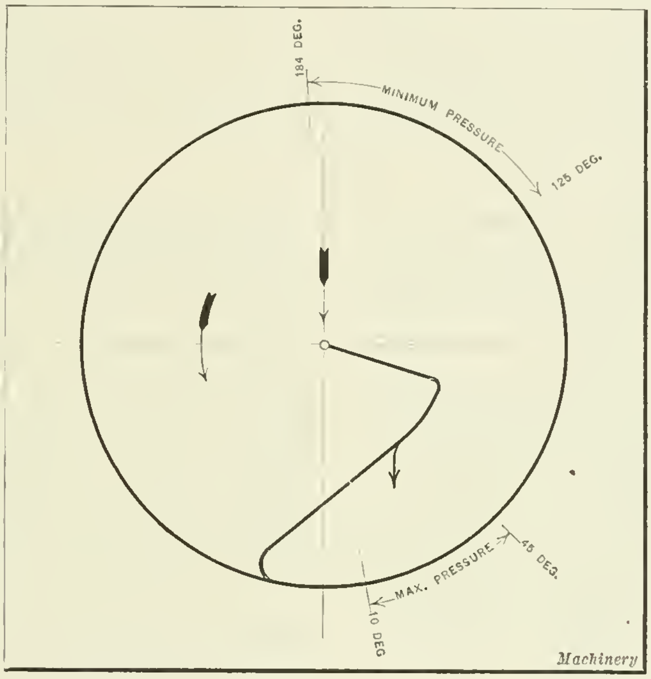


Fig. 1. Diagram showing Action of a Journal in a Bearing

Designing Bearings for Strength

Fig. 3 shows a bearing used in an established design of a well-known machine which gave trouble from the very first. It is provided with a split bronze bushing, 12 inches long, supporting a journal 6 inches in diameter. The maximum thickness of the bushing is 3/8 inch and it is recessed on its back to a depth of 1/8 inch as shown, leaving a thickness for the larger part of the bearing of only 1/4 inch. The cap of the bearing is held down by ten 5/8-inch studs. It is obvious that by clamping this bearing, the bearing surfaces are materially distorted by the pressure resulting from the tightening of the ten nuts. It is also apparent that the thickness of the recessed and unsupported part of the shell is not sufficient to withstand distortion under a normal oil film pressure. The trouble was, therefore, due entirely to the fact that the design is too light, since an examination of this bearing, after a short service, showed that the journal had scored along four circumferential lines corresponding to the four supporting edges beneath the bearing.

Design of Ring-oiler Bearings

Mention should be made here of another class of bearings which, together with their supports, are often improperly designed, namely, self-oiling ring bushings. These are nearly cut in half at mid-length in order to provide space in which the ring may operate, and the supporting wall beneath the bushing is slotted correspondingly at or near the center to permit the insertion of the ring into the oil-well. This often weakens the bearing unduly at a point where the greatest film pressure is normally exerted. In general, much of the trouble at present encountered in bearings can be overcome by simply increasing the strength and rigidity of the bearings and their supports, since a very small amount of distortion and deflection is sufficient to result in serious bearing troubles.

Machining Bearings

The manner in which bushings are clamped during machining is of great importance. They should not be clamped by a screw bearing on the outside cylindrical surface of the bushing. This is likely to distort it. Bushings to be machined should be clamped endwise. The importance of this is often underestimated, but it is only by holding the bushing by endwise clamping that distortion can be avoided. If bushings are clamped by screws bearing down on their cylindrical surface, it will often be found that after the bushings have been bored and the pressure released, they are far from round, and if they are then driven on an arbor and finished on the outside, the resulting product is very unsatisfactory.

Chamfering the Edges of Oil-grooves

The edges of oil-grooves should be rounded off or chamfered, and this work should be done last, after all the other machining work on the bearing has been completed. Any machining after the oil-groove edges have been chamfered is likely to produce a very sharp edge on the oil-groove, which would prevent the formation of an adequate oil film and should be avoided. By rounding or chamfering off the edge the very last thing, this difficulty is overcome.

Importance of Having Sharp Tools for Machining Operations

It is very important that bearing surfaces be machined with sharp tools having rake. This is true, not only of lathe tools, but also of reamers or other cutting tools used for finishing bearings. It is evident that a tool without rake produces a normal or radial pressure on the bushing far in excess of the pressure produced by a tool having adequate rake; also a dull tool exerts much greater pressure than a sharp tool. In the case of a reamer having, say, fourteen cutting edges, the amount of bursting or internal pressure exerted within a bushing will be very great if the edges are dull and without rake. The practice of using improper tools for this work cannot be criticized too severely.

The best practice for the final finishing of bearings is to use reamers or cutter-heads having only one or at best a very few cutting edges with a proper amount of rake, such as would be given to a proper cutting tool in a lathe. As pointed out by the author in a paper read before the American Society of Mechanical Engineers, experiments made in a large manufacturing plant on bushings of the same dimensions, produced from the same lot of material, finished at the same time—some, however, being reamed with the standard multiple cutting-edge reamer and others with a single cutting blade—showed that after being stored six months those bushings that had been reamed with a proper single cutting edge retained their accuracy and shape much better than those finished with the so-called "standard" reamer. The latter bushings exhibited a decided tendency to decrease in inside diameter and to assume elliptical forms. It was also brought out at this time that not only a superior product resulted from the use of a proper tool, but that by its use the production could be increased from 15 to 20 per cent.

An additional reason that bearing surfaces should be machined with sharp tools having the proper amount of rake is brought out by a microscopic study of bearing surfaces. In order to obtain the full bearing value of bearing alloys, it is necessary that these alloys be presented as bearing surfaces having their natural crystallization undisturbed. The mutilation, by improper machining, of the bearing surfaces gives rise to the crushing of the harder crystals and then imbedding these crushed particles into a compressed material, which does not permit the natural functioning of a bearing alloy.

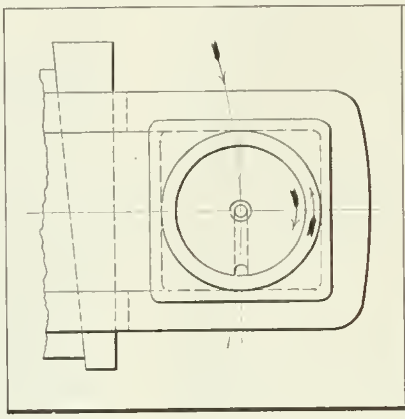


Fig. 2. An Example of Proper Conditions for Lubrication

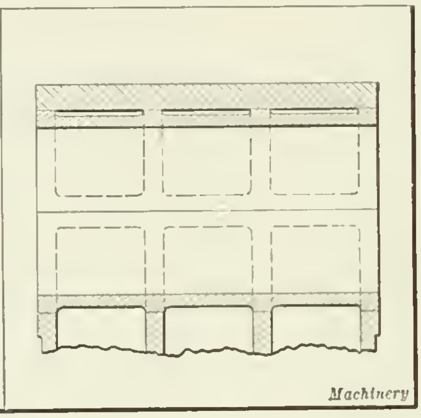


Fig. 3. Bearing with too Thin and Weak a Bushing

Characteristics of Bearing Alloys

It is well known that a single homogeneous metal is not suited for bearing purposes, but that the first requirement for a bearing metal is an alloy composed of at least two metals, or a metal and a metalloid which should have at least a limited degree of solubility while in the molten state; but upon cooling the alloys should partially separate into dissimilar crystals, and thus form the proper microstructure which is necessary in all bearing alloys.

The need of having a proper microstructure in a bearing alloy is always of far greater importance than its exact aggregate chemical composition. The value of an exact or definite chemical composition is secondary in that it can only serve in producing the desired microstructure in a given alloy, provided the alloy is subjected to the proper cooling conditions.

The essential characteristic of all bearing alloys is a structure made up of alternately hard and relatively soft microscopic particles intimately mixed. The function of the hard particles or bearing crystals is to support the load and resist wear; these bearing crystals should not be hard enough to prove distinctly abrasive to the journal surface. General experience shows that an extreme hardness of the bearing crystals is characterized by excessive wear of the journal. The function of the softer crystals is that of being plastic and of permitting the bearing crystals to adjust themselves to the surface requirements of the journal. These softer crystals are also more readily abraded and, therefore, wear slightly below the surface of the bearing crystals and thus form slight depressions on the bearing surface which serve to retain the lubricant. However infinitesimal in amount this may seem, nevertheless it is this lubricant that prevents scoring or seizing when the journal is starting up from rest at a time when actual metallic contact between the bearing surfaces exists. The same is equally true under an excessive load. This function of retaining a slight quantity of the lubricant on the bearing surfaces when metallic contact exists, characterizes a bearing alloy in its truest sense. Therefore, a bearing metal may be defined as an alloy that is capable of retaining a lubricant on a bearing surface.

In the operation of a bearing under normal conditions, when a continuous and unbroken film of lubricant exists, it matters little what metals are used while the film is sustaining the entire load. In the starting and stopping of the journal, however, or at all times when the film is interrupted and metallic contact exists, it becomes very important that the properties of a bearing metal should be present.

Hardening of Journals

Steel journals which have been hardened for bearing purposes should have hardened surfaces of an appreciable depth—a depth which is sufficient to permit grinding or polishing of these surfaces without actually cutting through the hardened portion. It is self evident that a surface of insufficient thickness will present a bearing surface of uneven hardness after polishing or grinding. Unsatisfactory results invariably follow in such cases. The hardening of journal surfaces should be done by the pack-hardening process, and enough time should be allowed in the heating to produce a hardened layer of sufficient thickness. The old-fashioned cyaniding process should never be used, because such surfaces, after polishing or grinding, are of very uneven hardness, and general experience shows that this process leads to a great deal of bearing trouble. In cases where a general heat-treating process is resorted to, and where a uniform hardness is produced throughout, the foregoing objections, of course, do not obtain.

Grinding of Journals

Due precautions should be exercised when bearing surfaces are being ground, to prevent any of the abrasive from being left embedded in the surfaces. This, in general, applies to all bearing materials, but is more particularly of importance in leaded bronzes. For the grinding of bronze bearing surfaces, silicon carbide wheels should not be used owing to the cleavage of this material, which forms long spicules that tend to embed themselves in the ground surfaces. For this class of grinding the author has found fused aluminum oxide wheels, including natural emery wheels, to give the least difficulty. It is very important to see that all ground bearing surfaces are free from abrasive material before they are put into service.

* * *

The production of automobiles and trucks in October reached a total of 244,000, according to the National Automobile Chamber of Commerce.

Polishing Wheels

The Manufacture of Full Disk Canvas Wheels, Compressed Muslin Wheels, Leather Wheels, Leather-covered Wood Wheels, and Walrus Hide Wheels—Second Article in a Series

By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y.,
and President of the Metal Finishers' Equipment Association

THE solid canvas polishing wheel is made from one-piece or full disks of canvas known as "Dryer canvas." This is a thick heavy canvas with very coarse yarns, and is better suited to a disk form of polishing wheel than a finer, thinner canvas would be. The wheel is constructed by assembling these canvas disks into a wheel, either by gluing each disk to the nearest one to it until the entire thickness is glued together, or by sewing together a number of the disks into sections, something like buffing wheels, and then gluing these sections together. It is evident, of course, that the less glue there is in a wheel the softer it will be, and the different degrees of softness are obtained by varying the number of canvas disks put into each section before the sections are glued together. The softest possible form of canvas wheel is obtained by using no glue whatever, and sewing the layers of canvas together in several rows with heavy twine; for very hard work, such as is met with in the agricultural trade, the sewing is done with copper wire.

To stiffen the center of these wheels so that they will stand up on heavy work, it is customary to use iron or steel plates on each side, the diameter of the plates being usually about four inches less than the diameter of the wheel, leaving two inches of canvas projecting beyond the plates, free and loose to crush out and provide flexibility. When the disks are put together without sewing, that is entirely glued together, an eighteen-inch wheel, for example, is glued for a diameter of eight or ten inches at the center. The construction can, of course be varied to meet individual requirements, the whole construction depending upon the form of wheel desired for any particular class of work.

Another form of canvas wheel is made from what is known as two-, three-, four-, or five-ply canvas belting. The canvas is woven to about ½ inch in thickness by a process quite different from that by which the Dryer canvas is made. Wheels made of this canvas belting are much softer and more pliable than Dryer canvas wheels, but are used to a much less extent now than formerly, because a much more efficient polishing wheel can be made in the "compress" construction the manufacture of which will be described in a following article. This construction gives the softness desired in a much better form of wheel.

The compressed muslin wheel, which was formerly commonly referred to as a "rag wheel," is made by gluing together sections of pieced-sewed buffing wheels. The sections of buffing wheels are assembled into polishing wheels by practically the same methods as are used in the manufacture of the Dryer canvas polishing wheels.

Leather Wheels

Leather wheels are usually made from bullneck leather in disk form; a special quality is known as "split leather wheels," and these wheels are made from leather from which both the grain side and the flesh side have been split off, leaving the leather about ⅛ inch thick; this part is the toughest, hardest, and most uniform in grain that can be secured from a cattle hide.

The first step in manufacturing a good bullneck leather wheel is to select a hide of the proper character—one that is not filled with clay or glucose, but is left pure and porous so that it will be resilient. The hide must also be thoroughly tanned by the old-fashioned process which takes months, instead of by some of the newer processes in which the tanning is rushed; these processes do not leave the fiber of the hide in as good condition for polishing as the old-time process. The shoulder of the bull produces a hide much coarser and more sponge-like than is the same hide back of the bull's shoulder to his tail. The bull shoulder hides vary in thickness from ¼ inch at the flank or leg to ¾ inch, or sometimes 1 inch, at the heaviest part in the back of the neck behind the horns. In cutting the disks for bullneck wheels, the purpose for which the wheel is to be used determines what part of the hide these disks shall be cut from, in order to secure a disk as equal in porosity and density as possible.

After the disks are cut, the loose portion on the flesh side or inside is removed, and often a considerable part of the hair- or grain-side has to be removed also, on account of the deep wrinkles in the hides. These disks are then held together by glue to which has been added isinglass or some other adhesive having a toughness and strength many times greater than that of the best glue. Wheels put together with glue not mixed with isinglass will frequently split apart. Great care must be taken to see that the glue, or cement as it becomes when mixed with isinglass, is properly applied to the leather disks. Upon the application of the glue to the disk it must be immediately placed in relation to the next disk, the whole mass being kept hot; and when the entire mass of disks for each wheel is assembled it must go into a press immediately, so that the glue will set uniformly throughout the entire wheel while under pressure. After the wheel is thoroughly dry, the center hole is bored. It is then placed on an arbor and the sides and face are trued up to the right dimensions. Bullneck wheels are commonly sold by weight, rather than by wheel units. The variation in weight of the hides, which is not controllable, prevents the manufacturer from putting out a fairly balanced wheel, and the balancing has to be done by the operator after he has set up the wheel with emery and glue.

The bullneck wheel is not adapted to finishing work on account of the alternating layers of leather and glue in the wheel. The glue is stiffer than the leather and will resist the pressure, while the leather will crush down with the result that the face of the wheel wears in ridges or grooves and cannot be kept flat. Such wheels are generally used on rough forms of work where a flat face is not essential.

Wheels made of split leather retain their shape better than regular bullneck leather wheels and are advantageous for certain classes of work. The method of construction is practically identical to that used for the bullneck wheel, the difference being only in the thickness and character of the stock used.

Leather-covered Wood Wheels

Although leather-covered wood wheels are not generally regarded as efficient polishing means, they are extensively used where the advantages of other wheels are unknown, there being a reluctancy on the part of some polishers to give up the old form of leather-covered wood wheel to which they are accustomed. The polisher knows that the leather strip on the face of the wheel often becomes loose, especially where the old heads of emery and glue are removed by a wet process. He also knows that the joining of the ends of the leather strap makes a spot which is harder than the rest of the face of the wheel; on accurate work, the shock of this hard spot can be plainly felt in the operation of the wheel, and on this account a smooth steady cut is difficult to secure.

The wood body of the wheel, especially when made of a soft wood, is susceptible to change in shape on account of dryness or moisture, and a wood wheel which runs true is a rarity and is highly prized by its owner. But inasmuch as wood wheels were one of the original forms of polishing wheels, and many old-time polishers have used them for years, there seems to be a strong conservative force that is responsible for their continued use.

The best wood from which wood wheels could be manufactured is mahogany, black walnut or other woods that are not very susceptible to the action of moisture and dryness. The cost of such woods, however, is prohibitive. Good white pine is the best common wood obtainable for polishing wheels. Bass wood and poplar are commonly used in a cheaper form of wheel, mainly because the wood is free from knots, comes in wide planks, and is easy to cut wheels from without much waste.

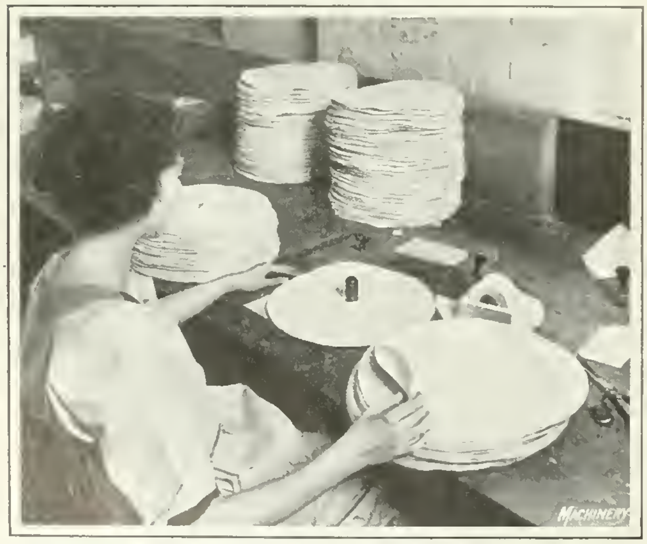


Fig. 1. Assembling Disks of Cloth for Solid Canvas Polishing Wheels

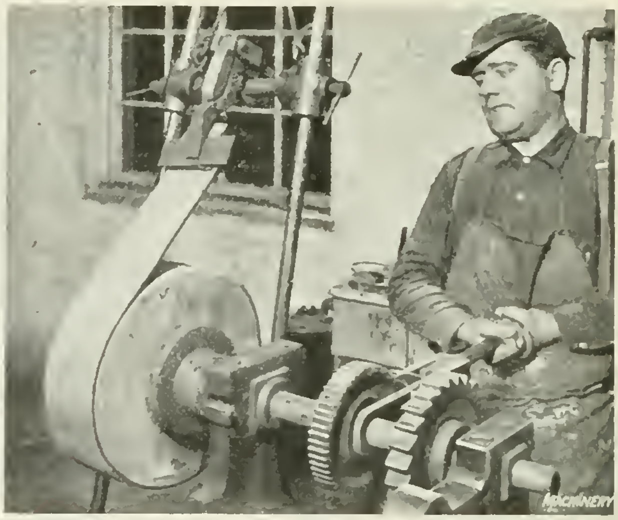


Fig. 2. Attaching the Leather to a Leather-covered Wood Polishing Wheel

In the standard pine wheel, the wood is air-dried and kiln-dried and usually cut ½ inch thick. The boards are cut in square blocks of the proper thickness for the wheel, the layers or strips being at right angles to each other and held together by means of nails (afterward removed) so that they cannot slip out of position while they are being dried in a press after the glue has been applied. After the square blocks are glued together, the center hole for the hub and the countersink for the flange of the hub are bored with a compound tool. The square block is sawed to an approximately round shape and then the wheel is turned to shape in a lathe, after the hub has been inserted.

The leather used for the covering of wood wheels is usually a strip down the back of the animal which is the closest grained, toughest and most uniform part of the hide. This is the most expensive kind of leather and gives the widest strips and the longest lengths of uniform density obtainable. The face of the wood is first sized as a bedding for the glue. The strap is placed in position as shown in Fig. 2, and stretched as it is wound around the wood center, both the leather and the wheel having been previously coated with hot glue. The ends of the straps are allowed to overlap and the butt joint made a close fit by cutting through both layers at the same time with a very thin sharp knife. The ends of the leather at the joint are held in place by wooden shoe pegs; in special cases iron pegs are used, which are removed after the glue is thoroughly set. In addition to holding the leather strap on the wood block with glue, wooden shoe pegs spaced in rows across the face of the wheel are used. Some straps are put on without pegs for the finer finishing processes. After the leather strap is thoroughly set, the wheel is placed in a lathe and the face turned off, leaving the greatest depth of leather possible. The strap is then sanded and finished, the wood part of the wheel well shellacked and varnished, and the wheel is ready for use when dry.

On large diameter thin wheels, 18 to 24 inches in diameter by 1 inch to 1½ inches face, side flanges of wood are used, these being glued to the body of the wheel to increase the thickness of the wheel at the hub and the resistance to side-warping. Sometimes an additional flange is used on the other end of the hub, but this is seldom necessary, and its use is a matter of custom rather than need.

Walrus Hide Wheels

Walrus hide is, as the name indicates, the hide of the walrus. Its soft, coarse, porous character permits it to be worked into a very soft cushion on the face of the polishing wheel. The hide comes in thicknesses of from ½ inch to 2 inches (occasionally 2½ inches), which permits a wheel to be cut out of one piece without gluing together disks, as is necessary in other forms of wheels. The great expense of walrus wheels has led the user of polishing wheels to seek other forms; the most common substitute for wheels 10 inches in diameter and larger, has been the compress canvas wheel, the control of the density of which permits a cushion to be secured that will do exactly the same class of work as the solid walrus wheel, with rare exceptions; but walrus wheels are still employed in the silverware trade, for "sand buffing," where polishing wheels of from 2 to 10 inches in diameter are most commonly used. There are many classes of work on which it would not be permissible to use any kind of wheel with glue or other adhesives in it, and the walrus wheel being of the proper texture, and thick enough to produce wheels up to 2 inches width of face, lends itself to that class of work. The manufacture of walrus wheels consists only in cutting out the circles, cutting the center hole, and truing up the sides and face.

Sheepskin polishing wheels have almost entirely disappeared, due to the substitution of other forms of wheels. They are, however, made up of russet or white sheepskin in the same manner as Dryer canvas disk wheels—that is either by gluing the full disks together at the center, or sewing them with one row around the center, or with several rows of hand sewing; or by cementing them together into a solid wheel. They are, of course, centered and trimmed in a lathe like all other wheels.

Paper wheels have almost gone out of existence, but they were formerly manufactured by gluing together disks of strawboard or soft felt paper, such as a carpet paper, cutting the center hole and truing up the face. In some cases cast-iron hubs were inserted as a special feature.

In the description of a line of manufacture of this kind, it is possible to include only the more standard forms of wheels made, as there are many varieties of wheels of special shapes for various purposes. The next article in this series will deal with the actual manufacture of compress polishing wheels.

* * *

IMPROVING INSPECTION METHODS

By H. H. ARMSTRONG

Inspection plays a particularly important part in plants where large quantities of cast-iron parts are machined on automatics. An automatic machine may operate continuously all day, with very little attention without spoiling a single piece of work; then again it may require constant attention and frequent adjustment in order to keep the work up to specifications. In any case, the finished work must be inspected with gages or micrometers, and all parts rejected that fail to meet requirements.

Inspecting the Work as it Comes from the Machine

If the work is inspected as soon as it comes from the machine, the inspector will detect any errors at once and have the set-up corrected before many pieces are spoiled. If he cannot do this and the operator does not check the pieces at all and is running, say, four machines, the pieces awaiting inspection quickly pile up in large quantities. This is obviously not a good practice, and too often results in the necessity for scrapping a large number of pieces. In such cases the inspector must sort out the spoiled pieces that cannot be used. While this prevents defective parts from reaching the assembly department, it does not prevent parts from being spoiled. A method that will bring the loss in scrapped parts down to a minimum is obviously desirable. The writer believes that in the majority of cases the desired results will be obtained by having the inspector act as a "machine checker." In other words, the inspector goes from one machine to another, continually testing the product as it comes from each machine. If he finds the work within limits, it is passed on to the next operation or to the assembly department, as the case may be. If the checker finds a machine that is producing work that is not up to requirements, it is a small matter to stop the machine and have the set-up corrected. He must then check the pieces that have been made and work back to the point where the spoiled parts first appeared. The spoiled pieces may then be segregated and thrown out.

When the operator sets up his machine for a job, it is good practice to have the inspector or checker carefully check the first piece produced. If the piece checks up with the drawing specifications, the machine may be put in operation and afterward checked periodically. Foremen in their efforts to meet the factory schedule do not like to have their work held up; consequently the machine checker is sometimes criticized or blamed by the foreman for holding up work that in his opinion will pass inspection. The inspector, however, should be amply backed up by the management for stopping work that he believes should not pass inspection. If the operator of an automatic has been started correctly on a piece of work and provided with gages so that he can inspect the work himself, there should be no excuse for spoiled parts. If a lot of work is done wrong, the checker may in some cases insist that the pieces be fixed up or salvaged by the operator on his own time. This will be a lesson for the operator that should make him more careful.

Inspection Procedure in Press Room Work

This procedure is equally applicable to press room work. Generally a man known as the die-setter sets up all work in the press room, and when he has produced a piece which in his estimation is right he passes it on to the checker. The checker carefully inspects the piece, and if it is found correct he instructs the operator to go ahead. If the operator is careful he will keep close watch of the work and if he notices any change in the product he will immediately take the piece to the checker for advice. There are so many things that may happen to a die while it is in operation that it is imperative for the inspector to keep constantly in touch with each machine.

What is true of the automatic machine department and the press room is equally true of nearly all departments. A careful study of the inspection methods and a checking up of the amount of work spoiled in various machining operations will serve to emphasize the importance of "machine checking" (checking the product as it comes from the machine) and show more clearly the impracticability of depending on a final inspection to eliminate defective parts.

* * *

EXPORTS OF MACHINE TOOLS AND METAL-WORKING MACHINERY TO DUTCH EAST INDIES, 1912-1921

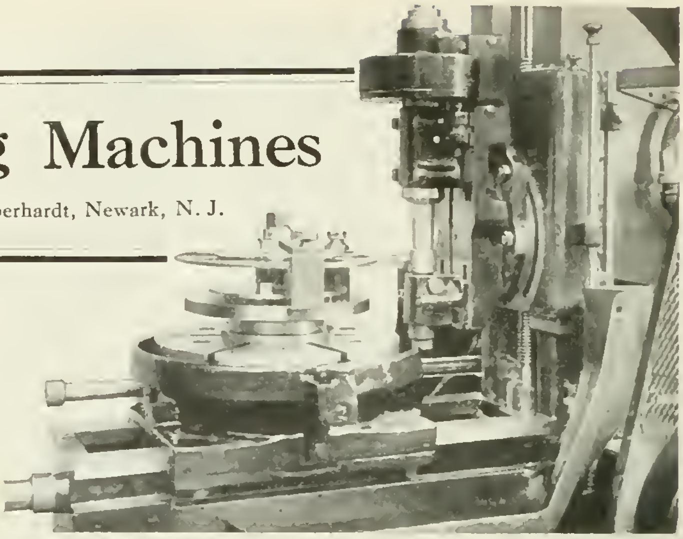
Year*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal working Machinery
1912	....	....	....	....	....	$26,443
1913	....	....	....	....	....	6,366
1914	....	....	....	....	....	20,216
1915	....	....	....	....	....	9,229
1916	....	....	....	....	....	56,281
1917	....	....	....	....	....	245 594
1918	$53,664	$8,737	$38,239	$100,640	$68,044	168,684
1919	273,302	27,412	81,144	381,858	232,640	614,498
1920	88,826	25,577	80,186	194,589	131,497	326,086
1921	76,512	17,165	104,660	198,337	163,059	361,396

Machinery

*Amounts given are for fiscal years, up to and including 1918, and for calendar years thereafter. The Department of Commerce statistics did not give machine tools separately previous to 1918.

Testing Gear-hobbing Machines

By D. VAUGHN WATERS, Mechanical Engineer, Gould & Eberhardt, Newark, N. J.



In no other class of machine tool is the exact synchronization of relative velocities between different members so essential as in gear-hobbing machines. That this is so will be readily appreciated from a brief consideration of the fundamental principles underlying the production of gears by hobbing. A hob cuts teeth in the periphery of a gear blank by means of the molding-generating process, the principle of which is that of rolling a rack in contact with a plastic blank, whereby involute teeth conjugate to those of the rack are formed in the blank. The normal section of the hob teeth corresponds to the rack teeth. If now, the rack were imagined to have rotating cutting edges capable of imprinting the tooth contour in the periphery of the blank, the results would be identical with those obtained by hobbing.

Since the circumference of the pitch circle is equal to the product of the normal circular pitch of the hob and the number of teeth to be cut, it is obvious that the circumferential velocity of the pitch circle and the velocity in an axial direction of the cutting elements of the hob teeth must be the same. In fact, these velocities must not only be equal for each successive revolution of the hob, but they must be equal at all parts of the revolution as well; otherwise the blank may accelerate or retard an infinitesimal amount during which the hob would generate teeth either thicker or thinner than the theoretical size.

A diagrammatic representation of the gearing connections necessary in a hobbing machine is shown in Fig. 1. The diagram shows only the simplest construction, for in an actual machine additional members may be added for constructional reasons or a differential mechanism incorporated to facilitate cutting helical gears, etc. An inspection of this diagram and consideration of the foregoing principles will make it clear that the hob must rotate in a predetermined ratio with the gear to be cut. It is highly essential, therefore, that the work-spindle and the hob-spindle rotate at a certain relative velocity and that this ratio be maintained as uniform as possible throughout the revolution of the spindles.

In a mechanism such as a gear-hobbing machine composed of gears, bearings, thrust washers, shafts, worms, etc., it is possible and highly probable that the machine as assembled at the shop may have slight errors in one or more of its component parts. Such errors are difficult to detect, and they will cause the machine to produce inferior work if not discovered and rectified. When a hobbing machine produces gears that do not measure up to the high standards established for certain classes of work, such as automotive timing gears, machine tool gearing, etc., either the machine or the hob is faulty. Hobs as manufactured today are closely inspected for truth of all essential dimensions before delivery to the customer, and can usually be relied upon to be as nearly correct as they can be made commercially. Notwithstanding this, methods of inspection should be employed that will definitely indicate whether the hob or the machine is at fault, and that will point out approximately where the defect lies.

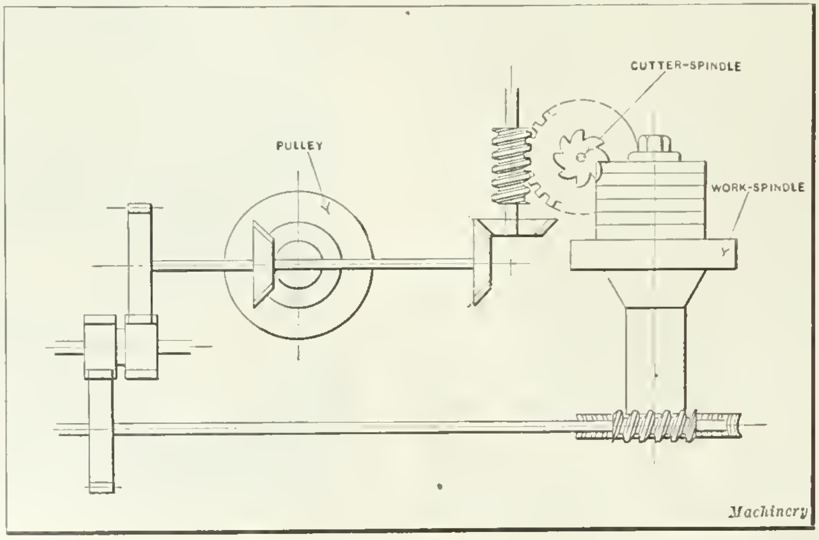


Fig. 1. Diagram of Cutter- and Work-spindle Gearing on Gear-hobbing Machine

Angular Velocity Testing Fixture for Hobbing Machines

In connection with the inspecting of hobbing machines, the angular velocity testing method used by Gould & Eberhardt, Newark, N. J., to check the uniformity of relative rotation of cutter- and work-spindles on Gould & Eberhardt gear-hobbing machines, is here described. A special testing fixture is applied to the machine, which graphically records the amount of deviation in cutter- and work-spindle speeds from their theoretical angular velocity ratio. This fixture is illustrated in section in Fig. 2, and its application is shown in Fig. 4. For the purpose of conducting the test, the swivel-slide is rotated so that the axis of the cutter-spindle is parallel to the axis of the work-spindle, as shown in Fig. 4.

The design of the fixture is more clearly shown in the sectional view, Fig. 2. It will be seen that the fixture consists of a base *A* secured to the work-spindle of the machine on which the various parts of the fixture are supported. Fixed in this base is an arbor *B* carrying disk *E*, bushing *C* and a retainer nut *D*. Bracket *F*, mounted on disk *E*, controls the movement of the stylus. Obviously all these parts move in coincidence with the work-spindle. Supported by disk *E* there is a large disk *G* which is fitted over bushing *C* and driven through contact with the compound disk *H*, the latter, in turn, being driven from a collar *J* on the cutter-spindle of the machine.

Immediately above the disk *G* there is a smaller disk *K* upon which the paper dial is secured. This disk does not rotate and is prevented from doing so by the following arrangement. There is a large disk *O* carried on the base *A*, which is free to rotate. This disk carries two brackets, one

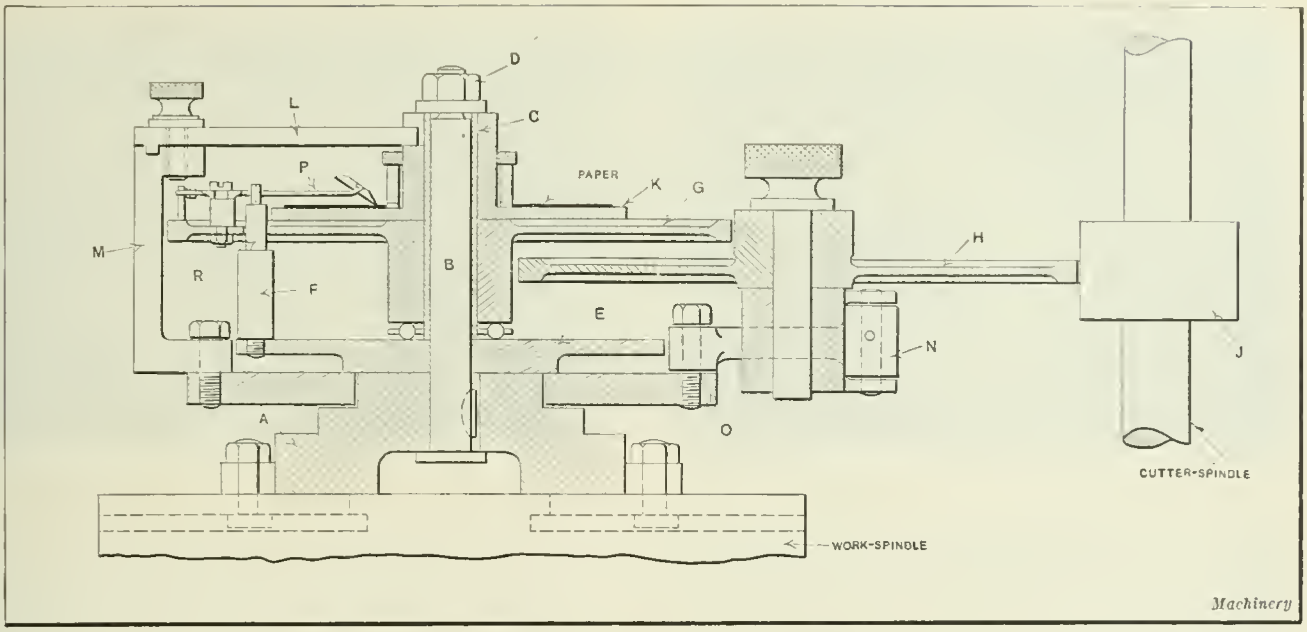


Fig. 2. Sectional View of Angular Velocity Testing Fixture used in testing Hobbing Machine Work- and Cutter-spindles

of which, *N*, furnishes the bearing for compound disk *H*, and the other, *M*, carries the stop *L*. This stop prevents disk *K* from rotating when disk *H* is brought to bear against collar *J* (see also Fig. 4), which stops disk *O* and all the parts supported by it from rotating about the work-spindle center. The paper dial is thus held stationary while the members that actuate the movement of the stylus arm *P* rotate.

The fulcrum of the stylus arm is mounted on disk *G*, and this arm is normally held tightly against the stop *R* by a small tension spring. Stop *R* is a part of bracket *F* and, of course, rotates with disk *E* and in unison with the work-spindle. Disk *G*, as previously mentioned, is driven by the compound disk *H*, and its angular velocity is by the same means reduced to nearly that of the work-spindle. A slight difference between the angular velocities of disks *G* and *E* will result in a spiral being traced by the stylus point instead of a circle, which is an advantage because two or three revolutions can then be recorded and the average amount of deviation taken. This slight difference in angular velocities of the two disks is provided by suitable gearing in the machine. The movement of the stylus arm is controlled by its contact with stop *R*. It is obvious, therefore, that any change in angular velocity of either of the two disks will cause a wavering movement of the stylus arm, proportionate to the amount of variation between the work-spindle and the cutter-spindle. This variation is then recorded on the paper dial secured to disk *K*.

Charts showing the results of these tests are reproduced in Fig. 3. The record shown at the left is that of a machine having defective gearing. It should be particularly noted that the inequalities in the spiral traced by the stylus, each about 3/16 inch high on the actual chart, are the graphic record of inaccuracies in the machine which are too small to be measured but which affect the accuracy of the gears.

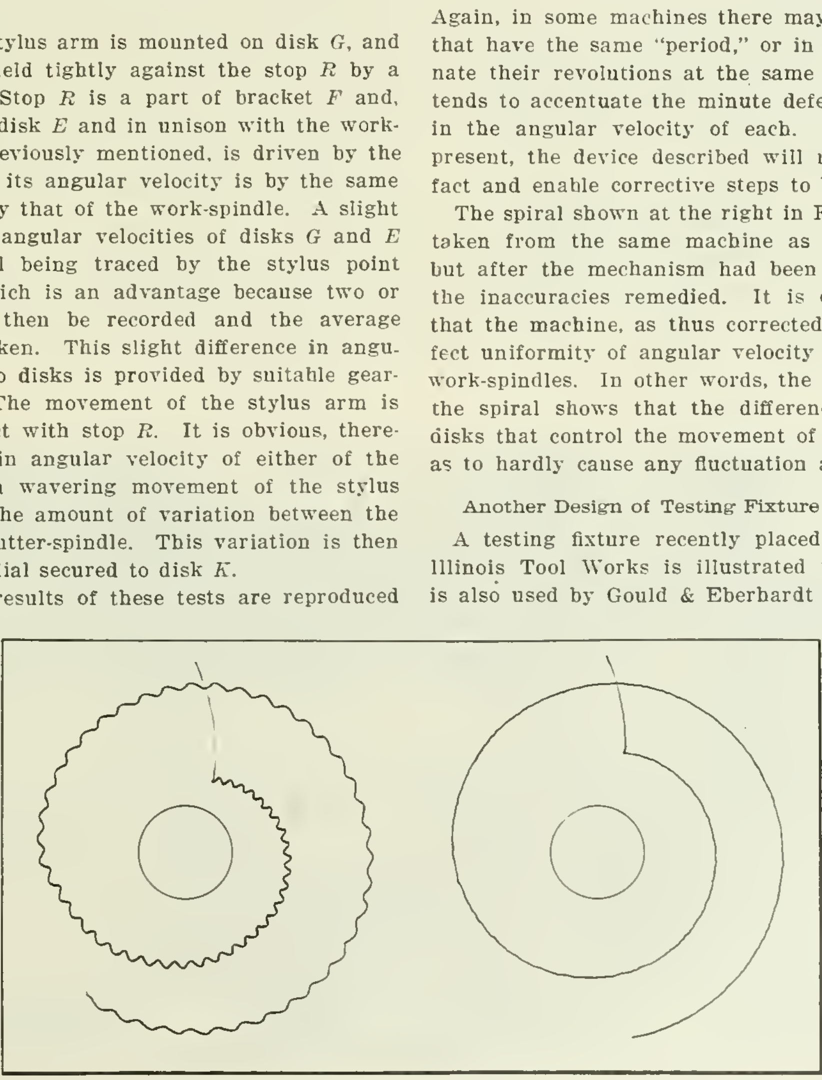


Fig. 3. Spirals traced on Paper Dial to show Variation in Speed of Cutter- and Work-spindles under Two Conditions

In some cases, departure from the uniform angular velocity ratio may be caused by tightly meshing change-gears, by dirt which has been allowed to remain between the collars and clamped therein, thus springing the arbor or spindle, or by numerous other factors under the direct control of the machine operator. These causes of variation in velocity are also revealed by the use of this type of fixture. Again, in some machines there may be two shafts or gears that have the same "period," or in other words, that terminate their revolutions at the same instant. This condition tends to accentuate the minute defects that may be present in the angular velocity of each. When this condition is present, the device described will unfailingly delineate the fact and enable corrective steps to be taken.

The spiral shown at the right in Fig. 3 is a graphic record taken from the same machine as that shown at the left, but after the mechanism had been carefully inspected and the inaccuracies remedied. It is obvious from this chart that the machine, as thus corrected, has very nearly a perfect uniformity of angular velocity between the cutter- and work-spindles. In other words, the comparative evenness of the spiral shows that the difference in speed of the two disks that control the movement of the stylus was so slight as to hardly cause any fluctuation at all.

Another Design of Testing Fixture for Hobbing Machines

A testing fixture recently placed on the market by the Illinois Tool Works is illustrated in Fig. 5. This fixture is also used by Gould & Eberhardt in conjunction with the one previously described. It consists fundamentally of a large disk mounted on a vertical arbor or spindle, which is attached to the hobbing machine work-spindle. Above this large disk there are two arms, one of which rotates in unison with the disk that is driven from the cutter-spindle, and the other in unison with the work spindle. The arm that operates in

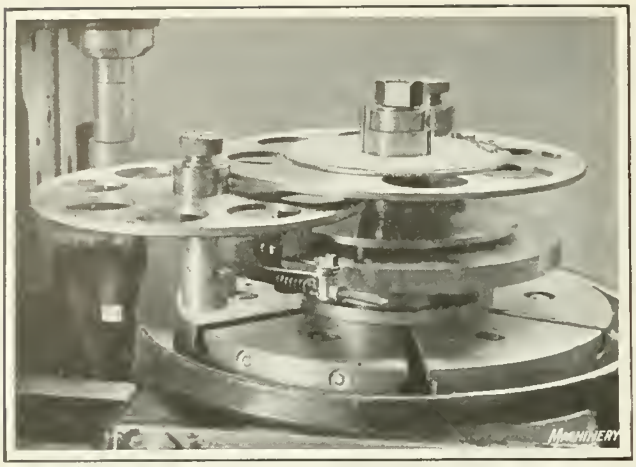


Fig. 4. Application of Testing Fixture to Hobbing Machine

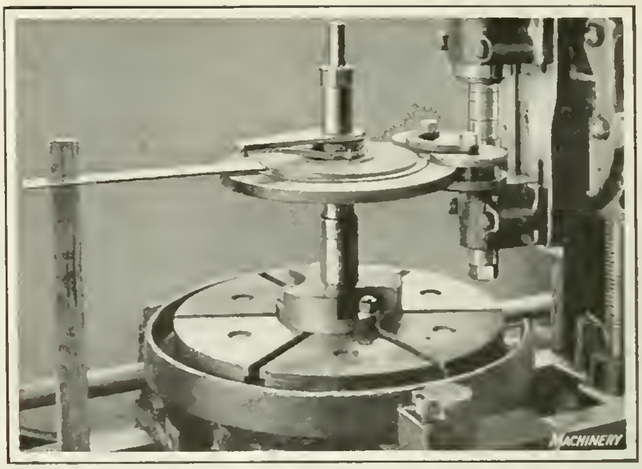


Fig. 5. Fixture of Similar Construction to that shown in Fig. 4

unison with the work-spindle carries a stylus at the end of a lever, and its angular position is influenced by an adjustable lug carried by the arm that rotates in unison with the disk.

The large disk is driven in much the same way as the disk that carries the stylus arm in the design of fixture previously described; it is rotated by means of a series of smaller disks, which are, in turn, driven by a collar on the cutter spindle. These disks and the arm revolve in coincidence with the cutter-spindle, and they control the movement of the stylus arm that revolves with the work-spindle. The stylus traces a graphic record of the variations of angular velocity ratio between the spindles on a paper dial. The disk on which this dial is mounted is prevented from rotating by an arm projecting radially and bearing against some stationary part of the machine. From this brief description it will be seen that this fixture is somewhat simpler than the one illustrated in Fig. 4, although the principle of operation is identical.

* * *

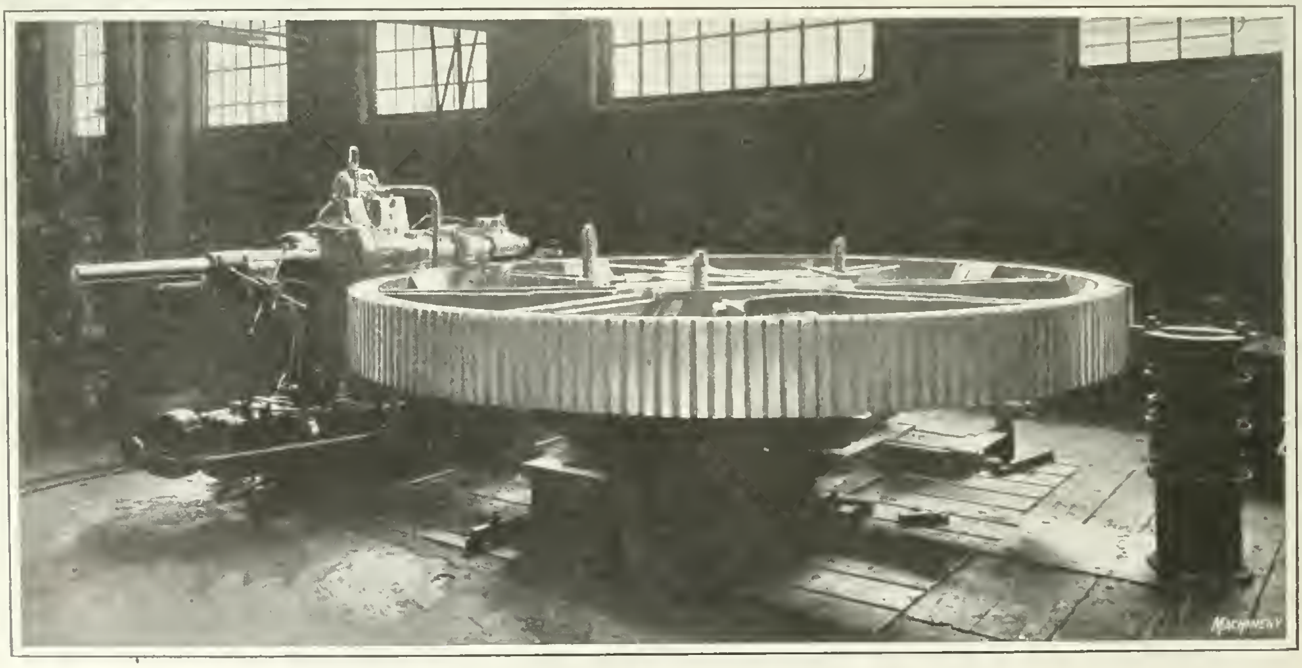
The American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa., now has a membership of over 3100 members distributed throughout practically all of the industries. In the iron and steel industry alone, there are 228 members, and in the industries manufacturing products from iron and steel, including machinery, tools, and hardware, 271 members. Non-ferrous metals and alloys are represented by 128 members.

LARGE GEAR CUT WITH A HORIZONTAL BORING MACHINE

An unusual method of cutting a large cast-steel gear was employed at the Union Plant of the Bethlehem Shipbuilding Corporation, Ltd., San Francisco, Cal., where a Lucas horizontal boring machine was used for this purpose, as shown in the accompanying illustration. This gear, which is the main bull wheel for a dredge, has a pitch diameter of about 14 feet, a face width of 15 inches, and 192 teeth of 2¾ inches circular pitch.

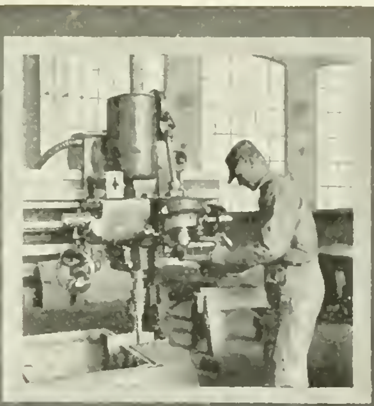
The gear was mounted on a revolving table taken from a large slotter. The lower slide for this table was bolted to a floor plate. A cutter having a diameter of 10 inches was used, and one roughing and one finishing cut was required for each tooth space, the teeth being milled from a solid rim. The cutting speed was 60 feet per minute, and the feed per cutter revolution was 0.027 inch.

In order to regulate the indexing, the tooth spaces were marked on the side of the gear blank and a pointer was attached to the machine. The gear was rotated for indexing by means of the revolving table, the pointer being set in alignment with the different division marks for milling successive teeth. Another fixed pointer was located on the opposite side of the gear to act as a double check. This gear-cutting operation illustrates how horizontal boring, drilling, and milling machines, as well as certain other types of machine tools, can be adapted for special work.



Lucas Horizontal Boring, Drilling and Milling Machine being used for cutting a Large Cast-steel Gear

Letters on Practical Subjects



BURNISHING PISTON-RING GROOVES

One manufacturer solved the problem of obtaining smooth, accurately sized ring grooves in a certain type of automobile piston by the use of a burnishing tool. The piston is shown by the heavy dot-and-dash lines in the illustration. It is 3¼ inches in diameter and has three grooves, each of which is required to be held to a width of not less than 0.187 or more than 0.188 inch. The piston is located and driven by an adapter attached to the lathe spindle. The tailstock center also serves to support the piston during the burnishing operation. The work is run at a speed of 45 revolutions per minute, and the entire burnishing operation is performed in fifteen seconds.

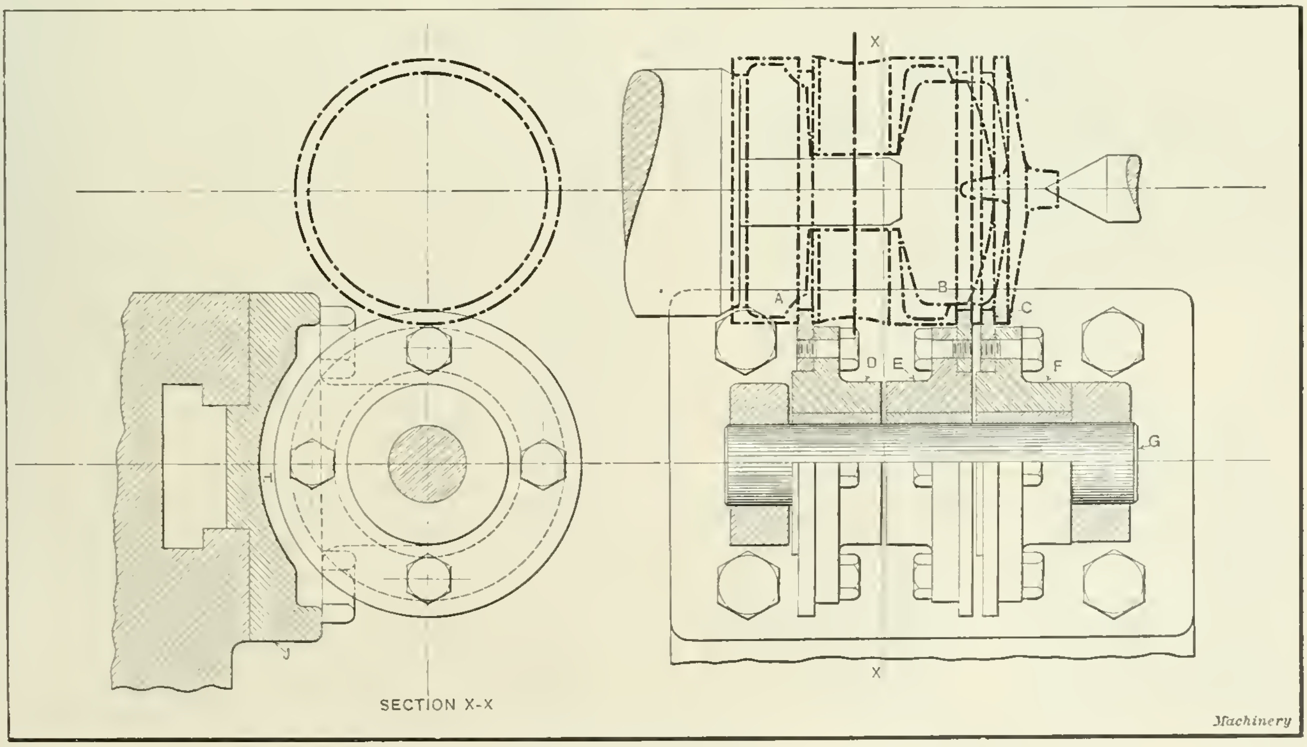
The burnishing tools *A*, *B*, and *C* are in the form of collars or washers made of high-speed steel. These tools are hardened, ground, and lapped to the correct width, and are secured to holders *D*, *E*, and *F*, as shown. The holders are made of machine steel and are fitted with brass bushings which are a good running fit on the hardened and ground tool-steel pin *G*. The holders are permitted to float sidewise to compensate for any variation in the spacing of the grooves.

The block *J* on which the burnishing tools are mounted has a depression at *H* which is kept filled with oil for lubricating the burnishing tools. Block *J* is fitted to the tool-slide of the lathe by means of machine screws and dowels. From 0.0002 to 0.001 inch is left in the ring grooves for burnishing. This allowance is sufficient to give a smooth finish and permit the tool marks to be removed. In operation, the burnishing tools are fed into the piston grooves by hand. After the tools have reached the bottom of the groove, the piston is permitted to make two revolutions before the tools are withdrawn. This type of burnishing tool has proved very satisfactory. Only one set of burnishing tools was required for finishing the grooves in a lot of 20,000 pistons.

Lakewood, Ohio H. G. Frantz

WASTE OF MATERIAL

Materials are wasted, perhaps, to a greater extent in railroad shops than anywhere else. Removed parts are likely to be scrapped, instead of being reclaimed in one of the following four ways: (1) Repaired by any suitable method—in case of broken parts, for example, by oxy-acetylene or autogenous welding—and used again; (2) put aside by some systematic method for subsequent repair to be used elsewhere; (3) converted at slight cost into similar pieces of other dimensions and used elsewhere; (4) converted economically into other pieces or articles useful in the railroad shop.



Tools used for burnishing the Ring Grooves in Automobile Pistons

Judgment, of course, must be used in determining upon the repair or utilization of material that would otherwise be scrapped. If the repairs cost more than new parts, which sometimes happens, especially if the repair work is inefficiently conducted, it is evidently cheaper to scrap the parts.

The collection of a great deal of scrap is often evidence of inefficient management, because it shows that parts have been allowed to become worthless, or comparatively so, through neglect, when they might have been saved if attended to in time.

New York City ROBERT GRIMSHAW

PIERCING AND BLANKING DIE

The compound die illustrated in Fig. 1 is designed to pierce and blank the special washer shown in the lower right-hand corner of Fig. 2. This washer is used on the shaft of a generator which comprises part of the electrical equipment of an automobile. The triangular-shaped pieces of cold-rolled steel from which the washers are blanked is 1/16 inch thick. The manner in which the stock is located on the die is illustrated in the upper view of Fig. 2. In this view, *A* represents the die, and *B* and *C* the locating or stop pins. The height of the heads of the stop pins is 0.010 inch less than the stock thickness.

A piece of stock from which the washers have been blanked is indicated by dotted lines at *D*. This illustration shows the manner in which the stop pins *B* and *C* are employed to locate the stock. In piercing and blanking the first washer, the stock is held in such a position that it is in contact with pins *B* and *C* at points *E* and *F*. The order in which the washers are blanked, beginning at the upper right-hand corner, is from left to right, as indicated by the numerals 1 to 10, the positions for the first blanking operation on the second row being indicated at *G* and *H*, and for the succeeding operation at *J* and *K*. This method of locating the stock is continued until the last washer is blanked at *L*.

The operation of the die is similar to that of any ordinary compound die. The piercing punch *C*, Fig. 1, pierces the 25/32-inch hole, and punch *D* blanks the 1⅛-inch outside diameter. Stripper *F* strips the stock from the punch on the upward stroke, and the three knock-out pins, one of which is shown at *G*, eject the blank from the die *E* through the action of knock-out rod *H*. The punch and die members are kept in alignment by two pillars located at the back of the die-bed. This type of die, when furnished with locating pins as described, provides an effective means of producing special washers when the quantity required does not warrant building a more expensive die of the multiple type, or when small pieces of scrap stock are used.

Brooklyn, N. Y. JOHN A. HONEGGER

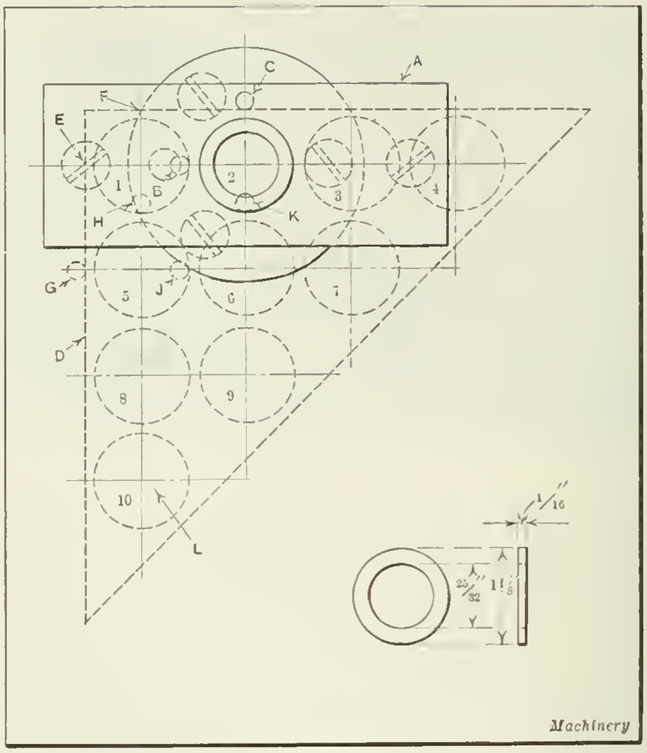


Fig. 2. Diagram showing Method of locating Stock on Die

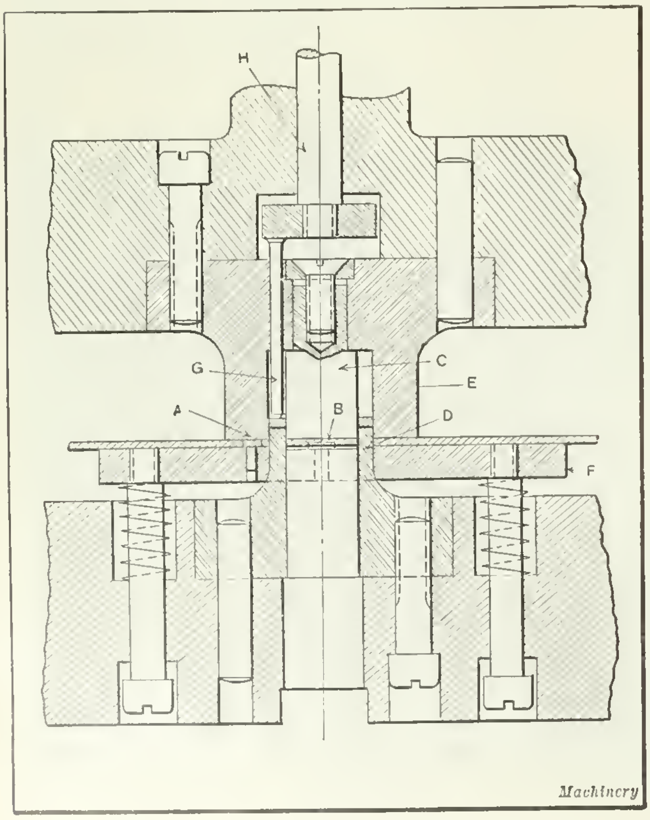


Fig. 1. Compound Die for piercing and blanking Special Washers

DRILLING A SMALL DEEP HOLE

The writer recently encountered an interesting drilling problem in making a small bushing for a special machine. The bushing was to be made of cold-rolled steel and was to be 13/16 inch long with a hole 0.0135 inch in diameter drilled its entire length. It was required to be turned down to a diameter of 1/16 inch for a length of 7/16 inch at one end and to a diameter of ⅛ inch for the remaining length. Several fine tool manufacturers and watchmakers were called upon to make this bushing, but they declined to accept the job because of the difficulty that would be experienced in drilling such a small hole through 13/16 inch of metal. The writer was therefore obliged to make the bushing on an ordinary 12-inch lathe, which was the smallest machine available for the work.

The small hole was started with a combination drill and countersink. A No. 80 drill was then put in a pin vise, and the shank of the vise placed in the drill chuck of the tailstock. The drill chuck was adjusted so as to allow the shank of the pin vise enough play to permit the drill to follow the hole already started in the steel. Instead of feeding the drill with the tailstock in the usual way, the vise was held in the hand and very carefully moved forward so that the drill was pressed lightly against the steel. The lathe spindle was, of course, driven at the highest speed available.

After drilling to a depth of about ⅝ inch, the bushing was cut off. A piece of cast iron was then placed in the

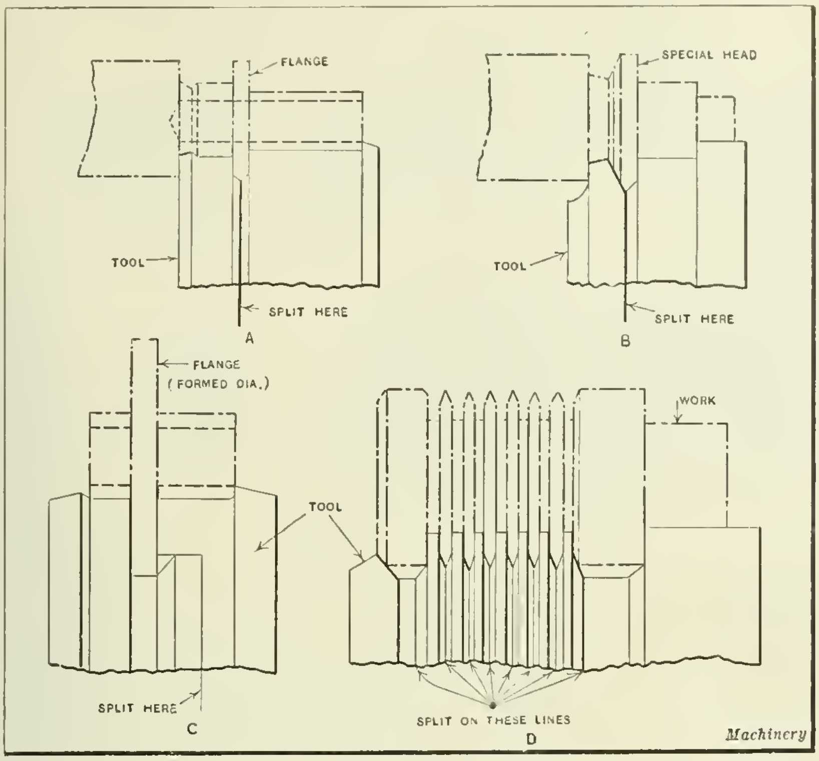


Fig. 1. Diagram showing Some Types of Split Forming Tools

universal chuck and a 1/8-inch hole drilled and reamed in its center. The bushing that had already been drilled half way through and finished on the outside was placed in the drilled hole in the casting so that the undrilled end would be presented to the drill. The drill was then fed in as before, so that it would meet the hole drilled from the opposite end.

Long Island City, N. Y. Jack Himoff

DESIGN OF SPLIT CIRCULAR SCREW MACHINE FORMING TOOLS

In designing circular forming tools for automatic screw machines, a condition occasionally arises which makes it advantageous to construct the tool in two or more sections. Generally, the object of this construction is to facilitate making the tool, especially if a deep and narrow flange such as shown at *A*, Fig. 1, is to be formed or if a special head such as that shown at *B* is to be produced. Circular tools used to form the outside diameter of a flange may also be made of split construction as shown at *C*. This design has a clearance space to guard against the possibility of the stock wedging between the sections. A tool used for this purpose will, of course, be split according to the design of the piece, but the diagram indicates one construction of such a split tool. The location of the parting line on a tool of this kind will depend largely upon the method by which the tool is held in the holder. Sometimes multiple circular forming tools are required, and these can best be constructed in sections. A design of this kind is shown at *D* in Fig. 1.

If the forming of the work does not require a deep groove in the tool, it may not be necessary or desirable to make the tool of split construction. The following rule will be found helpful in deciding when split circular tools should be used: *A circular form tool should be split when the depth of tool groove is more than one and one-half times its width.* That is, if a flange is to be turned 1/8 inch wide, a split tool should be used if the depth of groove required to produce it is more than 3/16 inch. If the tool is of complicated design it may, perhaps, be better to make the tool split, regardless of the depth of the formed section. It is believed that the saving effected thereby in the manufacture of the tool would fully warrant this construction.

In the case of multiple tools and tools of more or less complicated design, there is also the question of repairs to be considered. If a tool like that shown at *D*, Fig. 1, in which the cutting sections are comparatively frail and likely to break, were made solid instead of split it would be expensive and difficult to repair. With the sectional construction, the replacing of a broken section is comparatively simple and inexpensive. The matching surfaces of split tools should generally be ground to a good fit to insure against the stock wedging between them.

The various types referred to are constructed differently, depending somewhat on the methods by which they are held in the holder. Two split circular forming tools of different designs are shown in Fig. 2. The tool at the left has one member made with a tapped hub, which furnishes sufficient bearing surface for the threaded stud by means of which this tool is held. This hub enters the hole in the other member of the tool and serves to locate the two concentrically in relation to each other. Tools of this kind, not exceeding 3 inches in diameter, are held together by three fillister-head screws and a single straight pin. Tools of larger diameter have four screws and one or more pins. When it is necessary to provide adjustment for these split tools, a number of blind holes are machined, equally spaced, at one side of the tool in which a pin-lever is used to adjust the tool.

The design shown at the right in Fig. 2 has a counterbored hole in one member to receive a bolt for holding the tool to the holder. This is a much simpler construction than that requiring machine screws, the two sections being held concentric by means of the clamping bolt and straight pins, equally spaced. The number of these pins is usually four, but varies according to the diameter of the tool.

In the case of larger diameter tools that have provision for adjustment, the blind holes previously mentioned may interfere with the pin-holes or with the screw-holes used in fastening the two members together. In such a case it is recommended that the screws be fastened in from the opposite face to that shown in the design at the left in Fig. 2.

Dayton, Ohio Harold P. Berry

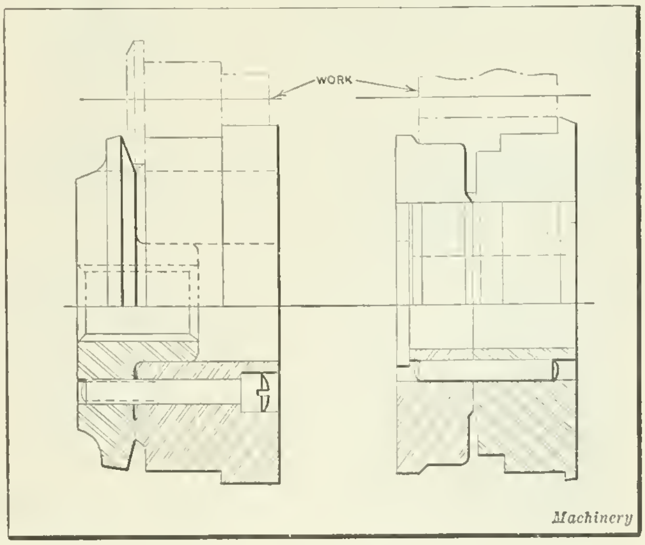


Fig. 2. Two Methods of making Split Circular Forming Tools

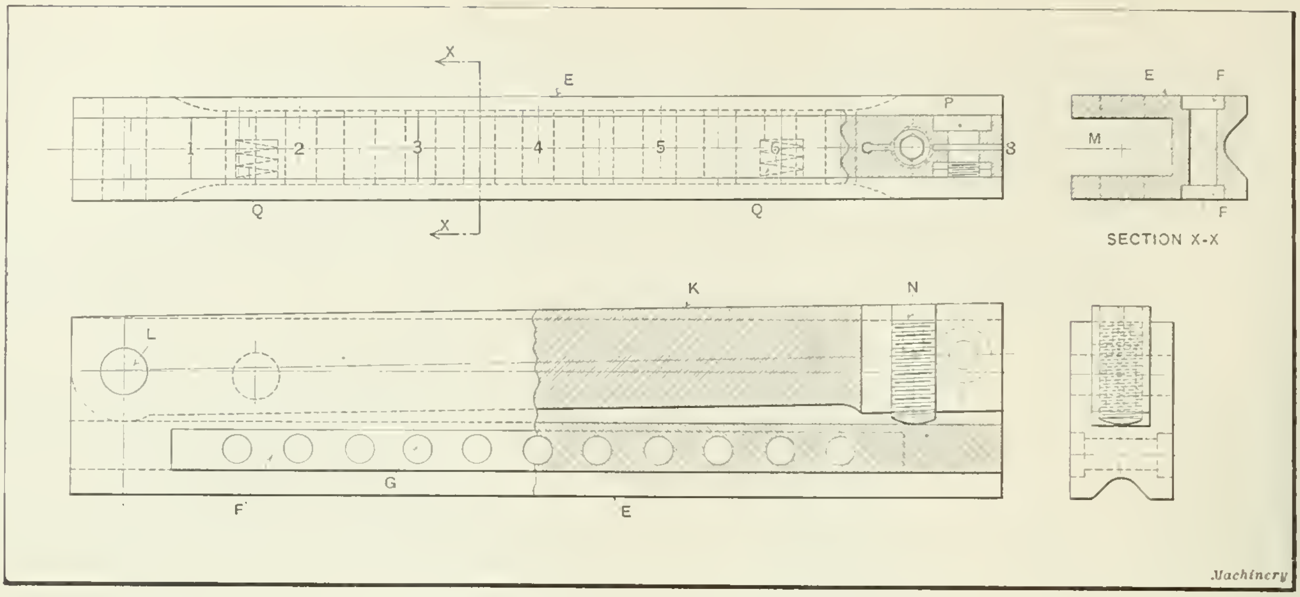


Fig. 1. Adjustable Parallel for Use in machining Tapered Work

COMBINATION ADJUSTABLE PARALLEL AND DRILL JIG

In the manufacture of jigs, fixtures, and machine tools, it is often necessary to machine tapered pieces either in a shaper, milling machine, or planer. The writer, having noticed the difficulty frequently experienced in holding the tapered pieces designed a special parallel to facilitate this work. One of these special parallels is shown in Fig. 1. This design is as useful in a large manufacturing plant as in a small machine shop, and can be made in any size from that suitable for ordinary tool-room work to the large sizes that are required in machining heavy castings on the planer.

The top view in Fig. 1 shows a plan of the parallel, and the lower view shows the front elevation which is partly in section. A sectional view of the parallel, equipped with a special work-holding clamp *A* for milling straight or tapered keyways is shown in the view at the left in Fig. 2. The view at the right shows the parallel equipped as a drill jig for drilling pin-holes in a round shaft. In this view part *B* serves as a holder for the drill bushing *C*, which guides the drill *D*.

The body *E* (see Figs. 1 and 2) of the parallel, in the smaller sizes, is made from machine steel, casehardened and ground. The slots *F* are milled in each side of body *E* to accommodate the tongue of the fixtures shown at *A* and *B*. The holes *G*, which are drilled at regular intervals, enable the fixtures to be located and clamped in any desired position by means of the bolt *H*.

A washer *J*, of rectangular shape, is placed under the head of bolt *H*. The adjustable bar *K* is made from machine steel, and the top of the working face has graduations from 1 to 8 inches as indicated in the upper view of Fig. 1. The graduations can be made with a sharp pointed tool held in a shaper, using the graduated dials of the feed-screw to obtain the required spacing. The graduations should be deep enough to avoid the danger of their being removed at the time the upper surface of the bar is ground.

The hole at *L* should be bored out with both the pieces *E* and *K* in place. A tight-fitting plug is inserted in hole *L* to keep the two members in accurate alignment when the upper and lower surfaces are being ground. The sides of bar *K* and also the sides of slot *M* should be ground. The bar *K* has a tapped hole at the end, which receives the adjusting screw *N*. This screw is made from tool steel and is hardened. It serves as a means of adjusting or raising one end of bar *K* when it is desired to use the parallel for taper-planing.

The bar *K* has a slot 0.40 inch wide cut in its end as shown and is provided with a clamping screw *P*, which can be tightened to compensate for wear in the tapped hole or to hold screw *N* in place. Two 3/8-inch holes are drilled in the sides of bar *K* to a depth of about 5/16 inch. These holes receive helical springs *Q* that bear against the sides of slot *M*. The parallels should, of course, be made in pairs. The bottom and top surfaces of a pair of parallels should be ground at the same time on a surface grinding machine, care being taken not to remove the graduations from the surfaces of the adjustable bars in the grinding operation. Steel castings are used for the fixtures shown at *A* and *B*, in the illustration Fig. 2, and the parts *R* and *S* are made of casehardened machine steel. For heavy planer work, the body *E* of the parallel should be made of cast iron and the bar *F* should be made of machine steel but should not be hardened.

B. R. WICKS
Bridgeport, Conn.

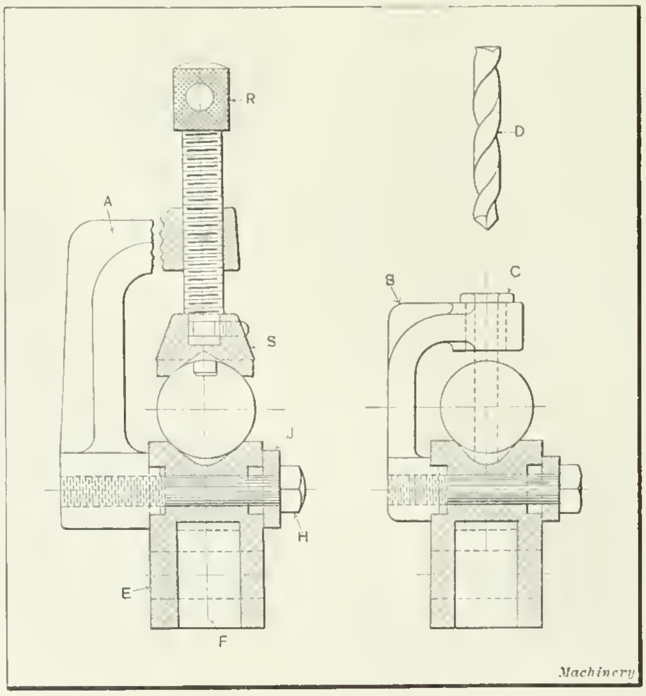
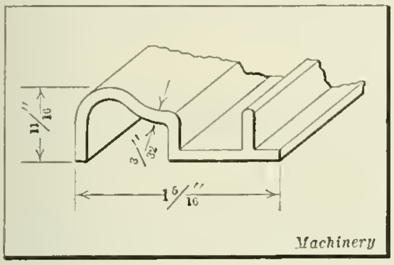


Fig. 2. Attachments for Parallel shown in Fig. 1

Shop and Drafting-room Kinks

CUTTING OFF BRASS STOCK



Section of Brass Sash Stock

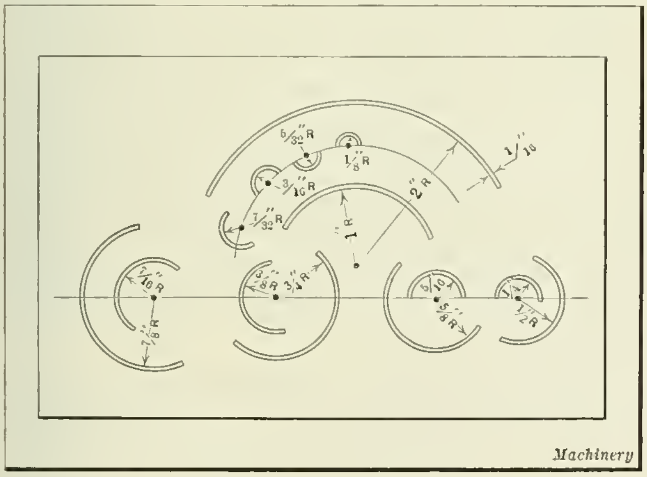
The cutting up of large quantities of brass stock of the cross-sectional shape shown in the illustration was a problem that recently confronted the writer. The stock was to be cut into pieces 20 inches long that were to be used for sash guides on passenger coaches. After considerable experimenting, it was decided to use a high-speed metal slitting saw mounted on the arbor of a wood-cutting saw table located in the woodworking department. The saw used was 1/16 inch thick and 6 inches in diameter, and was run at a speed of 2947 revolutions per minute, which gave a surface cutting speed of 4630 feet per minute.

The first trial with this equipment showed that 250 pieces could be cut off in ten minutes. On this basis of 1500 pieces per hour, less 10 per cent for rest periods, changing saws, etc., it was calculated that the production rate would be about 1350 pieces per hour. With the existing labor cost of fifty cents per hour for this class of work, the cost of cutting up the stock was $0.037 per 100 pieces. No jigs or fixtures were required.

Philadelphia, Pa. George L. Lind

DRAFTSMAN'S FILLET TEMPLET

A templet which is made from thin celluloid with circular openings of the sizes indicated in the accompanying illustration will be found convenient for drawing fillets and round corners. The openings are cut out with the sharp points of a compass and the centers are enlarged to facilitate the location of the centers of the arcs.



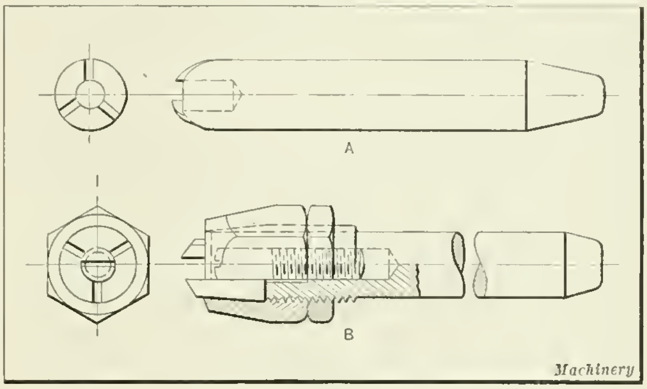
Draftsman's Fillet Templet

Detroit, Mich. George N. Dorr

STAKING TOOL WITH INSERTED BLADES

Staking tools of the type shown at *A* in the accompanying illustration were employed in assembling the parts of a time-recording device built by a well-known manufacturing concern. As the points of this type of tool broke off frequently, it was decided to make a staking tool with interchangeable blades as shown at *B*.

The tool with the interchangeable blades has two advantages over the solid blade type shown at *A*. First, it permits the blades to be hardened separately, thus lessening the danger of overheating at the points. Second, it permits the replacing of any or all blades when necessary, so that the whole tool need not be scrapped if one point is broken.



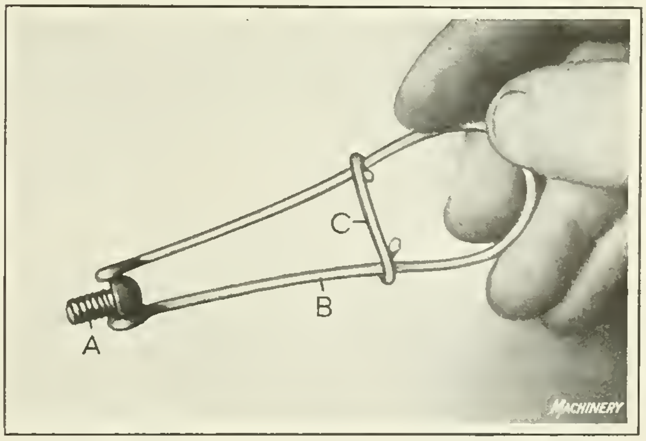
(A) Solid Staking Tool; (B) Inserted-blade Tool

Endwell, N. Y. H. Kurzweil

HOLDER FOR SMALL SCREWS

A holder such as shown in the accompanying illustration is of great assistance in starting small screws in tapped holes located in inaccessible places. This particular holder was used to insert screws through pads located at the bottom of a narrow slot. The pads were attached at intervals, and considerable trouble was experienced in inserting the screws in the holes with an ordinary screw-driver. By using the holder *B* all needless delay and trouble was avoided, and the work went along very smoothly. The holder is made from soft wire. Spring-tempered wire is not as satisfactory for holders of this type, because the sliding piece *C* will not grip this material as well. Furthermore, no springiness is required, as the opening and closing of the jaws is accomplished by sliding piece *C* up and down. The head of the screw *A* rests snugly in place in the jaws formed by the two oval loops at the end of the holder. Quite a wide range of adjustment is obtained with the holder shown. By making the handle longer a greater range can be secured.

Rosemount, Montreal, Canada Harry Moore



Holder used in starting Small Screws in Inaccessible Places

Questions and Answers on Practical Subjects

HOW SHOULD A ROYALTY CONTRACT BE WORDED?

F. H. F.—I am negotiating with a concern that wishes to manufacture and sell, on a royalty basis, a patented invention of mine, a minimum output being guaranteed me. The concern states that it will shortly send a contract for my execution. Can you furnish a form of royalty contract that will guide me in the consideration of the one to be submitted?

A.—It is impossible for MACHINERY to furnish information regarding a royalty contract, as the conditions in each case would in all probability vary greatly, so that no one form would serve for all. MACHINERY can only undertake to answer questions on the procedure in reference to applications for letters-patent, design patents, and trademarks, in this and foreign countries, and also on the law applying thereto, but cannot undertake to deliver opinions as to the patentability of inventions or the validity of patents, nor furnish information as to the proper drawing of instruments. In cases of this character, an attorney versed in patent practice should be consulted.

FORMULAS FOR CALCULATING SIDES OF TRAPEZOID

L. L. S.—Will you please give me a simple formula for finding the fourth side of a trapezoid when three sides and the altitude are given?

ANSWERED BY R. L. FRIESS, BOWLING GREEN, OHIO

Referring to the accompanying diagram, it will be evident that there are four cases to be considered in the solution of this problem. The formulas for each case are given in the following:

1. Given sides a, c, and d: In this case

$$b = d - (\sqrt{a^2 - h^2} + \sqrt{c^2 - h^2})$$

2. Given sides a, b, and c: Then

$$d = b + (\sqrt{a^2 - h^2} + \sqrt{c^2 - h^2}$$

3. Given sides b, c, and d: For this case

$$a = \sqrt{(d - b - \sqrt{c^2 - h^2})^2 + h^2}$$

4. Given sides a, b, and d: Then we have

$$c = \sqrt{(d - b - \sqrt{a^2 - h^2})^2 + h^2}$$

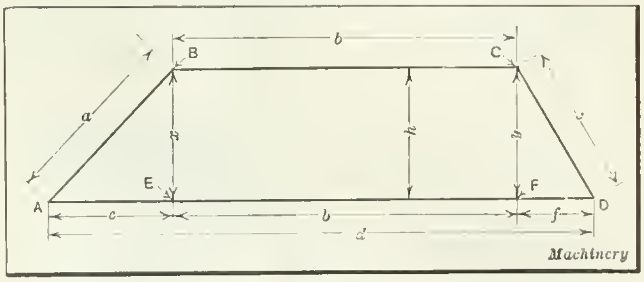


Diagram used in calculating Sides of Trapezoid

The derivation of these equations is as follows: Draw lines x and y parallel to altitude h from the points B and C, respectively. Then x forms one leg of the right triangle ABE and y forms one leg of the right triangle DCF. Then (by construction) x, y, and h are equal. Now in any right triangle the hypotenuse squared equals the base squared plus the altitude squared. Therefore we have the formulas:

$$c = \sqrt{a^2 - h^2} \text{ and } f = \sqrt{c^2 - h^2} \qquad (1)$$

$$e = d - (b + f) \text{ and } f = d - (b + c) \qquad (2)$$

$$a = \sqrt{e^2 + h^2} \text{ and } c = \sqrt{f^2 + h^2} \qquad (3)$$

Then by substituting these values in their proper places according to the accompanying diagram, we obtain the four formulas given in the preceding.

CAN A PATENT REJECTION BE APPEALED?

D. H. M.—My attorney advises that my application for letters-patent has been finally rejected. I have examined the patents cited by the patent examiner in his rejection of my application, and do not see in what respect they meet my invention. Have I any appeal?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

Your attorney, if competent, should be in a position to advise whether the patents cited against your application are pertinent, and should know what action to take in the matter. While it is possible that the patents referred to by the examiner in the rejection of your application do not meet your invention, it is probable that the wording of the claims in your specification is so broad that the terms are met by the other patents. If your claims were limited to the differences existing between your invention and the references cited, and if the advantages of your invention over these references were clearly set forth, the examiner might reconsider his action, provided your contentions are well founded. Should the examiner refuse to reconsider his rejection of the application, there is an appeal to the Board of Examiners-in-Chief, and from its adverse decision, to the Commissioner of Patents, in person. Should the commissioner's decision also be against you, an appeal may be made to the Court of Appeals of the District of Columbia.

CUTTING ANGLES FOR BEVEL GEARS

J. H. B.—Dies are to be made for casting white metal bevel gearing of 16 pitch and having 32 and 12 teeth for the gear and pinion, respectively. These dies are to be cut on a milling machine by the following method: A singled toothed cutter is to be used. The cutter will remain stationary and the operation will be one of planing rather than of milling, owing to the particular conditions in this case. In MACHINERY'S HANDBOOK, pages 627-631, is given a table which may be used for finding the cutting angles of bevel gears. This table, according to an explanatory note, is for rotary cutters. Does the method of cutting a bevel gear affect the cutting angle?

A.—When bevel gears are cut on a generating type of machine, which gives a theoretically correct tooth, the cutting angle equals the pitch-cone angle minus the dedendum angle, but when they are cut by using a rotary formed cutter, it is preferable to obtain the cutting angle by subtracting from the pitch-cone angle the addendum angle instead of the dedendum angle. When the addendum angle is subtracted, a somewhat closer approximation to the required tooth form is obtained with the rotary cutter, which, at best, does not give the tooth the correct shape throughout its length. While the teeth in the dies referred to are to be formed by planing, this is not, of course, a generating process, and the method of cutting gives practically the same result as the rotary method, so far as accuracy is concerned. Consequently, the cutting angle in the case under consideration should be obtained by subtracting the addendum rather than the dedendum angle.

The British Metal-working Industries

From Machinery's Special Correspondent

London, November 13

DURING the last two months improvement has been more generally noticeable in the metal-working industries. Unemployment is declining, though very slowly, but workers are being absorbed in several directions, and this would indicate that the improvement is not due to exceptional activity in only one or two trades. At a rough estimate it may be said that engineering plants are averaging about 30 per cent capacity. Several trades, however, can show quite good figures, and as an example, tube works may be cited as working full time. Many such works have sufficient orders in hand for a twelve months' output at the present rate of production. This general improvement in the engineering industry is due largely to overseas trade, and home demand still fluctuates.

Improving Demand for Machine Tools

In the machine tool industry, business remains quiet, but contrary to some other lines inquiry for the home market is a fair proportion of the whole. France is a good buyer of light manufacturing tools, considering the position as a whole, and one firm is reported to be doing a certain amount of business in Germany with gear-cutting machines. A firm in the Midlands, after a gradual expansion since the lockout, is now engaged at about 50 per cent capacity. At present there seems to be a fair demand for milling machines, and a number of promising orders for tools of this type have been placed recently.

In other shops a number of heavy-duty machine tools are in course of construction for the home and Colonial Railways, including boring mills, and wheel- and tire-turning lathes. Several special machines for the electrical trades are also in hand. As a rule, however, makers of this class of machine are not by any means busy, although it is understood that the prospects are much brighter. There is plenty of inquiry from abroad, and there are signs that the home railways will resume buying in the near future.

Several well-known machine builders have placed new designs on the market during the last month. A Halifax firm has in hand a large order for a gang of girder radial drilling machines for use on the 60,000-ton floating dock being built for the London and South Western Railway Co. by Sir W. G. Armstrong Whitworth & Co., Ltd., Newcastle-on-Tyne.

The demand for small tools is well maintained, and in some quarters manufacturers are working up to full capacity. The overseas trade in small tools is good, Australia being particularly prominent as a buyer. Grinding wheel manufacturers are also busy. In fact, one well-known Midland firm is busier than at any previous time in its history.

The Automobile Industry

In the automobile industry preparations are being made for the coming season. At the annual motor show now being held at Olympia and the White City, several new designs of light cars to carry three or, at the most, four people are shown for the first time; the prices range from £180 to £250, and it is expected that a hitherto untouched market will now be drawn upon.

Another development in the automobile industry is the decision of some makers who up to now have specialized on one model powerful car of the highest grade, to undertake the manufacture of a smaller powered car at a moderate price. The Rolls Royce Co. is among such makers, and the firm expects to have a car of this type on the market by the end of the year.

Overseas Trade in Machine Tools

For the second consecutive month an increase is noted in the exports of machine tools. Although not so big as the increase in August, this is the first occasion for more than a year that the promise of one month has been continued through the next. An export tonnage of 819 with a value of about £105,700 in August rose to 835 tons with a value of £115,700 in September. Imports showed a decline in September to 231 tons with a value of £34,410 from 431 tons and a value of £56,604 in August. The value per ton of exports rose from £129 in August to £131 in September, and that of imports rose from £131 to £149.

This year the highest point in exports of machine tools was reached in April, with a tonnage of 1400. From then until the end of July a sharp and continuous fall occurred, and only 500 tons were exported during July. To bring this year's exports up to the pre-war average in weight 4000 tons would have to be exported in the three last months; and only a considerable spurt of trade can realize this. The average price per ton of exports is, however, more than double the pre-war rate, and as this is a bigger increase over pre-war prices than is noted in the prices of machines sold in this country, it points to the fact that the exported goods are on the average in a more valuable class than was formerly the case. Imports remain at almost pre-war level.

Labor Conditions

Employment in the engineering industries during September showed little change on the whole, as compared with the previous month. The position on the north-east coast remains bad, as it also does in the Lancashire districts, with the exception of the textile machinery makers, some of whom still report over-time. The percentage of registered unemployed in the engineering industries for September was 22.9—a total of 261,062—the August figures being 258,830, or 22.7 per cent.

Materials and Prices

The production of pig iron in this country in September was 430,300 tons, and of steel ingots and castings 555,900 tons. In both cases these figures are greater than during any month since the coal strike in 1921. They represent, however, a production of only 60 to 70 per cent of that during 1920, and much of the material went to America to meet the abnormal conditions there due to strikes. Railway rates are still a great stumbling block to the expansion of the iron and steel industries and in some cases are still more than 80 per cent over those prevailing previous to the war.

Finished steel prices are still steady; mild steel plates ⅜ inch thick and up remain at £9 to £9 5s. per ton, and pig irons also show little variation, ranging in price from £3 17s 6d to £4 12s 6d per ton according to grade. Machine tool gray iron castings up to 5 tons in weight are being sold in the Birmingham district for 20s to 21s per hundredweight, while light castings bring 27s per hundredweight. In the Manchester area, founders are quoting from 24s 3d per hundredweight up to 43s 6d for machine tool castings, these prices varying according to size and number.

The Machine-building Industries

DOES the general industrial outlook justify optimism and confidence? This question a great many executives ask themselves every day. The Federal Reserve Bank of Cleveland answers that "the business tide is rising. The receding tide has carried out most of the wrecks of business; the incoming tide is raising the tide line of business." The Federal Reserve Bank of Chicago says: "General business improvement is manifested in reports from all sections, and in practically all phases of industry. Moderate increases in the volume of employment reflect a general speeding up of production." The Department of Commerce states that "the most important development of recent weeks is the marked increase in the demand for goods. Increased employment and higher wages have been largely responsible for this increased demand."

First-hand information collected by MACHINERY from the machine-building industries bears out these statements. The machine tool industry shows steady improvement; the activity in some of the plants manufacturing shop accessories and tools has reached a normal level. The machine tool shops, as a whole, are working at an average of nearly one-third capacity; several plants have exceeded the 50 per cent mark, and a few are doing almost a normal business. The output of the automobile industry continues unusually high for this time of the year. As a consequence, many of the industries depending mainly on the automobile shops for an outlet are operating at capacity. Power plant equipment is in demand. The electrical industry is keeping step with the general improvement in business. Additional equipment has been ordered by many public utility corporations, to take care of the rapidly growing demand for electricity, a demand which is not confined to any particular locality, but is spread over the entire country. The hoisting machinery industry operates at about 50 per cent capacity. Turning from heavy machinery to light manufacture, we find the typewriter plants fully occupied. The same is true of the hardware factories. The activity in the metal-working field has not been exceeded since the early part of 1920.

The Machine Tool and Small Tool Industries

Referring specifically to conditions in a number of machine tool plants recently visited, we find one plant that builds automatic machinery doing a 70 per cent business; one of the leading lathe builders operates at about the same percentage of normal; and two other lathe manufacturers at from 50 to 60 per cent. A manufacturer of hammering and riveting machinery is doing a business equal to 80 per cent of normal. Several manufacturers state that October brought more business than any month since early in 1920.

In the accessories and small tool fields, conditions are encouraging. Two manufacturers of lathe chucks state that their business is about 50 per cent of normal, and that there is now some export business in this field, mainly to England, Australia, and Japan. The domestic business in chucks is not yet as active as it would be if there were not still large stocks of chucks in the hands of both dealers and manufacturers who use them as regular equipment on their machines. One manufacturer of chucks finds the business particularly quiet on this account. The drill chuck business is quite active, and at least one of the manufacturers in this line operates at capacity. There is a fair export business in drill chucks, mainly to England and Japan. The demand for drop-forged tools is good, except in lines where large quantities were put in stock by manufacturers and dealers two years ago. Generally speaking, the demand for small tools is considerably above the pre-war level.

In allied industries there is also a decided improvement. Shops engaged in making pyrometers and other heat-recording instruments see better business ahead. The screw products business is good, and some of the plants in this field are working over-time. Prices for screw products were too low to meet costs a year ago, but have now reached a more satisfactory level. The silent chain business is active, and will doubtless continue to be as long as the automobile business continues as at present. Some of the companies making abrasives and grinding wheels work nearly to capacity.

The Automotive Industries

Contrary to expectations, the automobile industry has continued to work almost at capacity throughout the fall months. The October production of cars and trucks amounted to about 244,000, compared with 206,000 in September. It was expected that the figures for November would be considerably less, but no signs of decreased production are as yet visible in the larger factories. At present, it appears that the automobile production for 1922 will exceed the record of 1920, which was 2,200,000 cars.

In the truck business, the principal demand at this time is for light trucks, of from ½ to 1½ tons capacity. One well-known manufacturer of trucks states that the present demand for this type of truck is greater than at any time in the past. Manufacturers of industrial tractors and trucks for handling heavy materials also report good business.

The farm tractor industry has shown a substantial increase, compared with 1921, and the production schedules that manufacturers are now preparing for 1923 are much larger than those for the last two years. Several companies have made greater shipments during the last two or three months than ever before, and others state that the business done approximates that of a normal year. As stated, industries that depend directly on the automobile business are also working at capacity, like ball and roller bearing manufacturers, gear and axle manufacturers, and chain makers.

The Iron and Steel Industry

Unless the iron and steel industry is in a healthy state, the other metal-working industries cannot be expected soon to return to a normal state of business. The steel production is increasing, and the mills of the United States Steel Corporation are now operating at 78 per cent capacity, with the industry as a whole working at from 70 to 75 per cent. The greatest difficulty this industry is confronted with at the moment is the necessity of accumulating adequate coal reserves for the winter. Buyers seem inclined to wait for lower prices, but under existing conditions it is doubtful whether any material price reductions will be made.

The Employment Situation

The increased activity in the principal industries has resulted in a shortage of labor in many parts of the country. In New York state, for example, there are now 160,000 more people employed in factories than there were a year ago, and the number of employes is now larger than in 1914. Marked gains are especially noticeable in iron and steel plants and in the metal-working shops generally. There is a scarcity of skilled machinists which will spread as the machine-building industries become more active. This will influence the wage rate, and make it necessary for manufacturers to adjust their prices in keeping with the increased costs of materials and labor. Machine tool prices are now probably as low as they will be for a long time to come, and any change will mean an increase rather than a decrease.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

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Bullard Pipe Coupling Boring Machine

OIL-well casing or pipe couplings can be simultaneously taper- and straight-bored, faced and chamfered on both ends in a large horizontal type machine which has been developed by the Bullard Machine Tool Co., Bridgeport, Conn. During this operation the coupling is held stationary between two pneumatically operated jaws which, with an air pressure of 80 pounds per square inch, exert a pressure of 12,000 pounds on the work, thus insuring a positive grip which holds the coupling firmly under the heavy cutting action of the tools. When the operation is completed, the jaws open, the finished coupling is ejected, a new piece rolls into place, and the jaws are closed again. The entire operation of the machine is automatic, the attendant being required simply to place the work on a chute at the rear of the machine. The heavy lines in Fig. 4 indicate the surfaces that are finished, both ends being identical. It will be seen that there is a long taper-boring operation up to the middle of the coupling, a straight-boring or recessing step for a short distance at the end as well as facing and chamfering cuts.

Construction of Tool-heads

From Figs. 2 and 3, which show front and rear views of the machine, respectively, it will be seen that there are two opposing heads of similar construction. A holder having eight cutters is mounted on the front of each head. Two cutters are supplied for each surface machined, those for chamfering and facing being mounted on the faceplate of the cutter-head, while those for taper-boring and recessing are mounted on the cylindrical part of the cutter-head. The heads have a rapid traverse to the point of cutting, a slow feed during the cutting, and a rapid traverse for the return. An ingenious mechanism provides for feeding the taper-boring tools radially to suit the amount of taper. A square-section guide or former bar extends through the spindle of each head and the holders for the taper-boring tools slide on the sides of this bar. Two of the sides are tapered to conform with the coupling, and thus feed the tools radially as they are advanced into the work. When either head starts to advance, the former bar is pushed forward by means of a lever mechanism at a much faster rate than the head, so that by the time the head begins its slow feeding movement the bar is stationary. When the operation is completed the bar is pulled back with the head to enable the work to be removed, which would otherwise be prevented as the former bars project, at this point in the operation, almost to the center of the work-holding jaws.

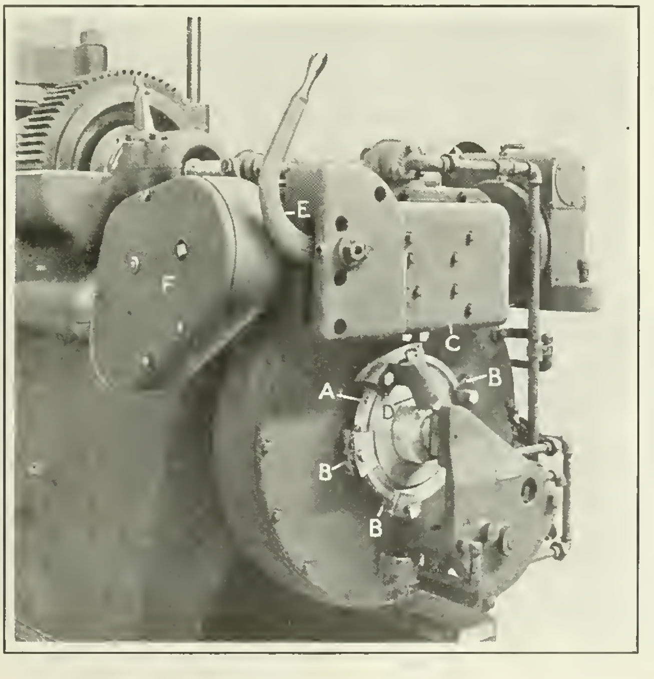


Fig. 1. Timing Mechanism which controls the Movement of the Heads and the Operation of the Work-holding Jaws on the Bullard Pipe Coupling Boring Machine

The right-hand head advances slightly ahead of the other and returns slightly before it. This is necessary in order that the taper surfaces may be cut to the center of the coupling from each side without the heads interfering with each other. The cutter-heads revolve in opposite directions, and are both driven from the motor on top of the machine at the left, which drives through spur gears and a shaft at the rear to the right-hand head, and through a shaft at the front to the left-hand head. The horizontal movements of the

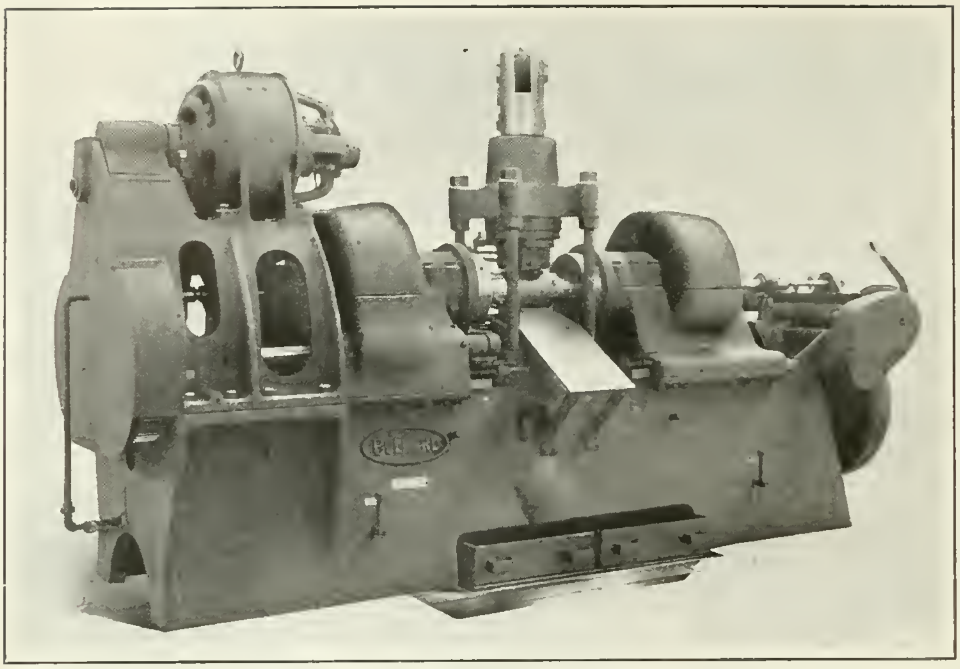


Fig. 2. Bullard Boring Machine for Oil-well Casing or Pipe Couplings, which functions automatically

heads are controlled by two barrel cams in the bed. The shaft on which these cams are mounted is driven from the motor on top of the machine through change-gears for feeding the heads during the cutting period, the drive being transmitted through the shaft which furnishes power to the spindle of the right-hand head. However, for the rapid traverse, the camshaft is driven by an auxiliary motor at the rear of the machine, through large proportioned worm-gearing.

The former bar of each head may be quickly removed so that another can be substituted, this being essential because the taper bore may vary with different couplings. The tool-heads may also be quickly removed from the spindle ends when a coupling of a different diameter is to be handled. The cutters are ¾-inch square tool bits and can be independently adjusted or removed from the holders. Cutting compound is pumped to the work during the cutting period through a hole running the length of the former bars. The cutting compound drains from the work to a reservoir under the bed, from which it is strained and repumped to the cutting tools.

Timing Mechanism

The feed and rapid traverse movements of the heads are controlled by a timing mechanism at the right-hand end of the bed, which is shown in Fig. 1. Disk *A* is mounted on the camshaft and carries three blocks *B* which have projecting pins that alternately trip two interlocking levers projecting from clutch box *C*. The movement of these trip-levers shifts clutches in this box so as to rotate the camshaft slowly or quickly for the feeding and rapid traverse movements, respectively, of the tool-heads. It was stated in the preceding that when the camshaft is revolved slowly it is driven from the motor on the top of the machine, and when it revolves at the fast rate it is driven by the motor at the rear. Bracket *D*, also carried on disk *A*, has a plunger which opens and closes an air valve at the proper moment for supplying air to the cylinder of the work-holding jaws and for cutting off this supply.

The timing mechanism gives the following cycle of movements to the camshaft: A fast rotation during which the heads are traversed forward to the cutting point, a slow rotation while the heads are fed forward during the cutting period, and a fast rotation during which the heads are traversed back to the starting point. The work-holding jaws are opened simultaneously with the rapid return of the heads, and are closed simultaneously with the forward rapid traverse. There are three positions for handle *E*: When it is all the way down, the heads operate back and forth only at the rapid rate, this being convenient in setting up the tooling for a job; when the lever is in the neutral position, the machine runs with the heads stationary, so far as longitudinal movement is concerned; and when the handle is in the upper position, the machine functions normally. The rate of feed may be changed within certain limits by means of change-gears in box *F*. The position of blocks *B* may be adjusted around disk *A* to vary the lengths of the rapid traverse and slow feed movements of the heads in accordance with the length of the coupling being handled.

Operation of the Work-holding Jaws

The couplings are placed on the chute seen at the center of the machine in Fig. 3, where they are held from rolling by

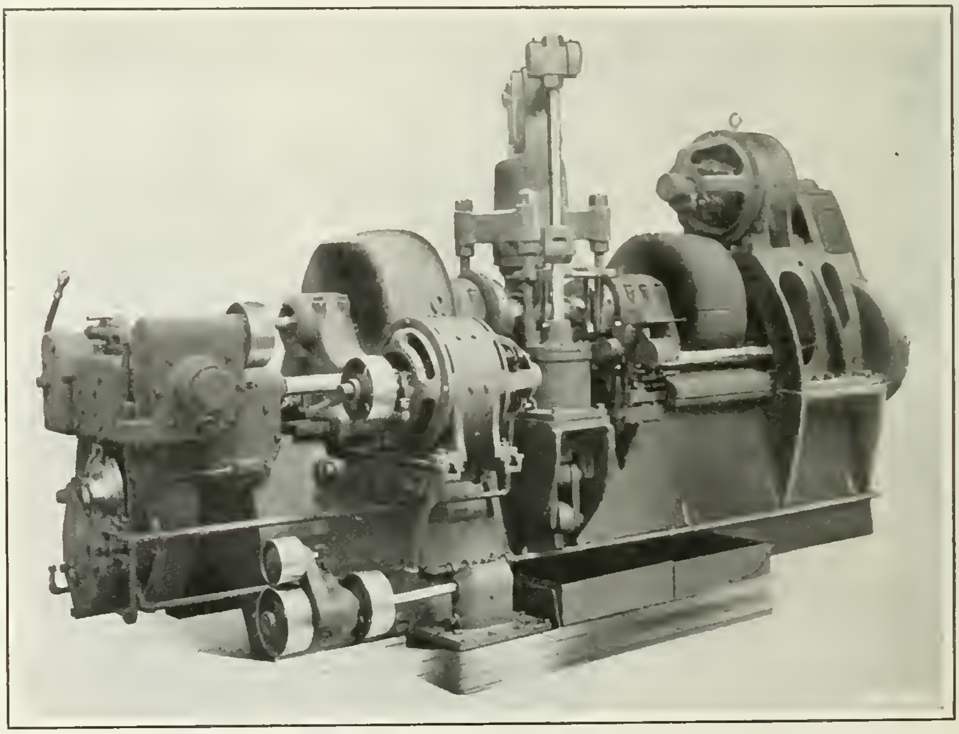


Fig. 3. Coupling Boring Machine from the Rear, showing the Pneumatic Opening and Closing Arrangement for the Work-holding Jaws

means of two vertical pins while another coupling is being clamped between the jaws. However, when the heads are withdrawn at the completion of an operation, air is supplied to the releasing end of the cylinder, as mentioned in connection with the timing mechanism, to actuate the toggle mechanism so that it raises the upper jaw and lowers the bottom one. Simultaneously with the jaw movements an ejector rises in the bottom jaw and lifts the coupling so that it will roll down the chute at the front of the machine into a receptacle. At the same time the vertical pins that hold the unfinished work on the rear chute are lowered to allow the next coupling to roll forward between the jaws, where it is located both radially and endwise. When the work is in place, the jaws are again brought together by the operation of the air valve through the timing mechanism.

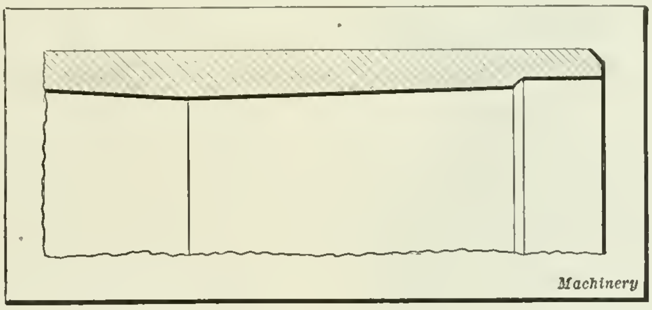


Fig. 4. Diagrammatic View, showing the Cuts taken on Each End of a Coupling

The main transmission gears are made of alloy steel and are heat-treated, and the feed-cams are made of steel. A large ball bearing takes the spindle thrust in each head. Special attention was paid in designing this machine to provide adequate lubrication; the tool-heads contain reservoirs in which the driving gears revolve, and there is a provision for carrying oil to the main spindle bearings. Both the feed-cams are also immersed in oil. The motor on top of the machine should be of the variable-speed type and have a capacity of from 10 to 25 horsepower, depending on the size of the coupling to be handled. The auxiliary motor which drives the power traverse and cutting compound pump should be of 5 horsepower capacity. The main driving motor should be equipped with a magnetic remote control for starting and stopping the machine.

Specifications

Some of the important specifications of this boring machine are as follows: Minimum and maximum diameter of coupling that can be machined, 5 and 12½ inches, respectively; maximum length of coupling, 12¼ inches; total movement of each tool-head, 9½ inches; minimum and maximum revolutions per minute of boring spindles, 10 and 40, respectively; feed range of tool-heads, from 0.025 to 0.075 inch per spindle revolution; and weight, 24,000 pounds.

NILES-BEMENT-POND HEAVY-DUTY ENGINE LATHE

A heavy-duty engine lathe having a swing of 60 inches has recently been added to the line of machine tools built by the Niles-Bement-Pond Co., 111 Broadway, New York City. This lathe is shown in Fig. 1, equipped with a constant-speed motor of forty horsepower capacity; with this drive, twenty-four faceplate spindle speeds may be obtained through speed change-gears which are operated by manipulating levers on the headstock. When the machine is equipped with an adjustable-speed direct-current motor as illustrated in Fig. 2, the speed range of the motor is such as to permit the change-gears in the part of the headstock above the joint line to be omitted without reducing the range of spindle speeds. The motor may be started and stopped by operating a handle on the carriage, and when the machine is driven by the adjustable-speed motor, any spindle speed within the range of the motor can be obtained through the same handle. A push-button on the headstock permits of jogging the motor to enable quick and easy shifting of the speed change-gears.

The headstock is of a substantial design, and is entirely enclosed. All bearings and gears are continuously oiled by means of a pump which supplies filtered oil to a large reservoir in the upper part of the headstock from which the oil is distributed by pipes to each member requiring lubrication. The surplus oil drains into a settling tank in the base of the head, from which it is pumped through a filter and back to the reservoir. The spindle bearings are fitted with oil distributing rings and have large oil-wells to furnish lubricant in addition to the continuous oil supply. The faceplate has four pairs of parallel slots for the attachment of steel jaws. The center is made of tool steel, is hardened and ground, and is fitted with a large spanner nut to facilitate its removal.

The tailstock spindle is also made of tool steel, and provided with a spanner nut. It is of ample diameter to insure stiffness when run out the maximum amount. This spindle is adjusted through gearing and a handwheel, which is located at an angle relative to the axis of the spindle,

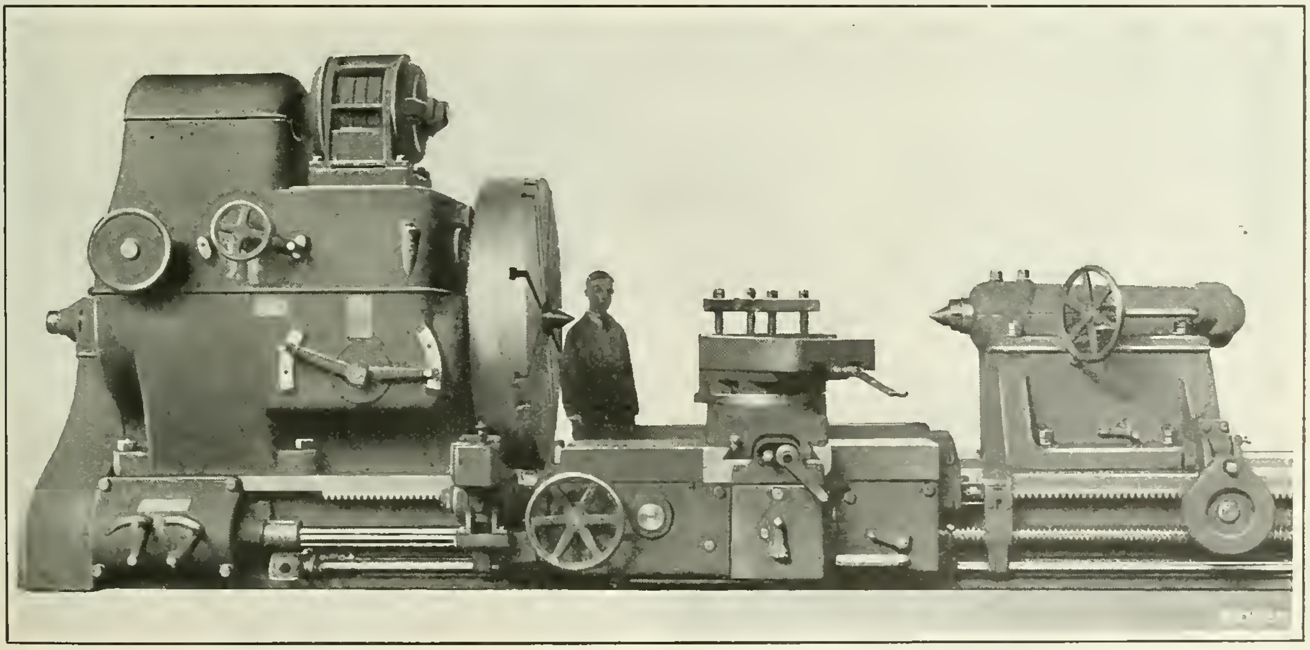


Fig. 1. Niles-Bement-Pond Heavy-duty Engine Lathe which has a Swing of 60 Inches

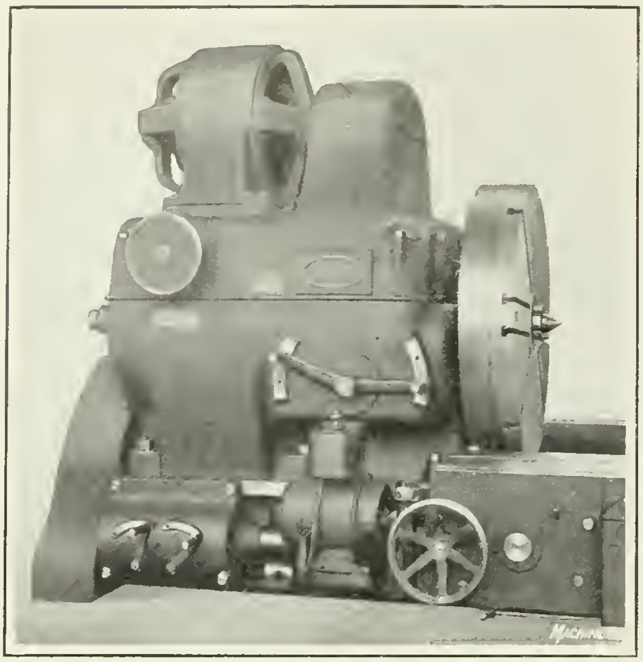


Fig. 2. Engine Lathe equipped with an Adjustable-speed Driving Motor

in a position especially convenient for the operator when placing work between the centers. The upper part of the tailstock can be adjusted crosswise by means of a screw, for turning slight tapers. This part of the tailstock is clamped to the lower section by bolts which are independent of the bolts that clamp the lower section to the bed. The latter are supplemented by a pawl which engages a ratchet on the bed to prevent slipping of the tailstock under a heavy end thrust. The pawl may be lifted out of engagement with the ratchet by the handle on the front of the tailstock. The ratchet is made in sections which are readily removable to allow chips that may accumulate in the bed to be cleaned out.

The tool carriage has longitudinal, cross, and angular feeds both by power and by hand. A rapid traverse along the bed is also provided through a five-horsepower motor and drum switch mounted on the carriage. The switch has a spring return to the off position. The apron is of the one-piece type, with all gears enclosed and all shafts having a bearing at each end. The gears and bearings are oiled from a reservoir filled at the top of the carriage. The direction of any feed may be changed, started, or stopped at the carriage, the operating levers being conveniently located and so interlocked that no two feeds can be engaged at the same time.

The thread of the lead-screw is used only in cutting threads, the carriage being fed for other work by a spline in the lead-screw. All feeds are obtained through a quick-change gear-box, which gives four feeds for turning, facing or thread-cutting without removing gears. Other feeds may be obtained by means of change-gears at the end of the headstock. When the lathe is built with a long bed, the lead-screw and controller shaft are supported at intervals by bearings which are automatically spaced by the carriage. This lathe is supplied with a five-jaw steadyrest.

MIDWEST STEEL BOX-RAILS AND STRINGERS

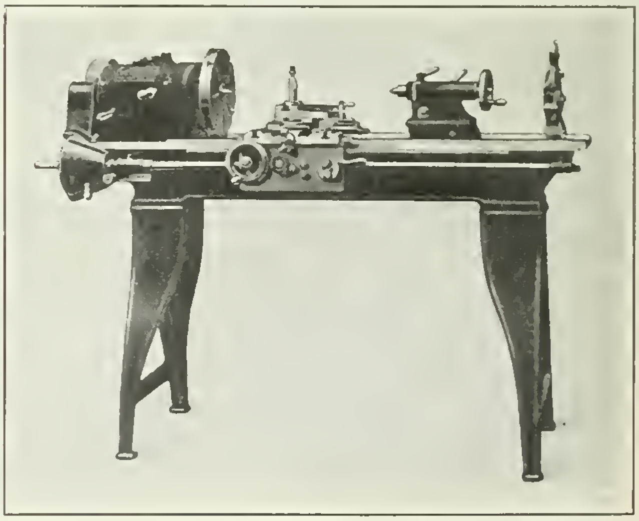
Rolled-steel box rails and stringers for attaching machinery, motors, lineshafts and countershafts, crane rails, pipe lines, sprinkler systems, etc., securely to ceilings, walls, or floors, are now being manufactured by the Midwest Steel & Supply Co., Inc., 28 W. 44th St., New York City. The box-rails are usually built into the ceilings or walls of concrete buildings during their erection, only a surface slot of the rail being left exposed. The anchorage of equipment to the box-rail is accomplished by simply slipping a special bolt into the slot at any point, and turning the bolt through 90 degrees. In the store-room the box-rails are especially useful in attaching brackets to the walls for supporting bar stock. The steel stringers are primarily intended for machine and transmission installations, and are readily attached to wooden or steel girders. Both the box-rails and stringers are furnished in various lengths.

OLIVER ENGINE LATHE

The engine lathe shown in the accompanying illustration is an addition to the line of machine tools built by the Oliver Machinery Co., Grand Rapids, Mich. The new lathe is made in three sizes, namely, 10, 12 and 14 inches swing, respectively. It may be equipped either with a single driving pulley and geared headstock or with a back-geared three-step cone-pulley headstock. Both types of heads may be motor-driven. The lathe may also be supplied with either a straight or a gap bed and with bench or floor legs. Six spindle speeds are obtainable with the geared headstock through two levers located at the front. One of these operates a positive clutch to engage either the back-gears or the direct drive, while the other shifts three gears and thus provides three speeds through the direct drive and three through the back-gears.

The driving pulley is fitted with a friction clutch which is operated by means of a bar that extends the length of the lathe. This clutch enables the spindle speed to be changed and the lathe to be started or stopped during an operation without stopping the motor or the driving belt. The headstock is equipped with a tooth clutch by means of which both the longitudinal and cross feeds may be instantly reversed without shifting gears or belts, reversing the spindle rotation, or stopping the lathe. This feature simplifies the cutting of threads and decreases the time for such operations. The screw of the tailstock is set over for taper-turning and the spindle is graduated in sixteenths of an inch for convenience in drilling to depth.

The carriage has a positive lock to prevent longitudinal motion while a cross cut is being taken. The back of the carriage is drilled and tapped to receive a taper attachment and a follow-rest, and has T-slots at the front and rear for attaching jigs, fixtures, or other special equipment. The swiveling bar of the taper attachment is graduated in inches, and tapers up to 4½ inches per foot may be turned. The cross-slide screw has a dial graduated in thousandths of an inch. The base of the compound rest is circular and is graduated in degrees to permit accurate settings to be made



Oliver 10-, 12-, and 14 inch Engine Lathe equipped with Geared or Cone-pulley Headstock at any desired angle. The compound-rest screw is also fitted with a dial graduated in thousandths of an inch.

The apron gearing is so arranged that the operator may readily change from thread-cutting to a job in which the longitudinal or cross feed is used, without shifting gears. The difference between the lead in chasing threads and that desired in feeding the carriage for turning or facing is made possible by worm-gearing. The feed lever on the apron has three distinct positions: In the first position it engages the power longitudinal feed; in the second position it is neutral and permits the engagement of the lead-screw; and in the third position it engages the power cross-feed.

CINCINNATI-ACME HAND MILLING MACHINE

For milling straight or taper squares on steel or brass parts, the Acme Machine Tool Co., Cincinnati, Ohio, has developed the hand-operated machine here illustrated. This machine is provided with two independently driven spindles mounted in headstocks. The inner end of each spindle has a No. 9 B. & S. taper hole to receive milling cutters, and is slotted across the face to accommodate the driving tang of the cutters. Both headstocks may be swiveled to suit the milling of either straight or taper squares, such settings being accurately accomplished by means of graduations. The heads are mounted on slides which have a longitudinal adjustment along the bed, the adjustment being accomplished by the handwheels at the ends of the machine. These handwheels are provided with micrometer dials to permit close adjustments to be made.

The bed carries a vertical slide on which the work-holding fixture is mounted, and adjustable gibs are provided to compensate for wear. The work-holding fixture is similar in design to an automatic spring collet chuck. The work is inserted from the front of the machine, and when a part has been located in the fixture, it is clamped in place by giving a slight rotary movement to the four-spoke handle. The chuck is then free to revolve, but before raising it to feed the work past the cutters, it is locked in position by means of a hardened and ground bolt which may be set in four positions. In addition to the vertical movement of the work-holding slide, it has a movement at right angles to the spindles.

Downward motion of the long lever at the front of the machine causes the slide to pass the work between the milling cutters, the two sides of a square thus being milled simultaneously. The slide is then withdrawn, and during this movement, the locking bolt in the work-holding fixture is also automatically withdrawn. The operator may then revolve the chuck with his left hand, keeping his right hand constantly on the vertical-slide operating lever. This slide is counterbalanced to allow it to move equally freely in both directions. At the end of an operation the four-spoke handle is given a partial turn to the left in order to open the chuck. In the rear view of the machine shown in Fig. 2, there may be seen at the center of the bed a small slide on which is mounted an adjustable stop, against which the work is brought to insure that all pieces will be held alike as regards the length of the square. This view of the machine also shows the arrangement of the pump for supplying coolant to the cutters. The machine is designed to be driven from a plain countershaft, and when necessary, two speeds can be provided for.

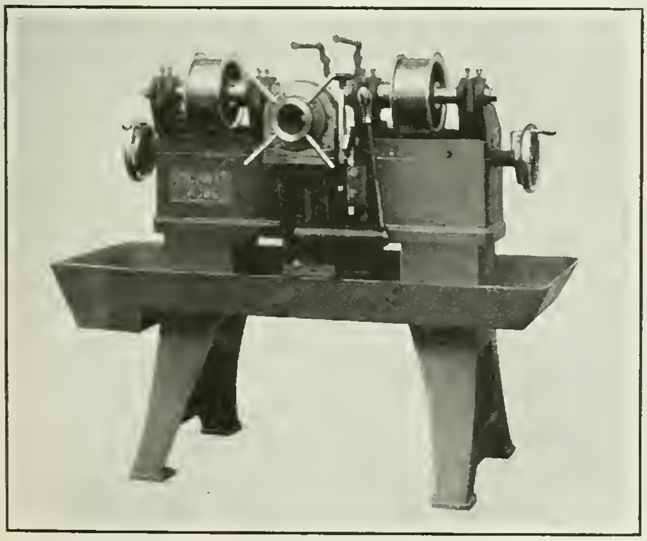


Fig. 1. Cincinnati-Acme Hand-fed Machine for milling Straight and Taper Squares

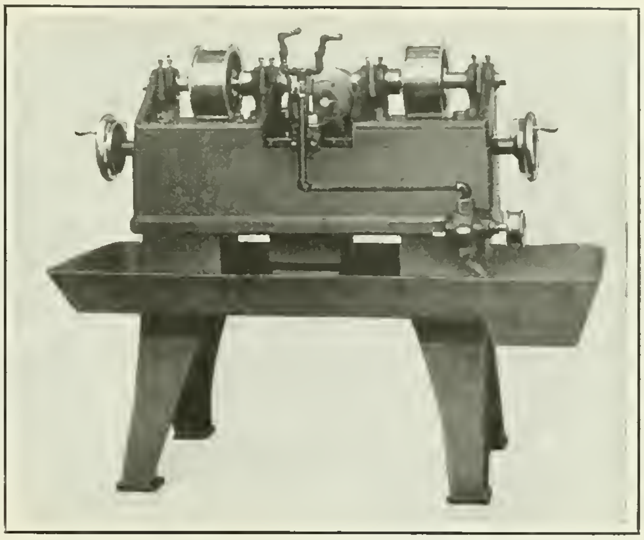


Fig. 2. View of Machine from the Rear, showing Slide on which the Adjustable Work Stop is mounted

PRATT & WHITNEY GAGES

Recent additions to the line of gages manufactured by the Pratt & Whitney Co., Hartford, Conn., include a gage for determining the amount of metal that must be removed from the steel tire of a railway wheel to restore the tire to the standard contour; a double-plug pipe-thread gage; and an adjustable limit-pin gage for internal measurements. The tire gage is known as the A. R. A. railway gage, and in addition to the measurement already mentioned, it indicates the amount of service metal that will remain on the worn tire after it has been trued. This gage is illustrated at the left in Fig. 1. In using it, pointer *A* is swung to the right, the gage slipped over the wheel with face *B* and point *C* in contact, point *A* swung to the left to engage the limit-of-wear groove in the tire, the four sliding points pushed down on the tire tread, and the gage removed from the wheel.

The sliding front plate of the gage is then moved downward until edge *D* coincides with the lowest point of the four sliding pointers. The position of scribed line *E* with respect to the grooves on the front plate will then indicate the amount of metal that must be removed from the tire at point *C* in order to restore the tread to the standard shape. The position of pointer *F* relative to the scale on pointer *A* will indicate the amount of service metal that will remain on the tire after it has been trued. This gage will be found useful in billing foreign roads for wheel replacements.

The double-plug pipe gage referred to is illustrated at the right in Fig. 1, and is intended for measuring the taper of female threads. In using this gage, the inner plug is first screwed into the thread, after which the outer gage is screwed into place, both parts being set tight by hand. If the taper of the thread is correct, the scribed line near the top of the stem of the inner gaging member will coincide with the zero line of the graduations on the handle of the outer member, but if there should be any variation from

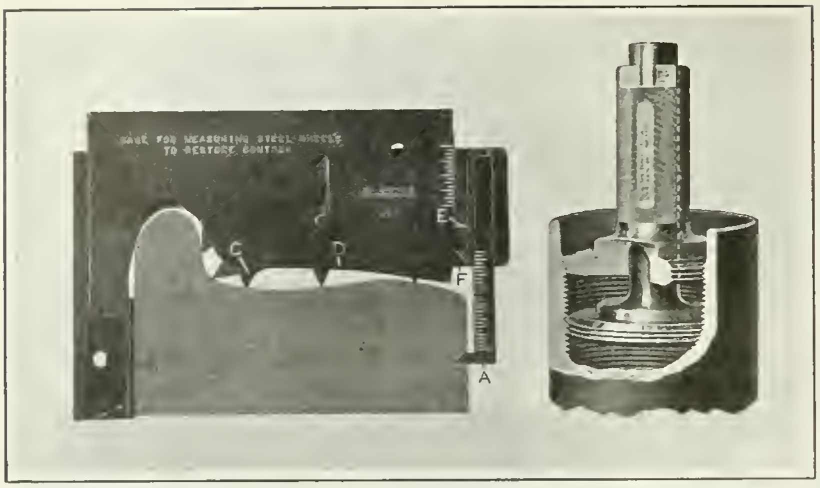


Fig. 1. Pratt & Whitney Tire Contour Gage and Double-plug Pipe-thread Gage

the true taper, this will be indicated by the position of the scribed line relative to the scale. Each division of the scale represents a variation in the pitch diameter of the thread of 0.002 inch per length of 2 inches, this being the length covered by the gage.

The adjustable limit-pin gage, illustrated in Fig. 2, has only one set of pins for taking both "Go" and "Not Go" measurements. This gage has two spherical-end hardened steel pins, which are carried in a cast-iron frame similar in construction to the frame of the Pratt & Whitney truss-form gages. One of these pins is adjustable by means of opposed set-screws which also lock it firmly in position when they are tightened. The opposite pin functions between two stops, one of which is adjustable to give any desired tolerance from 0.001 to 0.025 inch. This pin is instantly withdrawn to the "Go" position and advanced to the adjustable stop or the "Not Go" position, by a simple movement of the thumb and finger.

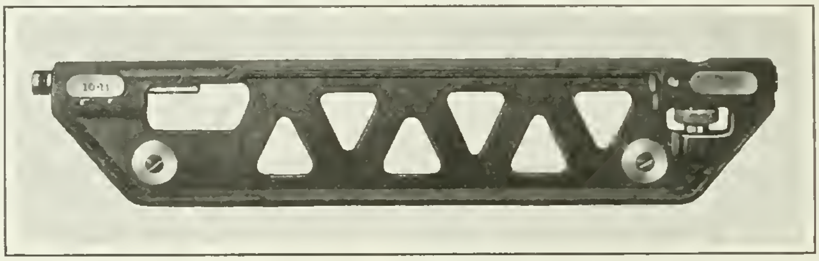


Fig. 2. Adjustable Limit-pin Gage which has Only Two Pins for Both "Go" and "Not Go" Measurements

COLBURN GANG DRILLING MACHINE

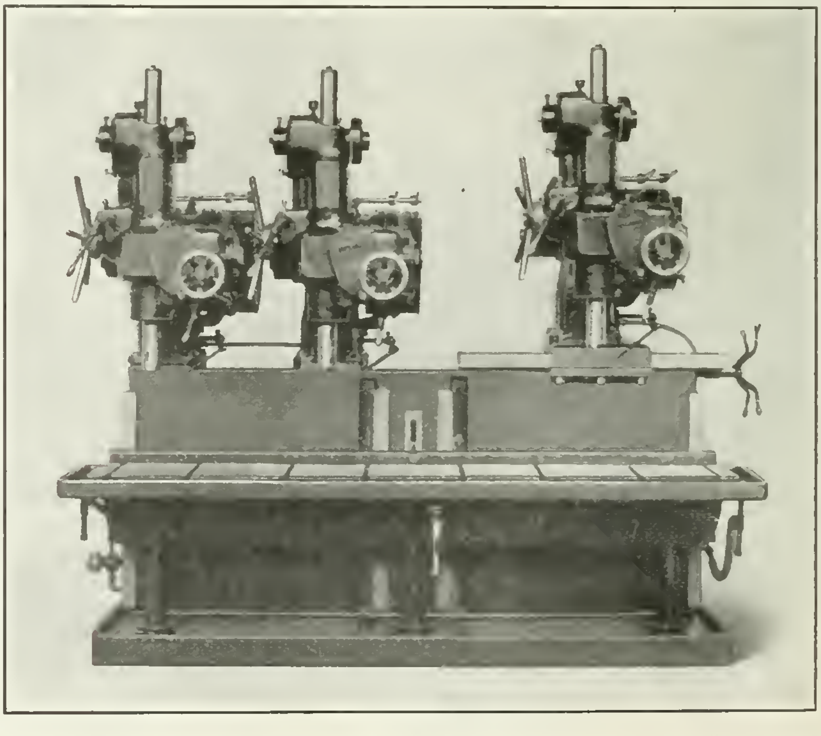
A gang drilling machine which may be equipped with different combinations of permanently located heads and a longitudinally movable head is being introduced to the trade by the Colburn Machine Tool Plant of the Consolidated Machine Tool Corporation of America, 1038 Ivanhoe Road, Cleveland, Ohio. The accompanying illustration shows this machine furnished with two permanently located heads at the left, which have a fixed center-to-center distance between spindles, and a third sliding head at the right. The movable head is mounted on the finished ways of a plate which extends to the extreme right-hand end of the column. Both the column and table are designed for four-spindle machines.

The sliding head has an adjustment of 27 inches on the ways by means of a screw and capstan handwheel, and may be securely clamped in any desired position along the ways. The minimum center distance between the second spindle and the adjustable spindle is 27 inches, and the maximum distance is 54 inches, while the minimum center distance between the extreme left-hand spindle and the adjustable spindle is 54 inches and the maximum distance 81 inches, giving a total range between spindle centers of 27 to 81 inches.

This gang drilling machine may also be arranged with but one permanently located head and one movable head. In such an installation, instead of the ways extending approximately one-half the length of the column, they could extend sufficiently to permit a minimum center distance of 27 inches between the spindles of the two heads; in other words, the ways could extend somewhat more than three-quarters the length of the column. The adjustment of the second head would then be from the position it occupies in the illustration to the extreme right-hand end of the machine.

Another modification is the machine equipped with a fourth head clamped to the ways at the extreme right-hand end, the movable head being then located at its extreme left-hand position. The fourth head is similar in design to the others. This arrangement gives a four-spindle machine with a center distance of 27 inches between all spindles The fourth head may be quickly removed in order to make use of the adjustable feature of the sliding head.

The driving and feeding gears are mounted inside each head and run in oil, the gears being made from chrome-nickel steel, hardened, and heat-treated. The shafts are mounted on ball bearings and the spindles are double-splined to equalize the strain. Each spindle has a drilling capacity of two inches through solid steel. The distance from the center of the spindles to the face of the column is 12½ inches.



Colburn Drilling Machine equipped with One Movable and Two Permanently Located Heads

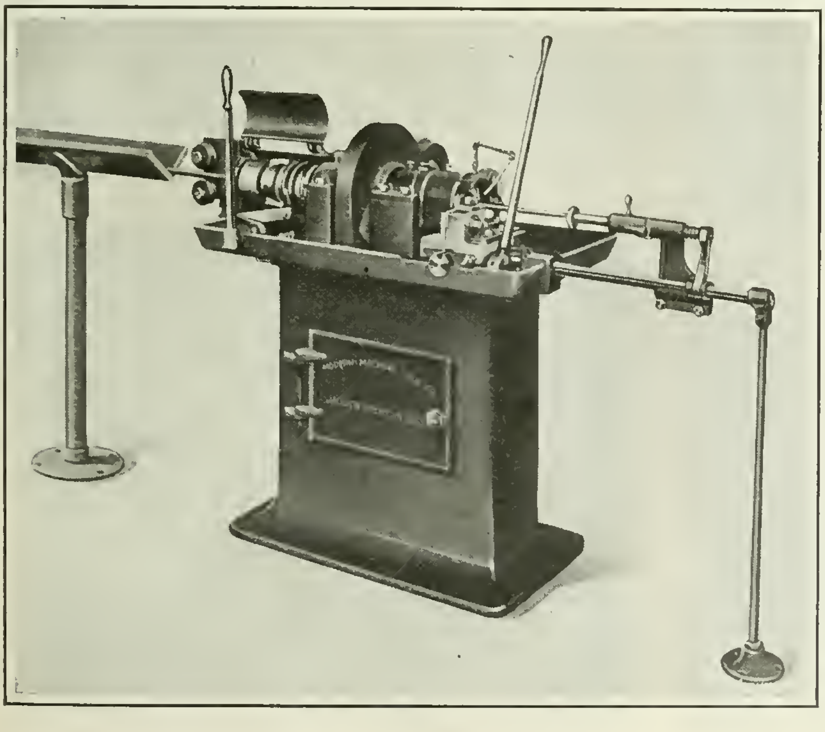
IMPROVED CUTTING-OFF MACHINES

Three or four movements of the operator and one step on each piece of work have been eliminated by several improvements incorporated in the line of machines built by the Modern Machine Tool Co., 601 Water St., Jackson, Mich., for cutting off piping, tubing, and solid bar stock. It will be evident that with a production ranging from 150 to 600 pieces per hour, this elimination of movements effects a considerable saving. The No. 1 machine is still equipped with the roll feed that has been supplied in the past, but Nos. 2 and 3 machines have a live double roller feed.

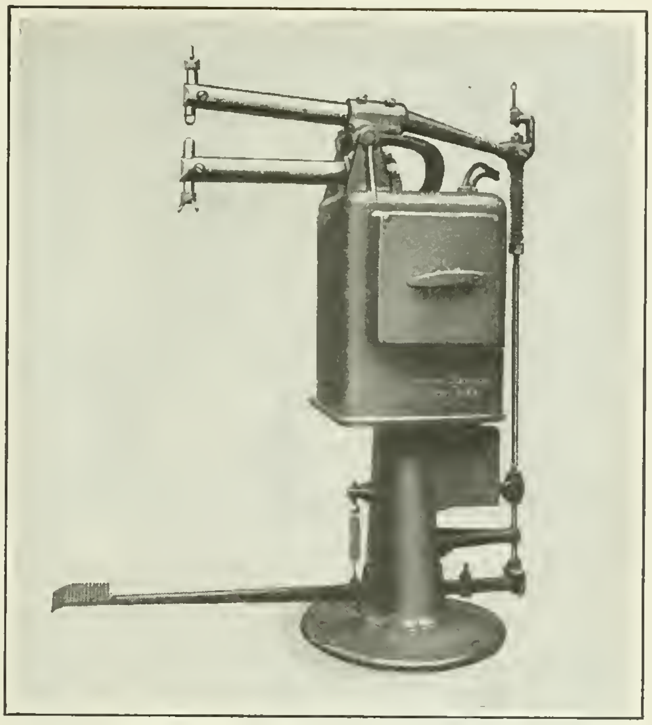
A stop, which is operated from the tool-block to automatically gage the length of the cut-off pieces, is furnished on all machines. This stop functions through a plate which is attached to the right-hand side of the tool-block, and is adjustable to take care of different sized stock. The plate is arranged with a lug that catches and rocks a block between the tool-block and the frame. During the last 1/8-inch movement of the tool-block, when the latter is withdrawn to remove the tool from the work the lug, through a lever and cam, rotates the stop to locate the stock as it is again fed. When the tool-block is advanced to start a cut, the stop is brought back clear of the work by means of a spring.

The roller feed is driven from the cone-pulley shaft through gearing. The rollers run continuously and are trunnioned and connected with the collet control-lever shaft so that an inward movement of this lever brings the rollers to the stock simultaneously with the opening of the collet. A slight further pressure is applied on this lever to feed the stock through the spindle and against the stop. The backward movement of the lever closes the collet and brings the rollers clear of the stock. This lever has been placed in a vertical position, and is said to operate more easily than on the old machines.

In the operation of the improved machine, the operator pulls the collet control-lever with his left hand to open the collet and feed the stock through the spindle to the stop; he then pushes this lever in the opposite direction to close the collet, at the same time placing his right hand on the tool-feed lever; and as soon as the collet is closed, he operates this lever to feed the tool to the work. By a reverse motion of the lever, the tool is withdrawn from the work and the automatic stop brought into place for the next piece. At no time is it necessary for the operator to remove his hands from the levers.



Cutting-off Machine built by the Modern Machine Tool Co.



U. S. Welding Machine for Light and Medium Weight Stock

U. S. WELDING MACHINE

An electric welding machine equipped with a transformer that was described in September MACHINERY at the time it was being introduced to the trade by the U. S. Electric Welder Co., 327-328 Permanent Bldg., Cleveland, Ohio, has now been placed on the market by the same company. This equipment is intended for welding light and medium stock, which it is said to handle as readily when it is oxidized and rough as when it is smooth. The internal automatic reactance of the transformer prevents breakdowns from overload and enables the welding of stock without overheating.

The machine is furnished with an enclosed automatic switch which is equipped with a magnetic blow-out and removable contacts. A pivot switch provides different voltages at the welding points, and these members are water-cooled by means of a simple system. All mechanical parts are made of a special alloy or cast steel to give lightness without loss of strength. Extra pressure may be applied on the welding points when necessary. About four seconds is required per weld for stock 3/16 inch thick, and in welding together two sheets of bright steel, 1/16 inch thick, the production is about 4000 welds per hour. This welding machine is made in two sizes and with horns of different diameters and lengths. It can be arranged for motor drive.

WESTINGHOUSE SAFETY MOTOR STARTER

Complete protection to an alternating-current motor and the operator, is assured by a safety switch of simple design incorporated in a motor starter now being placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. This starter is manufactured for motors of various capacities up to 15 horsepower. The operator of the switch is unable to touch live parts at any time because the door of the starter is so interlocked with the switch mechanism that it can be opened only when the switch is in the "off" position, at which time all accessible parts are dead and may be inspected or renewed.

The motor is protected from overloads both in starting and running, by means of thermal cut-outs or relays. These cut-outs or relays allow reasonably high starting currents or momentary overloads which do no damage to the motor. However, when the motor is subjected to a continuous overload sufficient to overheat or damage it, the cut-outs or relays quickly open the circuit. The capacity of the starter may be readily changed by substituting proper relays. An under-voltage release coil protects the motor from failure of voltage. The entire mechanism is mounted on a slate base and can be removed without disturbing the starting box or conduits.

HOEFER HIGH-SPEED DRILLING MACHINE

In a special ball-bearing high-speed sensitive drilling machine manufactured by the Hoefer Mfg. Co., Inc., Freeport, Ill., the spindle is automatically fed by means of a cam arrangement. The drive for the downward feed is transmitted to the cam by engaging a worm with a worm-wheel located near the top of the machine between the spindle and the column. The worm is engaged by turning the lever on the side of the column, and it is driven from the main spindle through a silent chain. The cam is made special for each job, so that the drill may be given the proper feed. At the end of the downward movement, the head is returned to its original position by springs located on the head. The head and spindle are counterbalanced.

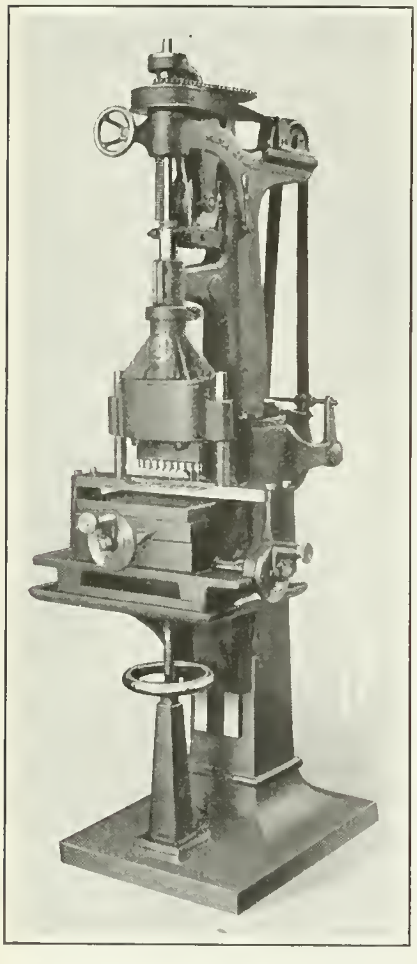


Fig. 1. Hoefer High-speed Drilling Machine with Automatic Feed

This machine is shown in Fig. 2, arranged for drilling 540 holes in a die-plate for an accounting machine. The plate is made from tool steel and is one of a series varying in thickness from ⅛ to ¾ inch. The holes must be drilled accurately, there being a tolerance of only 0.002 inch on the center-to-center distance of the two extreme holes of a row, and of 0.0005 inch between the adjacent holes. There are twelve longitudinal rows of holes and forty-five transverse rows. The holes in the longitudinal rows have a center-to-center distance of 5/32 inch, while those in the transverse rows have a center-to-center distance of ¼ inch. The holes are too closely spaced to permit drilling all those in a row at one time, and so a drill head has been provided which has nine spindles located to drill simultaneously every fifth hole in a longitudinal row. By successively shifting the plate longitudinally a distance equal to the center-to-center distance between two adjacent holes in the row, each longitudinal row may be drilled by five downward movements of the drill head.

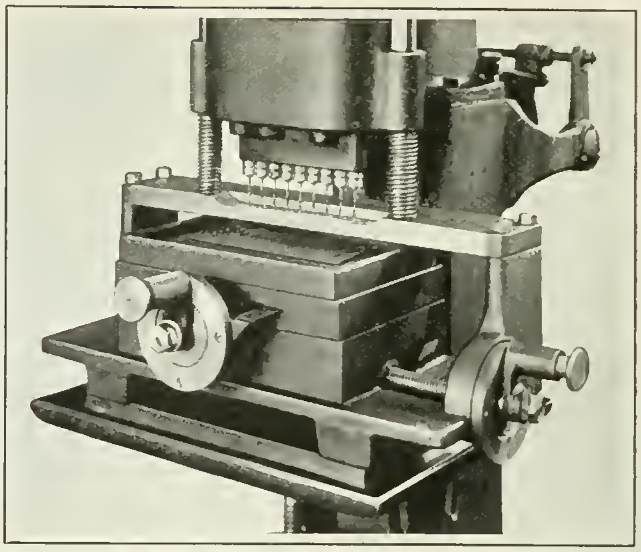
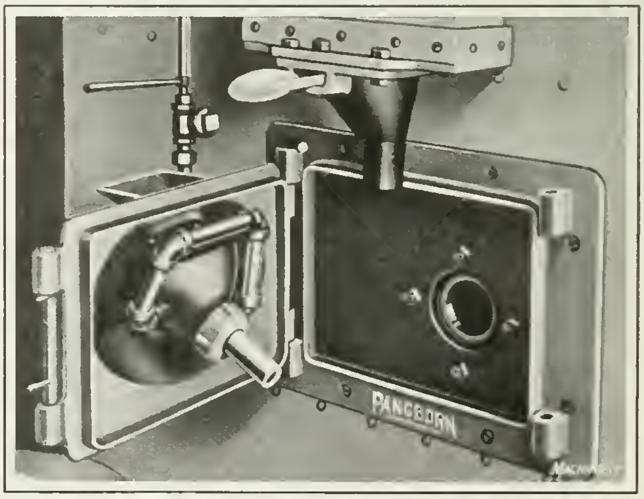


Fig. 2. Set-up for drilling 540 Closely Spaced Holes in a Tool-steel Plate

The work is located on the upper table by means of dowel-pins, so that should it be necessary to remove the plate during an operation, it could easily be replaced in its original position. This upper table is mounted on a compound table which may be accurately moved longitudinally or transversely to shift the plate beneath the drills, the thread on each adjusting screw being so cut that by turning the screw one revolution or a number of revolutions, the tables will be moved exactly the required amount. Across the top of the tables is carried a heavy steel plate in which are located slip bushings for guiding the drills during the downward movement of the head, and thus maintaining the required accuracy. Two vertical hardened and ground guide rods on this steel plate enter bearings in the head housing and keep the head and jig plate in alignment at all times. With this equipment, the plates are finished in twenty-two minutes, floor-to-floor time, whereas with the method employed before this machine was developed, from three to four hours were required for a plate.

PANGBORN BARREL SAND BLAST

The cleaning capacity of sand-blasting equipment is governed in some respects by the distance of the nozzle from the work and the angle at which the nozzle is directed toward the work. When the class and size of work varies, it would seem that the position of the nozzle should be

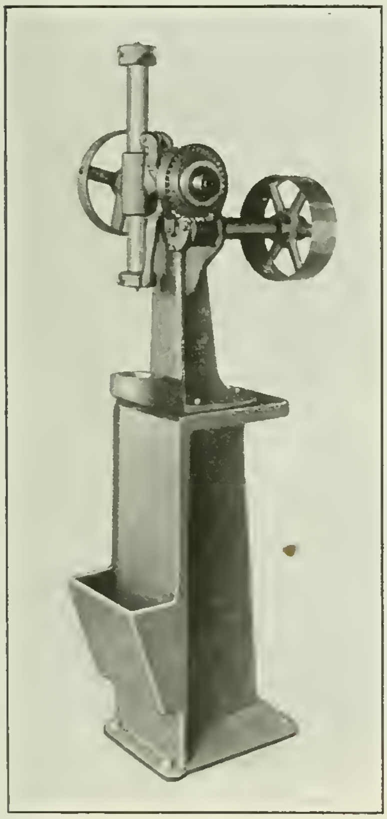


Adjustable Nozzle provided on Pangborn Barrel Sand Blast adjustable, and it is for this reason that the barrel sand blast manufactured by the Pangborn Corporation, Hagerstown, Md., which was illustrated on page 462 of January, 1921, MACHINERY, is now being equipped with a nozzle that is adjustable both horizontally and vertically to enable it to be placed in the most effective position. This nozzle is shown in the accompanying illustration.

Another improvement made in this sand blast is the provision of a mechanism which assures a constant and satisfactory separation of the abrasive so that it may be used again. The barrel drum is reinforced by plates at the door opening and by angle-irons on both the inside and outside. Steel tires are pinned to the head castings and are driven by manganese steel rollers. The driving sprockets are made of steel, and, with the chain, run in oil.

AMERICAN BENCH BROACH PRESS

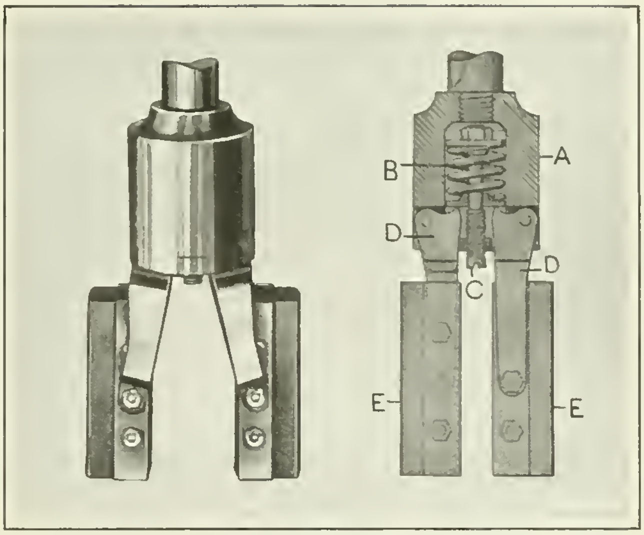
A power broach press of the bench type which has been improved in several respects over a previous design described in November, 1921, MACHINERY, has been brought out by the American Broach & Machine Co., Ann Arbor, Mich. In addition to other improvements, the machine may now be furnished mounted on a pedestal, as shown in the accompanying illustration. The new machine is provided with an automatic stop, and the movement of the ram is controlled by a positive jaw clutch made of steel and hardened. Power is transmitted to the ram through a steel worm and a bronze worm-wheel, and the return movement is accomplished by means of a counterweight. This machine can also be operated by hand through a handwheel, the latter being provided with hollow spokes to receive a leverage bar. The pedestal has an oil receptacle, as illustrated, and can be equipped with an oil pump.


American Improved Bench Broach Press mounted on Pedestal

Some of the principal specifications of this machine are as follows: Maximum stroke, 14 inches; maximum pressure developed, approximately 2 tons; maximum diameter of work that can be handled, 6 inches; diameter of hole through table, 2½ inches; and weight, approximately 315 pounds.

STORM CYLINDER-FINISHING TOOL

A tool for polishing or burnishing automobile cylinders after reaming, reboring, or regrinding has been brought out by the Storm Mfg. Co., 406 Sixth Ave., S., Minneapolis, Minn. This tool may be used in an ordinary drilling machine or in conjunction with a special driving mechanism furnished by the manufacturer. From the illustration it will be seen that the tool consists of a body *A* to which are attached two stones *E* by means of links *D*. Held between two disks in the body of the tool is a compression spring *B*, which exerts pressure on a point at the top of each link *D*, thus tending to swivel these links and expand the stones against the walls of the cylinder. The desired diameter across the stones is obtained by varying the pressure on the spring through adjusting screw *C*. There is no undue spread of the stones when the tool is not in use.

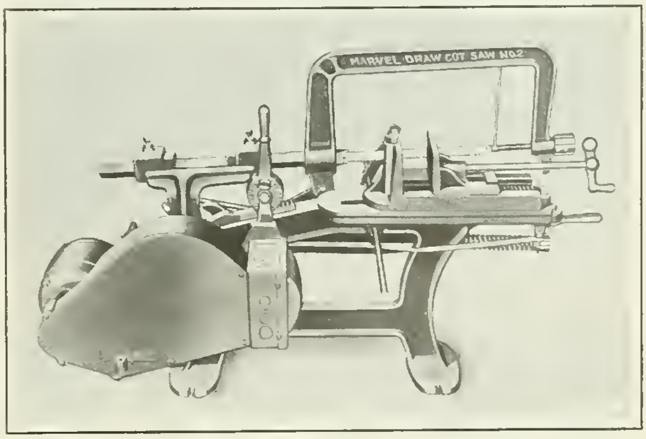


Storm Polishing or Burnishing Tool for Automobile Cylinders

The spring pressure is normally about 110 pounds, and when the tool is centered properly in a cylinder this pressure is evenly distributed between the two stones. However, should the tool be slightly off center relative to the cylinder, the entire pressure of 110 pounds will be immediately transferred to one link, and the other link will hang free. Then, when the tool is rotated, the cylinder block will be shifted by the tool until the cylinder is central with it and the pressure is equal on both links. This feature obviates the necessity of clamping the cylinder block to a base for the operation.

ARMSTRONG-BLUM MOTOR-DRIVEN HACKSAW

To provide a self-contained, portable equipment, the No. 2 Marvel draw-cut hacksaw manufactured by the Armstrong-Blum Mfg. Co., 343 N. Francisco Ave., Chicago, Ill., is now made with a direct-attached motor. The motor is mounted on the rear of the machine where dirt and saw chips do not get into the operating parts. It is connected to the driving crankshaft of the machine by means of a silent chain, sprockets, and intermediate gears. These driving parts are entirely enclosed and run in oil. The motor is furnished for operation on a 110-volt lighting circuit of either alternating



Armstrong-Blum Motor-driven No. 2 "Marvel" Hacksaw or direct current. The switch is wired to a plug receptacle on top of the switch box, and so the machine can be connected in a moment with any lamp socket by means of an extension cord. This arrangement provides a portable machine that can be taken about the shop on a small platform truck and quickly connected for use.

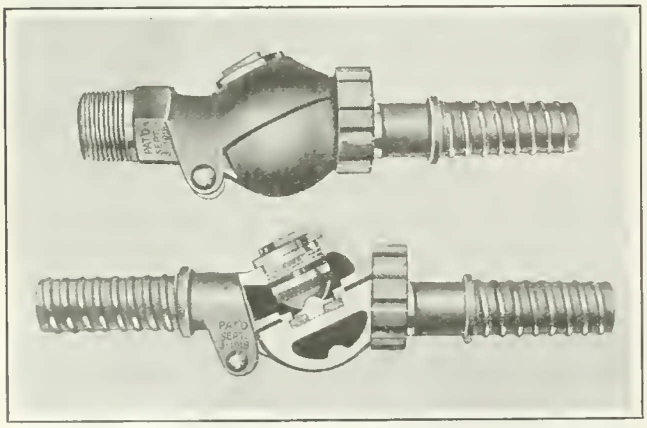
When a cut is completed, the saw frame trips the starting handle and automatically opens the switch to stop the motor. Thus the motor never runs with the machine idle, and power is saved. Millwright departments, garages, and small machine shops that are crowded for space often find it more convenient to take the machine to the job than to move the job to the machine. It is for such purposes that this portable equipment has been brought out. The hacksaw has a capacity of 6 by 6 inches on the long stroke and 8 by 8 inches on the short stroke. It receives blades of any length from 12 to 17 inches, and has an approximate weight of 350 pounds.

ROBINSON AIR-HOSE COUPLING

The elimination of a globe valve in compressed air lines is a marked advantage of a combination valve and coupling now being manufactured by the Robinson Machine Co., 39 Eighth St., Muskegon, Mich. The illustration shows a part sectional view of the coupling for a hose and a view of the coupling for a pipe line. When an air line is equipped with this coupling, tools can be changed at the place where they are being used, without requiring the workman to walk to and from a valve at a comparatively distant point in order to shut off and turn on the air. A check valve in one of the two halves of the coupling functions automatically in this respect.

The check valve half of the coupling is so constructed that the air pressure comes on top of a brass stem which has a leather disk facing that may be easily renewed. The valve stem is centered by a reamed hole in the valve cap. Two projections with a cross-bar extend beyond the valve seat, and protect the seat when this half of the coupling is dragged along the floor at the end of a hose. The cross-bar also forms a pivot for hooking the hose shank half of the coupling in connecting the two members.

The hose shank half has two small projections beyond the valve face which push the valve open when the connection is being made and admit air pressure to that section of the line. This part of the coupling is recessed to receive a special gasket, which is cemented permanently in place. This gasket is said to have stood up under severe tests and actual operation from six months to one year without causing any trouble or requiring replacement. The coupling halves are quickly locked together through the medium of an eccentric clamping ring. The hose shank half of the coupling is furnished with a positive-grip clamp for attaching it to air lines.

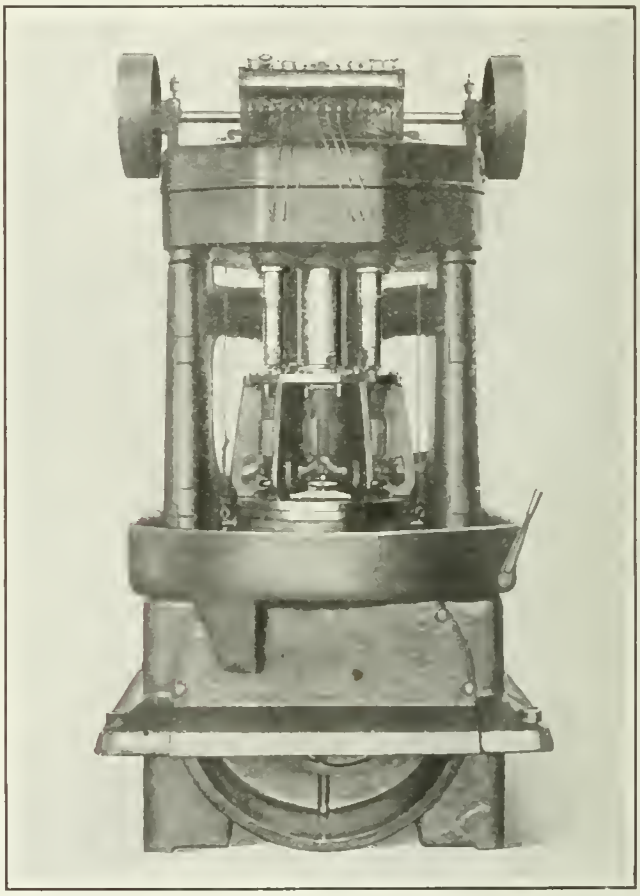


Robinson Patented Automatic Air-hose Coupling

SEMI-AUTOMATIC CYLINDER BORING MACHINE

A semi-automatic vertical machine for boring air-cooled gas-engine cylinders and finishing the head of the cylinders at the end of the bore, but which may also be employed for machining cylinders cast en bloc, has been developed by the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. Three separate cuts are taken in boring and two in finishing the head of the cylinder. The machine has five spindles which provide for taking all five cuts at the same time in separate cylinders. These spindles rotate but have no axial movement.

The cylinders are mounted in a rotary fixture having six positions, five working and one loading. The loading and unloading is done while the machine is in operation so that the only lost time is that required for indexing the fixture. This member is fed upward to the cutting tools by a cam which gives the fixture a quick approach to the cutting tools, a uniform boring feed, a slower feed for finishing the head of the cylinder, a dwell for the final finish of the cylinder head, and a quick return to the starting position. The cycle time of the machine for boring and finishing the head of a cylinder 3¼ inches in diameter and 9 5/32 inches long, is 1½ minutes.



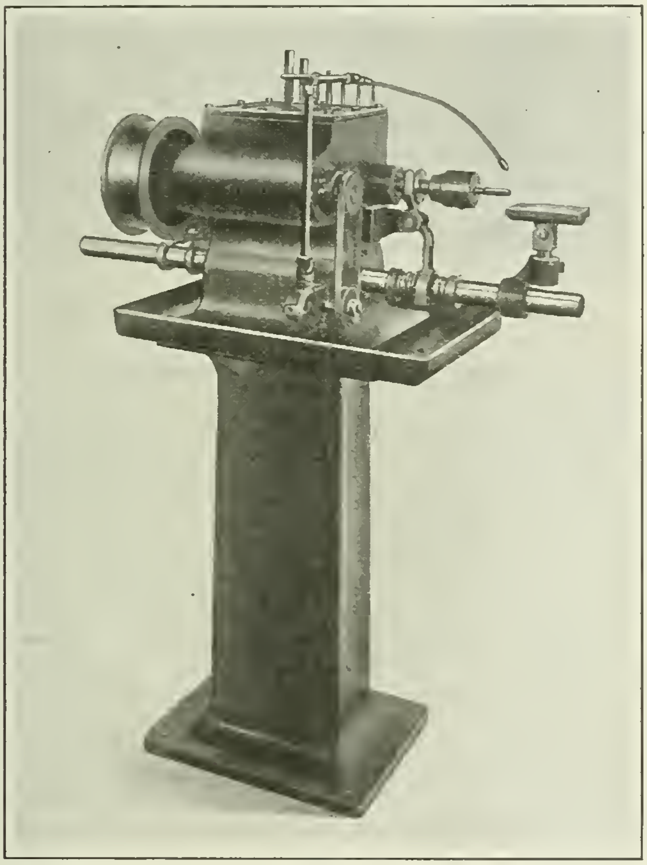
Semi-automatic Machine for boring Cylinders and finishing their Heads at the End of the Bore

Among the features of the machine which make it possible to obtain this production rate are its general rigidity and the accurate relation held between the cutters and the rotary fixture. This relation is maintained through the use of a large-diameter pilot which is integral with the head of the machine, and by means of pilots in the ram. The latter is actuated by the cam and carries the rotary fixture. This design gives a uniform rigidity to the machine throughout its stroke.

Coolant is supplied to the cylinders to keep them at approximately a constant temperature throughout the cut so that no heat distortions occur. The coolant is pumped through the spindles and discharged adjacent to the cutting tools on the surface to be machined. It is said that by passing the coolant through the spindles, they and their bearings are kept at a constant temperature so that the proper clearance between these members is maintained. The coolant also washes away all chips from the work. The duty of the operator consists simply of loading and unloading the work while the machine is in operation, indexing the work-holding fixture when the machine is stopped automatically at the end of the quick-return movement of this fixture, and throwing in the clutch after the fixture has been indexed.

BURKE AUTOMATIC TAPPING MACHINE

A tapping machine equipped with a power feed and an automatic reverse so that it is not necessary to depend on the pressure on the tap to make the machine drive and reverse itself, is now being introduced to the trade by the Burke Machine Tool Co., 516 Sandusky St., Conneaut, Ohio. As the tap runs entirely free, there is no tendency for it to cut over-size or to stretch the metal. In placing work on this machine, the operator pushes it against the tap until the tap starts to enter the hole, at which time the power feed begins to drive the tap and continues to do so until the thread is completed. The spindle is then automatically reversed and the tap backed out at twice the forward speed. This arrangement relieves the operator from continually pushing the work against the tap while the latter is entering, and from pulling on the work when the tap is reversing. Thus his hands are left free to select another piece of work. These features are said to permit of higher production rates than are possible with hand-fed machines.



Burke No. 10 Tapping Machine having a Capacity for tapping Holes from ⅛ to ⅝ Inch in Diameter in Steel

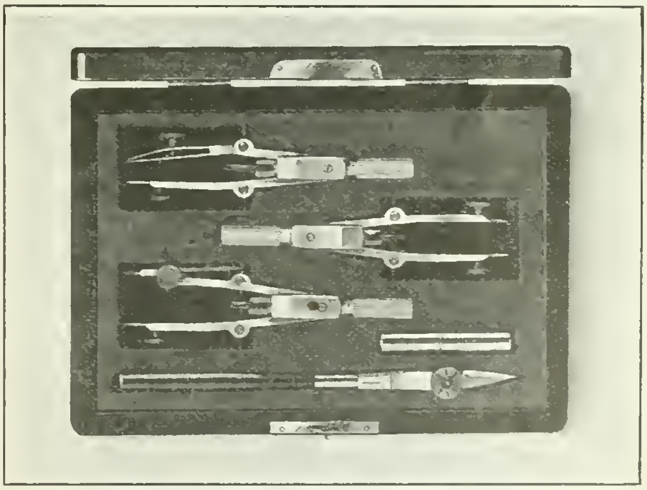
The machine is driven through a friction clutch governed by the automatic feed, which, in turn, is controlled by a second friction clutch. This design permits of setting the machine very sensitively, allows it to slip before breaking of the smaller sizes of taps occurs, and enables adjustment to insure the pulling of the larger coarse-thread taps. The machine is driven through a friction clutch not only on the forward motion, but also on the reverse motion, which does away with the breaking of taps if they should bind in backing out of the hole. The friction clutches are of the cone design, the face of the friction ring being tapered on both sides to fit into the driving and reversing cones, and the ring is keyed to the spindle.

All working parts of the machine run in oil, and the thrust of the spindle is taken on ball bearings in both the forward and reverse motions. The spindle is regularly equipped with a Skinner positive-drive chuck. The table is universal and is provided with a T-slot for attaching jigs, etc., so as to permit holes to be tapped at any angle. A face-plate is furnished to fit on the draw-bar for use in place of the table. The face of this plate opposite the front of the machine is accurately planed to suit jigs or other holding fixtures. With such a set-up the tap enters the work after passing through drilled holes in the plate, this set-up being convenient when the part to be tapped is larger than can easily be handled on the table. The plate can be set at various points along the draw-bar to accommodate different sizes of work. This machine has a capacity for tapping holes from ⅛ to ⅝ inch in diameter in steel.

LAWRENZ DRAFTING INSTRUMENTS

A set of bow pen and pencil compasses and dividers made from an aluminum alloy, and a ruling pen having a dial nut that facilitates resetting the pen blades to draw a line of given thickness after the setting has been changed for cleaning the blades, are now being made by E. Lawrenz, 2533 McClellan Ave., Detroit, Mich., and are sold under the trade name of "Normal." The bow instruments have a sturdy construction which does not give in using them. By virtue of this construction, it is easy to draw a true unwavering circle with the pencil compass, even though the circle is being produced with heavy dot-and-dash lines.

The handle of the bow instruments is not screwed into another member, but is integral with the part to which the legs are fastened. Thus the handle cannot work loose and become lost. An extension on the handle part reaches down between the legs to guide them and make the instrument rigid. This extension has a jaw in which the knurled head of the leg-adjusting screw is retained to prevent sidewise movement. A small coil spring placed between the two legs near their upper ends takes up any play between moving parts. The gripping end of the handle is made large to permit a secure hold. These instruments are made of an aluminum alloy having a tensile strength of about 50,000 pounds per square inch. By using this alloy it is possible for the instruments to be generously proportioned and yet



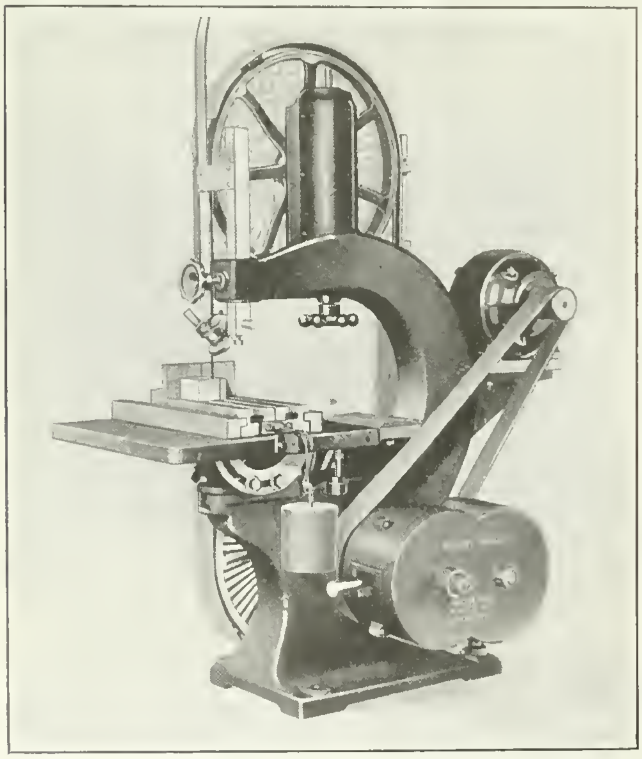
"Normal" Aluminum-alloy Bow Instruments and Steel Ruling Pen be light in weight. Another advantage of using this alloy is that the instruments do not become tarnished.

The blades of the ruling pen are made of steel and are hardened and ground separately. The ruling pen may be quickly opened for cleaning by pressing the tips of the blades together and then turning the adjusting nut and screw through 90 degrees to allow the head of the screw to slip through a slot in the rear blade. The reverse procedure is followed to close the blades.

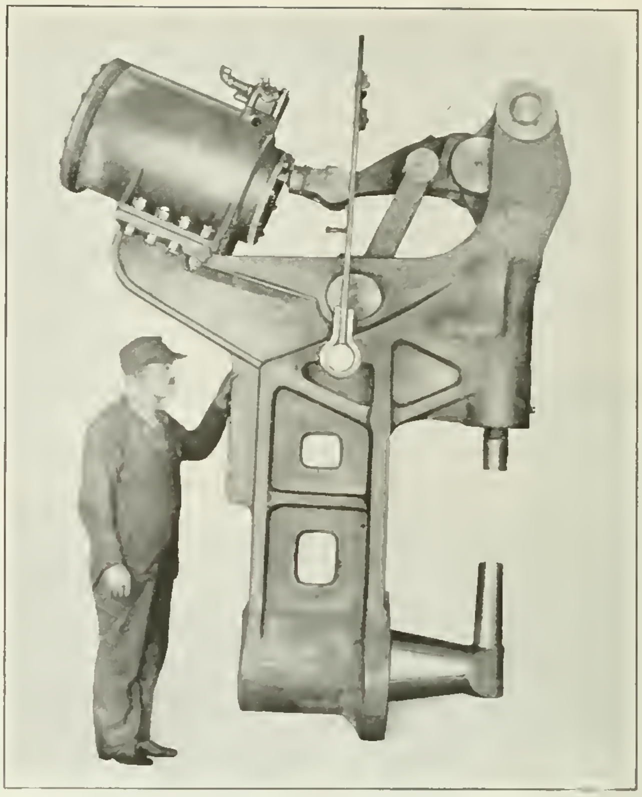
RACINE METAL-CUTTING BAND SAW

Both metal and wood may be cut on a portable band saw of the bench type which is now being built by the Racine Tool & Machine Co., 250 15th St., Racine, Wis. It may be used for sawing steel, iron, aluminum, brass, fiber, hard rubber, etc. A two-speed attachment provides the proper speeds necessary for cutting the different materials, the change in speed being accomplished by shifting a lever. The machine is driven by a 1/4-horsepower motor running at 1750 revolutions per minute, which may be connected to any electric lamp socket. The saw guide can be applied to bands for cutting metal or bands for cutting wood, and has a range of adjustment to accommodate all widths and gages of bands. The guide is quickly adjustable to any height within its range, and the table may be tilted at any angle up to 45 degrees.

The wheels are made of aluminum in order that the weight of the equipment may be reduced, and they are mounted on ball bearings. The alignment of the saw blade is accomplished by means of a hand screw, which is used to tilt the upper wheel, and the tension on the blade is controlled by a hand screw, which operates against a spring. This spring also serves as a safety device, allowing chips or blocks that may fall accidentally between the band and the wheel to pass around the wheel without breaking the band. A few specifications of this saw are as follows: Capacity under guide, with and without vise for holding metal parts, 3 and 5 inches, respectively; distance from band to throat, 14 inches; length of bands, from 7 feet 6 inches to 8 feet; and over-all height of machine, 39 inches. This equipment weighs approximately 200 pounds.



Racine Portable Band Saw designed for cutting Metal and Wood



Hanna Riveter for driving up the Last Head of Boilers through the Manhole

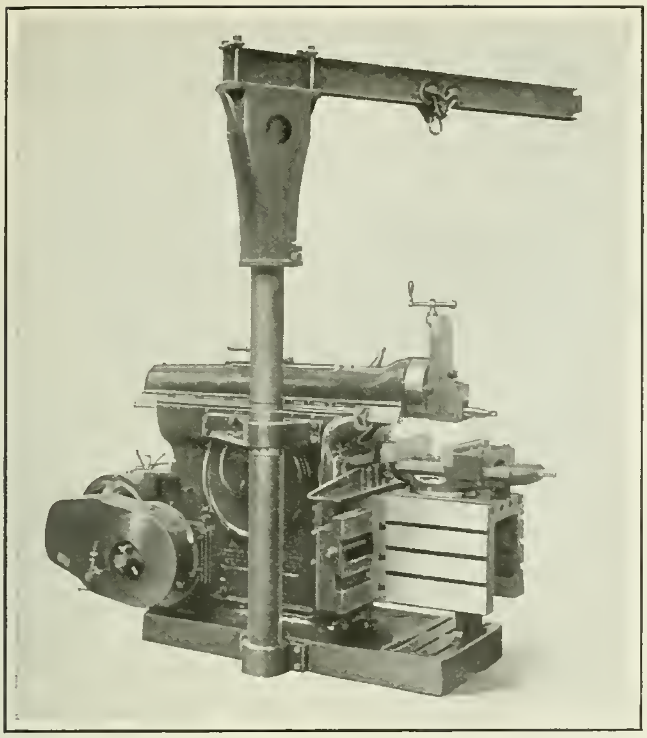
HANNA BOILER RIVETER

For use in driving up the last head of high-pressure containers through the manhole, the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill., have designed the large riveting machine here illustrated. The rivets of the container for which the machine was primarily designed are 1 1/4 inches in diameter, and the plates are 1 1/2 inches thick. The equipment is arranged for portable use in two positions and is intended for suspension with the dies vertical. The machine swivels about a point close to the center of gravity to allow swinging the stationary head on and off the forged head of the rivet in a direction approximately in the line of die travel. As a result of this construction, the mass or weight of the riveter is not lifted or lowered in riveting. The stake is an alloy-steel forging. This riveter may be arranged with either a straight-push hydraulic mechanism, or with the patented Hanna pneumatic mechanism.

The important specifications are as follows: Maximum and minimum diameters of shells which can be handled, 60 and 42 inches; reach of unit, 14 to 18 inches; distance from center of dies to the long face of the throat, 16 inches; length of gap, 35 inches; stroke of die, 5 3/4 inches; capacity, 100 tons; and weight, 9900 pounds.

BARRETT-CRAVENS TRUCK PLATFORM

A lift-truck platform known as the "Steeleg" which consists of two steel legs and a wooden-plank top is being manufactured by the Barrett-Cravens Co., 1328-34 W. Monroe St., Chicago, Ill. The legs are formed from heavy gage steel and run the full length of the platform. Each is flanged at the bottom to form a foot and at the top to protect the ends of the wooden planks. The boards are 1 1/4 inches or 2 inches thick, depending upon the character of the parts to be handled, and are attached to the legs by means of flat-head bolts so that no projections will interfere with placing parts on the platform. Plants now equipped with wooden platforms can be supplied with the steel legs only, for substitution in place of the present skids.



Gould & Eberhardt Shaper equipped with Jib Crane for handling Heavy Work

GOULD & EBERHARDT SHAPER JIB CRANE

For use in railroad shops, steel mills, and other industrial plants in which heavy work is handled, Gould & Eberhardt, Newark, N. J., have brought out a jib crane intended to be attached to the shapers built by this firm. This crane eliminates the necessity of using overhead cranes in placing work on the machine. The crane is attached to the shaper on the side opposite the operating side and can be revolved around a complete circle. It has an I-beam boom strong enough to carry a load of 1000 pounds at the extreme end. The mast is a piece of steel pipe, and is clamped against the frame at two points to distribute the load more equally on the machine.

The upper pintle is a steel casting, and is rigidly held in a cap attached to the mast. It has a ball and socket bearing, which insures proper alignment of the beam at all times and makes it possible to revolve the crane by the application of only a slight force. The shaper illustrated is equipped with a single-pulley drive and a selective-type gear-box, all the gears of which are made of steel, and are heat-treated and run in oil. By means of a patented double-train gear drive, which is combined with the selective-type gear drive, eight changes of speed are obtainable for every stroke, and the range of strokes is from 9 to 115 per minute. This feature makes the shaper adaptable to manufacturing purposes in plants where a considerable variety of work is done. All control levers are located for convenient manipulation from the operating position.

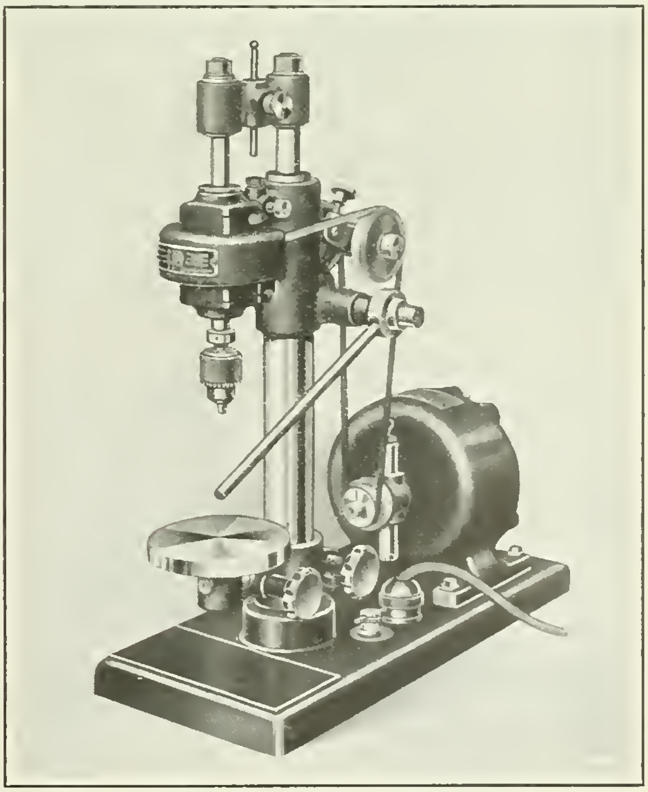
NEW BRITAIN SEXTUPLE AUTOMATIC BAR MACHINE

In February, 1918, MACHINERY, on page 562, a 1-inch sextuple automatic bar machine built by the New Britain Machine Co., New Britain, Conn., was described. This company has now brought out a 1⅝-inch machine following the same general design as the machine previously built. Six pieces are operated upon at once, being cut off from bar stock passing through the spindles. The machine is especially adapted for cutting off pins and rolls, and for making sleeves and pipe couplings from the solid, as well as for making nut blanks, the machine having a capacity up to ⅞-inch standard nuts. The larger machine, while it follows the general design of the smaller machine previously described, embodies several improvements, including an outboard bearing for the main driving pulley, so that a ring-oiling bearing can be provided at each end of the pulley. Two pumps provide cutting lubricant; one feeds oil under high pressure through the drills, and another provides cooling lubricant to the forming tools.

MUEHLMATT BENCH DRILLING MACHINE

A sensitive drilling machine of the bench type, which is said to have the "feel" necessary for drilling holes accurately down to 0.010 inch in diameter, and which is equipped with a chuck for holding drills up to ¼ inch, is a recent development of Adolph Muehlmatt, Lion Bldg., 5th and Elm Sts., Cincinnati, Ohio. This machine is entirely self-contained, and may be supplied from any convenient lamp socket with electric current for the motor. Although of sufficient precision for the laboratory and tool-room, it is sturdy enough for general production work. The table bracket is made in two parts, so that the table may be inclined for operations requiring an angular setting. The table may also be removed from the bracket to permit the substitution of special work-holding devices.

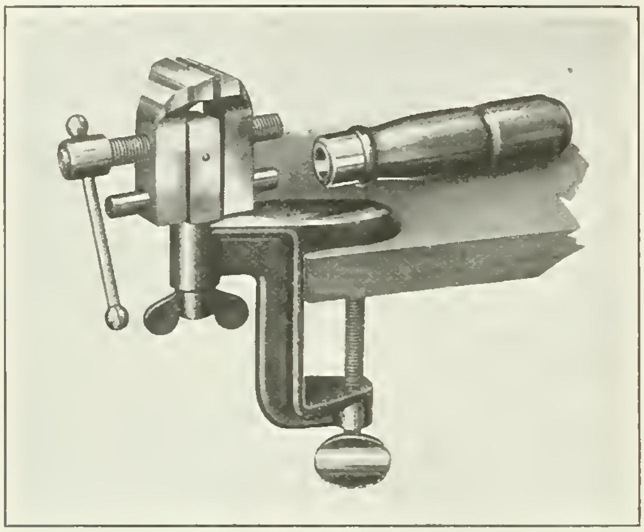
The spindle is fed by means of a ratchet mechanism, and the feed is controlled by convenient adjustable stops. The feeding lever may be set radially to any desired position. The spindle is equipped with a No. 1-A Jacobs chuck. The chuck spindle and the entire feeding mechanism is held in a floating condition by means of a helical spring inside the column. Ball bearings receive the thrust of the spindle, and all frictional parts of the machine are made of tool steel and hardened and ground. Normally the machine is built to give four spindle speeds of from 1200 to 2500 revolutions per minute, but speeds up to 8000 revolutions per minute can be obtained by substituting a larger motor pulley. An idler pulley at the back of the head offers a means of adjusting the belt tension. Special tables of any shape or size may be substituted for the four-inch round table with which the machine is equipped in the



Muehlmatt Sensitive Bench Drilling Machine illustration. Some of the principal specifications of this bench drilling machine are as follows: Dimensions of base, 16 by 7 inches; over-all height of machine, 18 inches; rating of motor, ⅛ horsepower; and weight of machine, about 50 pounds.

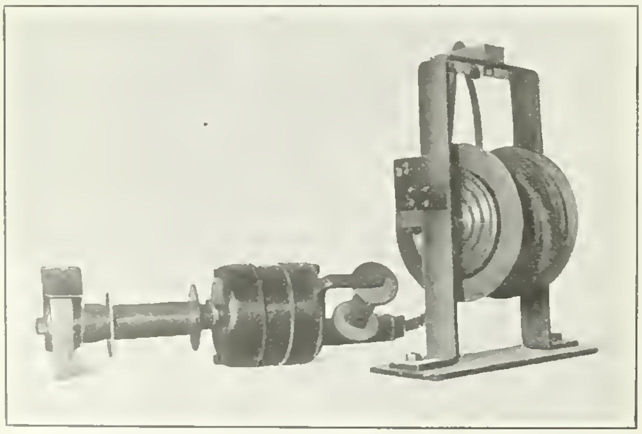
STARRETT COMBINATION HAND AND BENCH VISE

A hand vise which is furnished with a clamp to permit it to be used also as a small bench vise has been brought out by the L. S. Starrett Co., Athol, Mass. This vise, which is designated as the No. 86, is shown in the accompanying illustration. The ball-end handle employed for tightening the jaws offers a considerable leverage. The clamp for converting the device for bench use may be fastened on shelves having a thickness of from ½ to about 2⅛ inches. This clamp is simply substituted for the handle seen lying on the bench in the illustration, and when the vise is mounted on the clamp, the jaws may be adjusted to any position about a complete circle. The jaws are tempered and polished drop-forgings, 1½ inches in width, and they have a capacity for work up to about 1½ inches wide.


Starrett Combination Hand and Bench Vise

FORBES AND MYERS CABLE REEL

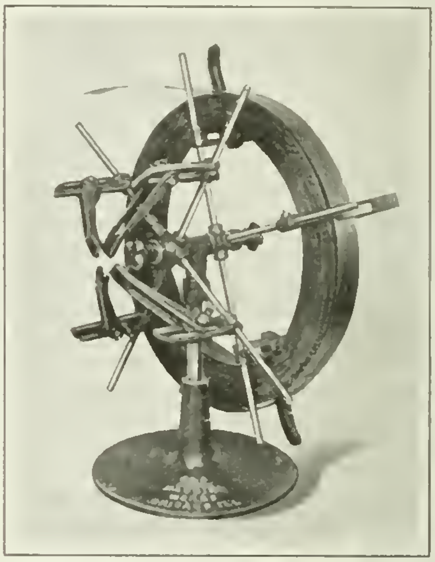
Portable electric tools usually receive current for their operation from a lamp socket to which they are attached by a flexible cord. This cord is constantly dragged over the floor as the operator moves from one position to another, is frequently stepped upon, catches on objects, and receives other treatment injurious to the cord and annoying to the operator. To avoid these difficulties, Forbes & Myers, 178 Union St., Worcester, Mass., have designed a reel which receives about 35 feet of cable. This reel has a spring strong enough to keep the cable off the floor, but not of sufficient strength to interfere with easy unreeling of the cable. This equipment considerably lengthens the life of the cable and when located centrally in a room, either on the ceiling or on a column, is sufficient for a room 60 feet square. A four-wire cable is used, three of the wires being for three-phase current, while the fourth is a ground wire which connects the frame of the portable tool to the frame of the reel. With this equipment permanently located in some part of the shop a tool is always ready for use by merely closing the switch.


Forbes & Myers Cable Reel attached to a Portable Grinder

S & S POWER-PRESS STOCK REEL

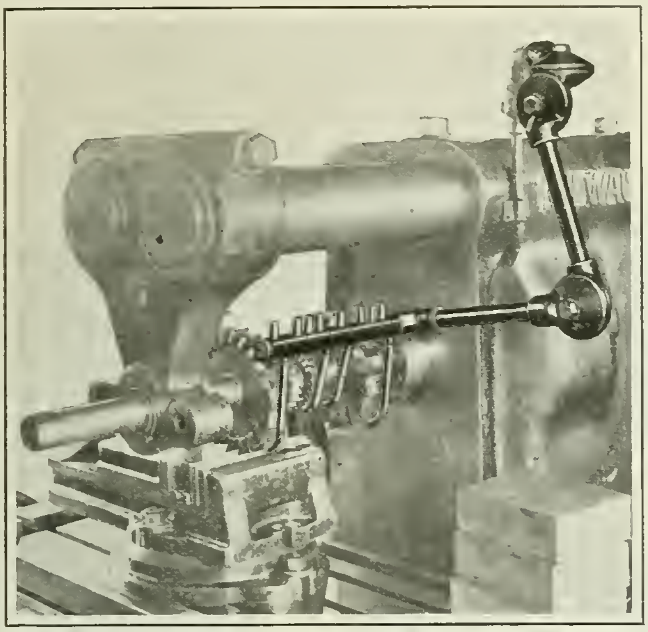
To reduce the idle time of power presses in starting to feed a new coil of stock through the dies, the S & S Machine Works, 4522 Lexington St., Chicago, Ill., have brought out a reel which may be loaded while the machine is in operation. Two spools are mounted on a swivel-head and these spools are alternately swung into position for feeding stock to the machine, the empty spool being reloaded while the other spool is reeling out stock. The arms that retain the coil on the spools are of a quick-loading type, a feature of their construction being a snap locking knuckle joint. The arms are bent toward the center of the reel for loading a coil, and then pushed outward to hold the coil in place.

Friction may be produced on both sides of the spool hub by means of an adjustable brake, so that any desired drag may be put on the stock. This feature is of value when the reel is used with an intermittent feed and prevents the stock from being tangled up or bent between the reel and the feeding rolls. The reel is easily adjusted to accommodate different widths of stock and core diameters, and different heights. This company also makes a reel with only one spool which can be set in any plane from the vertical to the horizontal. The reels may be furnished with or without a scrap cutter or a straightener. Reels with disks and small cores are used for such stock as copper, which is wound on small diameter mandrels.


S & S Double-spool Stock Reel for Power Presses

BORGESON & DAVERN LUBRICATOR

For supplying cutting compound to cutters on machine tools, especially in cases where the set-up comprises multiple cutters as on screw and chucking machines, Borgeson & Davern, Inc., 501-507 E. Water St., Syracuse, N. Y., have placed on the market the "Multi-production" lubricator with which the milling machine here illustrated is equipped. This lubricator has a slotted distributing tube which is attached to one of the swinging arms of the lubricator by screwing into a threaded plug. Mounted on this tube are a number of nozzles which may be readily adjusted to open or closed positions, and when in the open position, are provided with spouts for delivering the compound directly to



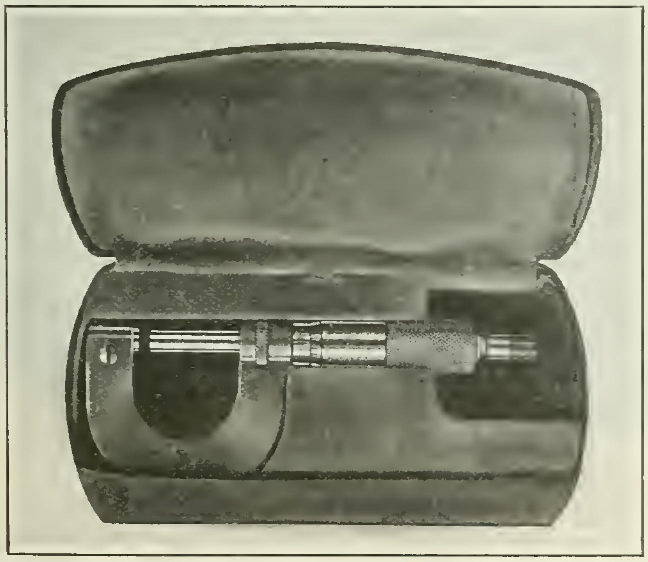
Milling Machine equipped with the Borgeson & Davern Lubricator

the cutting edges of the tools. The spouts vary in length to suit circumstances, and the nozzles are held in the set position by spring tension. The thread on the attachment plug is made special to suit Jones & Lamson machines.

The compound is delivered from the distributing tube to the nozzles through elongated slots which register with holes in the nozzles when the latter are in the open position. These slots are comparatively long to allow a considerable range of nozzle adjustment in the open position. The swivel joints of this lubricator may be either single or double to allow the distributing tube to be located in any desired position relative to the work. The frictional surfaces of the joints are ground to prevent leaking. This lubricator is made in three styles.

BROWN & SHARPE MICROMETER CASES

Two styles of pocket cases for protecting micrometers from dirt and injury are being placed on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. These cases are designed to hold the "Rex" 1-inch micrometers and the regular type made by the company. They are made of metal, leather-covered, and are plush-lined. These cases are of a shape that adapts itself to the pocket without causing the pocket to become bulged.



Pocket Case for Brown & Sharpe 1-inch Micrometers

A CORRECTION

In April MACHINERY an article was published referring to a proposed merger of machine tool manufacturers, and in the list the Lodge & Shipley Machine Tool Co. of Cincinnati was included. Before the MACHINERY form containing this article went to press, we received a telegram from Mr. J. Wallace Carrel, vice-president and general manager of the Lodge & Shipley Machine Tool Co., requesting us to make no statement of the merger as then proposed, because it had not been consummated and probably would not be. That request should have been complied with, as his company did not join the combination, and it was an error on our part to include the name of the Lodge & Shipley Machine Tool Co. in our article.

* * *

NEW MACHINERY AND TOOLS NOTES

Circular Slide-rule for Metallurgists: Pittsburg Electric Furnace Corporation, Union Bank Bldg., Pittsburg, Pa. A circular slide-rule known as the "Lectromelt calculator" which lessens the computations of furnace superintendents, melters and metallurgists in the steel-making industry. This device is useful in calculating the amount of various alloys to be added to a furnace charge for obtaining the desired mixture of metal.

Foot and Power Punch Press: A. F. Way Co., Hartford, Conn. A small press with a stroke of one inch. By simply changing a bolt, the press can be operated either by foot or by power. As a foot-press, it is operated by a swinging foot-lever or pendulum which actuates the clutch mechanism, and when arranged for operation by power, the pendulum becomes a trip-lever and the machine is then actuated through an eccentric and toggle levers at the rear.

Bench Drilling Machines: Sigourney Tool Co., Hartford, Conn. Several bench and column drilling machines which may have a single-, two-, three-, or four-spindle head. On one machine the spindle is equipped with ball bearings for operation at high speeds, the maximum speed being normally 8000 revolutions per minute, although considerably higher speeds may be employed. Another type intended for operation at slower speeds is provided with plain spindle bearings except for a ball thrust bearing which takes the pressure on the spindle.

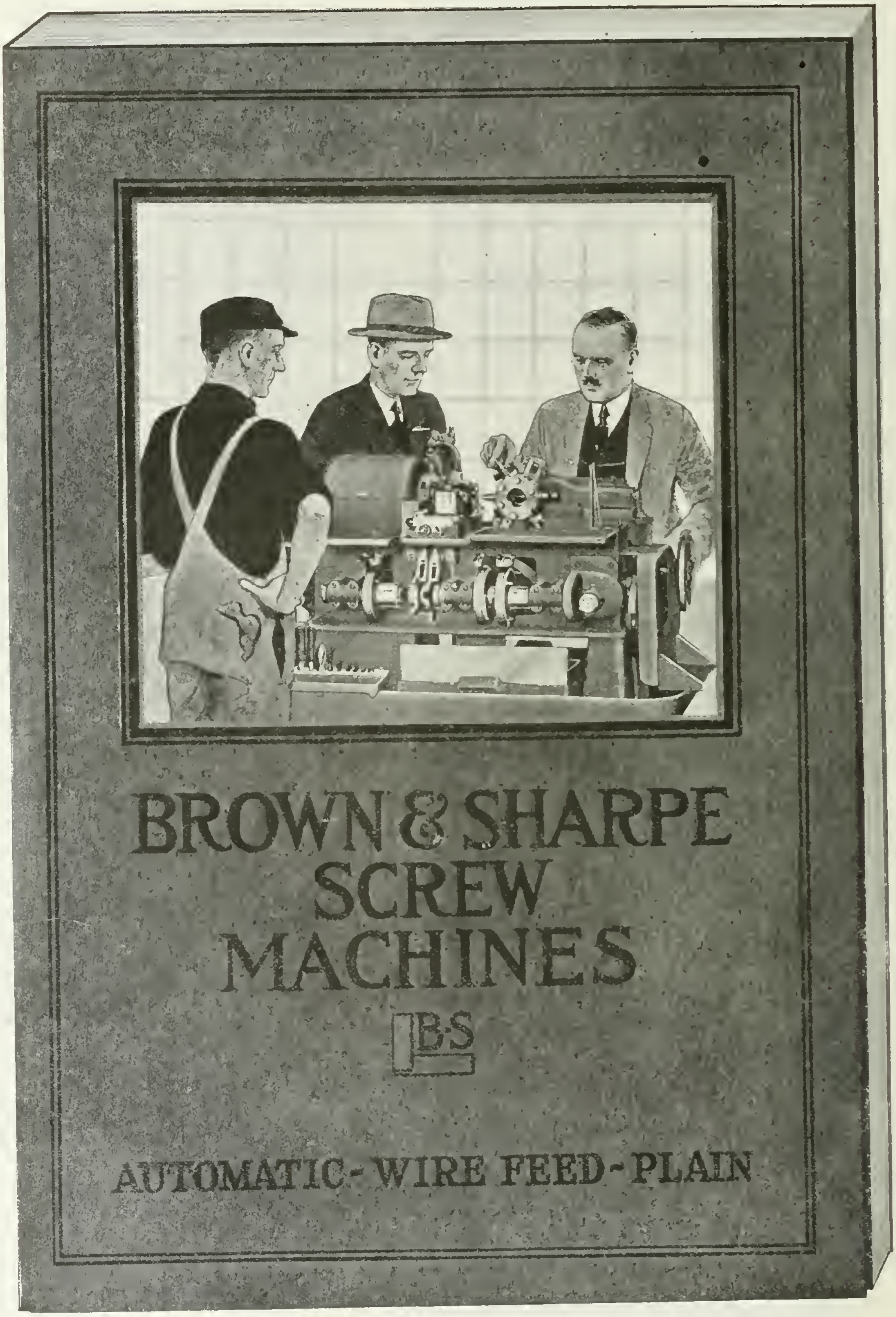
Bolt and Cap-screw Shaving Machine: Asa S. Cook Co., Hartford, Conn. An improved machine for shaving the heads of bolts and cap-screws. One tool faces the shoulder under the head of the bolt or cap-screw while another rounds or otherwise forms the end of the head. The tool-carriers swing about axes set at a slight angle to the center line of the machine, so that as the tools advance to the work, they are drawn slightly nearer together. By this movement the tools are cleared immediately upon finishing the cut and withdrawn without dragging.

Spring Chuck: Rockford Milling Machine Co., Rockford, Ill. A spring chuck or collet-holder for small rods, straight-shank drills, milling cutters, etc., in which the spring collet is held securely in place by means of a worm-wheel threaded on the inside to fit threads on the end of the collet. The worm is turned toward the right by means of a key wrench in order to draw in the collet, this member being drawn against a taper seat which closes the nose centrally without producing side strains. The collet is forced out by turning the key wrench to the left.

* * *

EGYPTIAN ENGINEERING STUDENTS IN AMERICAN SHOPS

Ten Egyptian students, graduates of the engineering schools of Egypt, have been sent to America by the Egyptian Government to learn American manufacturing methods. These men have been placed by the Department of Commerce in automobile and other factories, where they will work as employes for two years with the purpose of acquiring a knowledge of American methods and machine shop equipment. The Egyptian Government pays all the expenses of these students. Some will study the subject of interchangeable manufacturing, and others railroad transportation, telephone systems, marine engineering, and Diesel and internal combustion engine construction. It is expected that when these students return to their native country they will introduce American methods, which will increase the demand for American machine tools and shop equipment.



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WAGES IN GERMAN INDUSTRIES

An agreement was made in September between the employers and the employes in the German machine industries in regard to wages. This agreement was in effect from September 25 to October 29. Now it has become the practice to make new wage agreements every two weeks, because this is the only way in which wages can be maintained in a fair proportion to the falling value of the mark. To mention the amount of wages in marks per hour, means comparatively little to American readers, yet it may be of interest to know that early in November the wage rates in force for workers over twenty-one years of age varied from 70 to 120 marks per hour. For workers from eighteen to twenty-one years of age, wages early in November varied from 61 to 102 marks per hour. Workers from fourteen to eighteen years of age earned from 40 to 58 marks per hour. On November 19 all these wage rates were increased approximately 10 per cent.

The best idea of what these wages mean is obtained by measuring them by their purchasing power. The average hourly wage of a worker over twenty-one years of age will purchase one pound of bread or one quart of milk. Four hours' wages are required to purchase a pound of beef, and twelve hours' wages will buy a pound of butter. It takes forty hours to earn a 25-pound bag of flour.

On the other hand, in proportion to selling prices, employers say these wages are high. The general manager of a large machine tool concern stated early in November that the wages and costs of materials are too high for profitable operation of the plants, and that if present conditions continue, some of the shops will have to go into bankruptcy. While there are fewer strikes for higher wages at present, the efficiency and the willingness on the part of the workers to do hard work has greatly decreased. For example, it is stated that the Krupp Works in Essen are getting only 46 per cent of the output that they should, and the Phoenix Works give 45 per cent as the figure of the productive capacity obtained in their works in pig iron production. The steel output is only 60 per cent, as compared with 1913. The true rulers of Germany, it is said by many, are the labor unions, and the German Government is only their mouthpiece.

The machine-building industries in general book comparatively few new orders. The locomotive shops have relatively little to do, and an order from Roumania recently received for fifty new locomotives was, therefore, considered a great help. The production costs in the shipbuilding industries have increased so much that the steamship companies are not ordering new ships. The well-known Siemens concern celebrated its seventy-fifth anniversary this fall. In August of this year this company employed over 96,800 men.

Reports of large dividends paid by German concerns expressed in per cent are very misleading. One German machine tool builder, for example, paid a 30 per cent dividend last year, the net profits running into hundreds of thousands of marks. When converted into dollars, however, the total net profits of the concern for the year were less than $200. Another large machine tool builder paid a 25 per cent dividend and 250 marks extra per share; but the total net profit was less than $700 and the 250 marks per share amounts to only a few cents.

The prices of machine tools change so rapidly that they are of interest only as a record of the financial conditions that Germany is passing through. The price of a punch press, weighing 4000 pounds, was 750,000 marks (approximately $125) early in November.

* * *

During the past fiscal year the Bureau of Foreign and Domestic Commerce answered 589,533 inquiries relating to foreign trade and tariffs, foreign commercial law, and other subjects which come within the scope of the Bureau.

PERSONALS

W. W. Sayers of the Link-Belt Co., Chicago, Ill., has been promoted to the position of chief engineer of the company's Philadelphia works and eastern operations. For many years Mr. Sayers represented the company in the Chicago territory. His headquarters will be in Philadelphia.

R. H. Becker, formerly connected with the machine tool building and sales department of Joseph T. Ryerson & Son, is now with the Milwaukee Machinery Co., 93 W. Water St., Milwaukee, Wis. He will have charge of machine tool sales in part of the Milwaukee and southern Wisconsin territory.

Ogden R. Adams, Rochester, N. Y., who for the last eighteen months has been associated with the Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y., in the capacity of president and general manager, resigned November 1. Mr. Adams will hereafter devote his entire time to his business interests in Rochester, Buffalo, and Syracuse.

John H. Peckham, who has been connected with the Norton Co., Worcester, Mass., for many years as a grinding machine specialist, is now associated with Henry Prentiss & Co., 149 Broadway, New York City, in the same capacity. Mr. Peckham will cover the entire territory of the company in an endeavor to give better grinding machine service to its customers.

Frederick Franz, who, for the last four years was chief engineer of the Terminal Engineering Co., manufacturer of a truck designed for combined indoor and outdoor service in connection with railroads, shipping and industrial plants, has established an engineering office at 27 Warren St., New York City, for the purpose of solving special problems of engineering relating to labor-saving machinery for industrial plants.

C. E. Skinner, assistant director of engineering of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., is now in Europe attending the meeting of the Rating Committee of the International Electro-Technical Commission in Geneva, Switzerland. A large delegation from the United States, and delegations from most of the European countries interested in the manufacture of electrical machinery are in attendance.

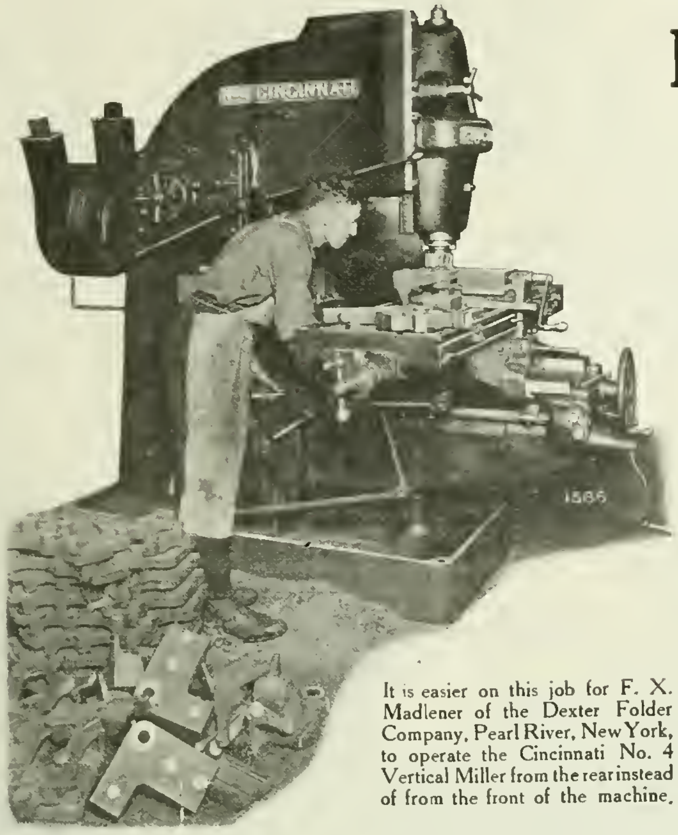
Frank W. Wirfs, until recently sales manager of the Power Equipment Co. of Minneapolis, Minn., has joined the sales organization of the Chicago Belting Co., 127 N. Green St., Chicago, Ill. He will be located in Minneapolis and will cover the surrounding territory. Mr. Wirfs spent the first five years after he left the University of Washington, running his own sawmills in Oregon. Later he was salesman for a year and a half for the A. H. Averil Co. at Portland, Ore., jobbers of sawmill and threshing machinery, and more recently sales manager of the Power Equipment Co.

Paul M. Lincoln has been appointed director of the School of Electrical Engineering in the College of Engineering, Cornell University, to succeed Professor Alexander Gray, who recently died. Mr. Lincoln graduated from the Ohio State University in 1892, and has since been connected with the Westinghouse Electric & Mfg. Co., and the Niagara Falls Power Co. In 1919 he became connected with the Lincoln Electric Co., which was organized by his older brother in 1894. He thus brings to his position as director of the School of Electrical Engineering a practical engineering experience of nearly thirty years.

Benjamin G. Lamme, chief engineer of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been awarded the Joseph Sullivant medal by the Ohio State University. Mr. Lamme, who was graduated from the Ohio State University in 1888, is the first person to receive the medal; in the future it will be awarded once every five years for an "admittedly notable achievement on the part of a son or daughter of the university." In June, 1919, the Edison medal was awarded to Mr. Lamme by the American Institute of Electrical Engineers for the solution of special problems and developments in electrical machinery.

* * *

The Committee of Science and the Arts of the Franklin Institute, at a recent meeting, awarded the Edward Longstreth medal to the Noiseless Typewriter Co. of New York "in consideration of the ingenuity shown by the inventors, the excellence of design and construction as exhibited in the machine, resulting in a thoroughly commercial noiseless typewriter"; and also to Edward J. Brandt of Watertown, Wis., "in consideration of the ingenuity shown in the design of the automatic cashier, the excellence of its construction, and its successful use in money-changing operations."



It is easier on this job for F. X. Madlener of the Dexter Folder Company, Pearl River, New York, to operate the Cincinnati No. 4 Vertical Miller from the rear instead of from the front of the machine.

Double Control
(Complete)

A VALUABLE FEATURE
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CINCINNATI
No. 4 & No. 5
Millers

Facility of observation determines the operator's choice of position on all Cincinnati No. 4 and No. 5 High Power Millers. A duplicate set of levers gives complete independent control of all feeds from the rear as well as from the usual position in front of the table.

There are other important features. Our catalog tells about them. Write.

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Plain and Universal Milling Machines
including Cone and Single Pulley Types
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(Six Sizes)

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Complete line of Milling Attachments
(In all, thirty-eight (38) Types and Sizes of Milling Machines)

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for any or all
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Catalogs No. 4 and No. 5—Cincinnati Millers
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Catalog—(Treatise)—No. 1½ Cutter and Tool Grinder
Tool Room Methods
Locomotive Repairs
Autobiography of an Arbor
Treatise on Milling and Milling Machines ($1.50)
Industrial Medicine in a Labor Policy

The Cincinnati Milling Machine Company
CINCINNATI OHIO, U. S. A.

TRADE NOTES

Reed-Prentice Co., 677 Cambridge St., Worcester, Mass., announces that the Detroit office of the company has been removed from 642 Beaubien St., to 6526 Cass Ave.

E. L. Essley Machinery Co., 551 Washington Blvd., Chicago, Ill., has moved its Milwaukee branch into more spacious quarters at 78 W. Water St., Milwaukee, Wis., where a large number of new and used machine tools will be displayed.

Whiting Corporation, Harvey, Ill., manufacturer of cranes, foundry equipment, and railway specialties, has appointed C. F. Bulotti Machinery Co., 67 Main St., San Francisco, Cal., agent for the state of California, to succeed the Eccles & Smith Co., of the same city.

Monitor Controller Co., Baltimore, Md., manufacturer of the "Just Press a Button" system of automatic control for motor-driven apparatus, has recently established a southern branch office at Birmingham, Ala. Other branch offices are located in a number of the larger cities.

Pyrene Mfg. Co., 520 Belmont Ave., Newark, N. J., announces that, on account of the fact that it has been very successful in using the Parker process for preventing rusting of steel on fire extinguisher brackets, the company has now enlarged its plant in order to handle work for other manufacturers.

Herberts Machinery & Supply Co., 3rd and San Pedro Sts., Los Angeles, Cal., has been appointed exclusive representative by the Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., in connection with the sale of Diamant standard punch and die sets, in the territory covered by the entire states of California, Arizona, and Nevada.

Norwalk Iron Works Co., South Norwalk, Conn., builder of air and gas compressors and refrigerating machinery, has opened a Chicago office at 627 W. Washington Blvd., in charge of L. R. Bremser, who for thirteen years was associated with the Gardner Governor Co., and who is thoroughly familiar with all the phases of the compressor business.

Firth-Sterling Steel Co., McKeesport, Pa., has added to its line the Globe polished drill rods drawn by the Globe Wire Co., of Sharpsburg, Pa. These rods are made from steel produced by the Firth-Sterling Steel Co. Complete stocks of Globe drill rods are now carried in the Firth-Sterling Steel Co.'s New York, Boston, and Philadelphia warehouses.

Cleveland Twist Drill Co., Cleveland, Ohio, announces that E. G. Buckwell retired from his position as secretary and sales manager on November 1, after more than twenty-three years of service. Mr. Buckwell retains his interest in the company, and will remain a director. He will be succeeded as sales manager by W. E. Caldwell, formerly assistant sales manager, who has twenty-one years' experience in the company's sales department.

Gibb Instrument Co., Detroit, Mich., manufacturer of electric welding equipment, announces the removal of its plant and offices to Bay City, Mich., effective December 1. The purpose of this change is to provide greatly increased manufacturing facilities to take care of the company's rapidly increasing business. For the last two years this company has concentrated on the development of automatic and semi-automatic arc, spot, and seam welders.

Western Screw-Products Co., St. Louis, Mo., whose plant was recently destroyed by fire, has obtained a new permanent location at Main and St. George Sts., St. Louis, and is now again in production. The capacity range of the new plant will be larger than formerly, the new shop being equipped to handle screw machine work up to and including 2¾ inches in diameter. Plain and castle nuts are also manufactured, and special work done to order.

Victor Tool Co., Inc., Madison & W. M. R. R., Waynesboro, Pa., has appointed Edward T. Oliver representative in northern Ohio for the company's entire line of self-opening dieheads, collapsible taps, nut facing machines, and floating reamer-holders. Mr. Oliver's headquarters will be at 2031 Lincoln Ave., Lakewood, Cleveland, Ohio. The company has also appointed the J. F. Burh Machine Tool Co., 7762 Dubois St., Detroit, Mich., representative for its entire line in eastern Michigan.

Street Bros. Machine Works, Chattanooga, Tenn., manufacturers of hoisting equipment, have been consolidated with the Patten Mfg. Co., Chattanooga, Tenn., also a manufacturer of hoisting machinery. The products of the two companies will henceforth be manufactured and marketed by Street Bros. Machine Works, Inc., and will include the Street line of large hoisting equipment, together with the small and medium-sized Patten hoists. J. H. Street will continue as president of the consolidated company, and J. W. Burress, sales manager of the Patten Mfg. Co., will be sales manager of the consolidated company.

Rockford Milling Machine Co., Rockford, Ill., has made the following changes in agencies: J. C. Austerberry, of Detroit, Mich., will sell Rockford milling machines in that territory; the Cooperative Machinery Co. of Cleveland, Ohio, has been appointed exclusive dealer for the Rockford Milling Machine Co. and the Rockford Tool Co., in the Cleveland territory; and the Western Iron Stores Co., Milwaukee, Wis., has been made exclusive representative for the Rockford Milling Machine Co. and the Rockford Tool Co. in the state of Wisconsin.

Dolman Mfg. Co., Springfield, Mass., has been formed by Guy W. Donahue, formerly president and sales manager of the Victor Saw Works, Inc., Middletown, N. Y.; William F. Pollock, formerly president of the Napier Saw Works, Middletown, N. Y., and for many years, general manager of the Victor Saw Works; and Chester C. Jackman, formerly factory manager of the Victor Saw Works. The new company will engage in the manufacture of high-grade tools. The first of these, known as the Dolman screwdriver, is already on the market.

Reliance Gauge Column Co., 6008 Carnegie Ave., Cleveland, Ohio, announces that the "Cleveland" clutch business has been sold to the Western Engineering & Mfg. Co., 360 E. Grand Ave., Chicago, Ill., which has been incorporated as a subsidiary of the Western Valve Bag Co. for the purpose of taking over the manufacture and marketing of this clutch. The increased demand for the steam specialty line made by the Reliance Gauge Column Co. and the development of a new method float caused the company to dispose of this end of its business.

Alvord Reamer & Tool Co., Millersburg, Pa., manufacturer of reamers, milling cutters, twist drills, punches and dies, chisel blanks, special tools and drop-forgings, has started a service department in connection with its engineering department under the direction of A. M. Lindsley, chief engineer. This service department will give consulting engineering advice in connection with special tool equipment. Paul A. Cuenot has been appointed representative to furnish special tool service to customers. Mr. Cuenot was formerly connected with the American Locomotive Co. and the Pennsylvania Steel Co.

Consolidated Tool Works, Inc., 296 Broadway, New York City, is now represented in New York City by William H. Thompson, formerly with the Union Hardware Co., Torrington, Conn. Howard A. Postley, formerly with the Knickerbocker Mfg. Co., Belleville, N. J., represents the company in the New England states. William L. Rubin, formerly with the Jacobs Scale Co., New York City, represents the company in New York, Pennsylvania, Maryland, District of Columbia, and parts of West Virginia and Ohio. Charles Alburtus, formerly with the American Safety Razor Co., Brooklyn, N. Y., represents the company in New Jersey.

* * *

RELATIVE DURABILITY OF DIFFERENT KINDS OF WOODS

In response to many requests for information on the relative durability or resistance to decay of untreated woods, the United States Forest Products Laboratory at Madison, Wis., has prepared a table based on such records and information as are available on this subject. Taking the durability of commercial white oak as 100 per cent, this table shows that black locust and osage orange are the most durable of woods, the former being from 150 to 250 per cent, and the latter from 200 to 300 per cent. Among other woods that are more durable than white oak are eastern red cedar juniper and other species of cedar except white southern; cypress; redwood; Pacific yew; catalpa; chestnut; red mulberry; and black walnut. Of the fifty native kinds of woods listed all the others are equal to or less durable than white oak. Hemlock, fir (except Douglas fir), and pine (except southern yellow pine) are among the least durable of the native woods.

* * *

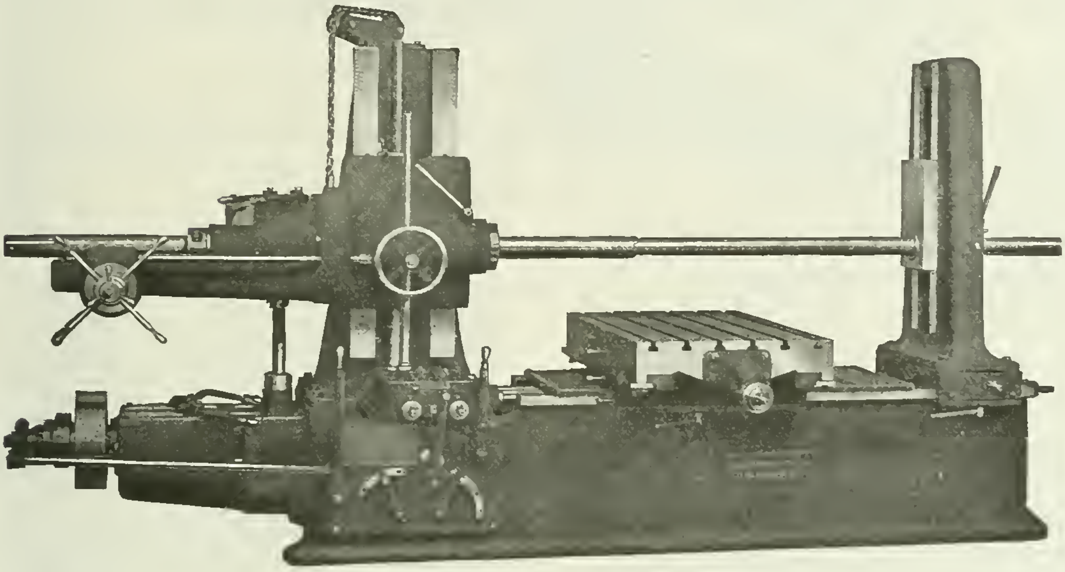
NEW FORM OF INVOICE FOR AUSTRALIA

The Department of Trade and Customs of Australia announces through its office at 44 Whitehall St., New York City, that a new form of invoice and certificate has been adopted to be effective January 1, 1923, but the new form will be accepted for goods arriving before that date. A copy of the form may be obtained by communicating with the Australian Department of Trade and Customs at the address given in the foregoing.

"Art stays the relentless hand of time"

The "PRECISION"

Boring, Drilling and MILLING MACHINE



Makes
a good
OLD
Machine

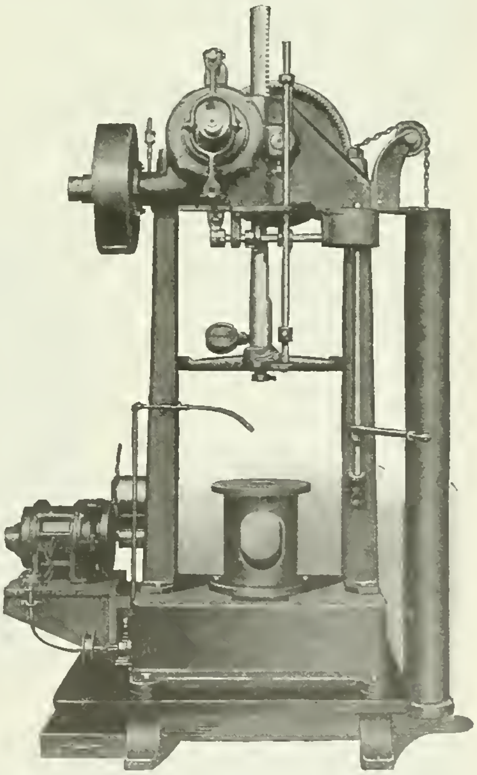
Almost like SLEIGHT OF HAND is the ease and quickness with which our new

Vertical Push-Broaching Machine

handles the broach.

"A SIMPLE TWIST OF THE WRIST"
DOES THE TRICK

Less floor space—More production



LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo, Japan.

NATIONAL FOUNDERS' ASSOCIATION CONVENTION

The National Founders' Association held its twenty-sixth annual convention at the Hotel Astor, New York City, November 22 and 23. Among the important addresses presented before the convention was the annual report of William H. Barr, president of the association, which called attention to the duty of employers in industrial relationships, and showed clearly that under present conditions there is no definite solution of the labor problem. The other addresses presented were as follows: "The Railroad Situation," by L. F. Loree, president of the Delaware and Hudson Railroad; "The Open Shop," by John E. Edgerton, president of the National Association of Manufacturers; "The Proposal to Destroy the Judicial Power," by James A. Emery, counsel for the National Founders' Association; "The Physician in Industry," by Dr. J. J. Moorhead, New York; "Improved Foundry Practice," by D. R. Wilson, vice-president of the Wilson Foundry & Machine Co., Pontiac, Mich.; and "Apprenticeship," by William M. Taylor, Chandler & Taylor Co., Indianapolis, Ind.

* * *

An important step toward the elimination of the differences between specifications for government purchases and commercial practice has been taken through the appointment, by the American Engineering Standards Committee, of a standing Committee on Cooperation with the Federal Specifications Board. Work carried out under the general direction of this committee will give industry a better opportunity to participate in the development of specifications for government purchases, and it will at the same time bring to the government, to a greater degree than has heretofore been possible, the assistance of the industrial organizations cooperating in the work of the American Engineering Standards Committee.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for October 1, 1922

State of New York }
County of New York } ss.

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Matthew J. O'Neill, who, having been duly sworn according to law, deposes and says that he is the treasurer and general manager of the Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, and Matthew J. O'Neill, Treasurer and General Manager, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Alexander Luchars, Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars; Matthew J. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

MATTHEW J. O'NEILL, General Manager

Sworn to and subscribed before me this 18th day of September, 1922

WILLIAM E. BACON,
(SEAL) Notary Public, Kings County No. 444
Kings Register No. 3109
New York County No. 79 New York Register No. 3047
(My commission expires March 30, 1923.)

COMING EVENTS

December 4-7—Annual convention of the American Society of Mechanical Engineers, in the Engineering Societies' Bldg., 29 W. 39th St., New York City. Calvin W. Rice, secretary.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St. and Lexington Ave., New York City.

January 11-12—Annual meeting of the American Engineering Council at the new headquarters of the Federated American Engineering Societies in Washington, D. C. L. W. Wallace, 24 Jackson Place, Washington, D. C., secretary.

February 14-16—Convention of the American Institute of Electrical Engineers at the Engineering Societies' Bldg., 29 W. 39th St., New York City.

February 17-22—Exposition of inventions and patents to be held at the Grand Central Palace, New York City, under the auspices of the Universal Patent Exposition Corporation, World's Tower Bldg., 110 W. 40th St., New York City.

February 19-21—Annual meeting of the American Institute of Mining and Metallurgical Engineers at the Engineering Societies' Bldg., 29 W. 39th St., New York City.

March 18-24—Second general meeting of the International Chamber of Commerce in Rome, Italy. Lacey C. Zapf, secretary American Section, Mills Bldg., Washington, D. C.

April 30-May 3—Annual convention of the American Foundrymen's Association at Cleveland, Ohio. C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill., secretary.

NEW BOOKS AND PAMPHLETS

War Surplus. Published by the Sales Promotion Section of the War Department, Office of Director of Sales, 2515 Munitions Bldg., Washington, D. C.

This booklet describes in a general way the methods of sales used by the War Department in disposing of its vast stock of surplus property, and outlines briefly what these stocks are composed of.

Publications of the Bureau of Standards. 199 pages, including supplement, 7 by 10 inches. Published by the Department of Commerce as Circular No. 24 of the Bureau of Standards.

This book contains a list of the scientific papers, technological papers, circulars, handbooks, and miscellaneous publications brought out by the Bureau of Standards.

Concrete Floors and Sidewalks. By A. A. Houghton. 63 pages, 5 by 7¼ inches; 8 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, 75 cents.

This is No. 2 in a series of concrete worker's reference books. The book explains the methods of molding concrete floor and sidewalk units, and the construction of plain and monolithic floors. Complete instructions are given for the practical worker, and ample illustrations are included to make the instructions clear.

Steel. By Charles Rumford Walker. 157 pages, 5½ by 8 inches. Published by the Atlantic Monthly Press, Boston, Mass.

This book is the story of a graduate of Yale University, who three years ago went to work on an open-hearth furnace near Pittsburg, to learn the steel business. In this book he has put down what he saw, felt, and thought as a steel worker. The book is written from a diary of notes made in the evenings when the author was working on day shifts of ten hours. Alternate weeks he worked the fourteen-hour night shift, at which time he evidently did not devote his spare hours to writing. The book may be read as a story of men and machines, as well as a study of conditions and of the system in the steel industry.

Belt Conveyors and Belt Elevators. By Frederic V. Hetzel. 338 pages, 6 by 9 inches; 291 illustrations. Published by John Wiley & Sons, Inc., New York City. Price, $5.

This book was especially written for four classes of men: Men who have material to handle and who want to know more of the "how" and "why" of conveying and elevating machinery than can be told in the catalogue and advertisements of manufacturers; consulting engineers who have to advise in the selection of the proper machinery to do certain work; engineers and draftsmen who design conveying and elevating machinery: and students in technical schools and colleges. The author has been chief engineer of one of the largest companies in the conveyor business for a period of thirteen years, and has been responsible for the design of all kinds of conveying and elevating machinery. He has also acquired valuable experience in dealing directly with suggestions and complaints from users of this class of machinery, and in cooperating with them in effecting improvements in the design of this type of apparatus.

The Welding Encyclopedia. Compiled and edited by L. B. Mackenzie and H. S. Card of the Editorial Staff of the "Welding Engineer." 388 pages, 6 by 9 inches; 550 illustrations. Published by the Welding Engineer Publishing Co., 608 S. Dearborn St., Chicago, Ill. Price, $5.

This is the second edition of a reference book on the theory, practice and application of the four autogenous welding processes. The new edition, which contains fifty per cent more text material than the previous one, has been brought up to date, and recent developments in welding procedure, have been added. The first half of the book consists of a dictionary of all the words, terms and trade names used in the welding industry. Following the dictionary sections are chapters on oxy-acetylene welding, electric arc welding, electric resistance welding and thermit welding. Charts and tables are included, showing different methods of preparing joints for welding and giving information on the characteristics of the commoner metals. The book concludes with a catalogue section, describing and illustrating standard lines of welding equipment and apparatus.

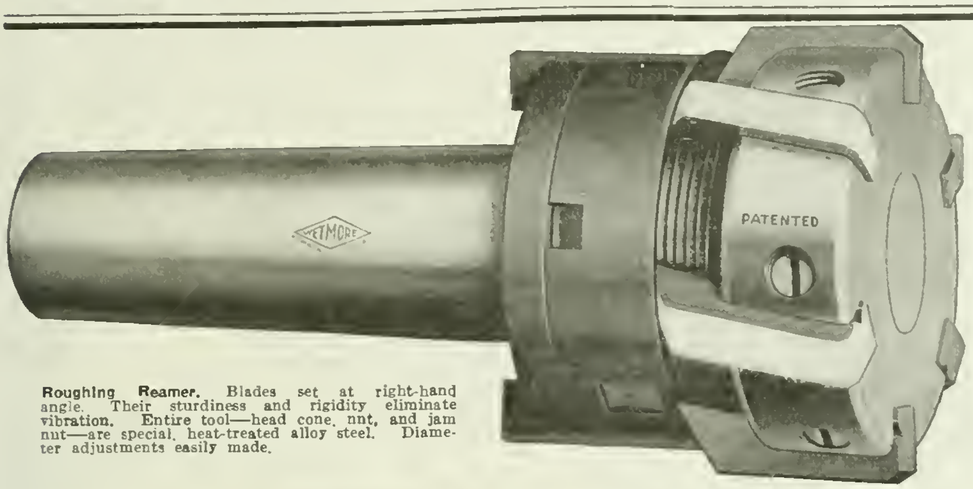
American Malleable Cast Iron. By H. A. Schwartz. 416 pages, 6 by 9 inches; 190 illustrations. Published by the Penton Publishing Co., Cleveland, Ohio. Price, $7.

This book summarizes and records the present practice in making malleable cast iron. In this book the specialist may find much that appears to him elementary, and the non-technical reader may find much matter which appears too complex; but the author states that the reason for this was his desire to prepare a book that would suit many kinds of readers. This has necessitated including some elementary matter both in metallurgy and in regard to the practical application of the art of making malleable castings; on the other hand, it has necessitated that in order that the advanced reader may secure full value from this book, no known fact or theory should be excluded, even though it may appeal only to the more experienced man. The author has been very broad-minded in his treatment of the subject in that he has not considered his own views as final, but has also recorded opinions contrary to his own, so as to place on record every theory of any importance; but a constant effort has been made to record facts rather than opinions, wherever possible. This is particularly true in the chapters dealing with manufacturing methods. These chapters record what has been accomplished, rather than the theories of what might be accomplished.

Condensed Catalogues of Mechanical Equipment. 622 pages, 7 by 10 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, $5. (Free to members of the society.)

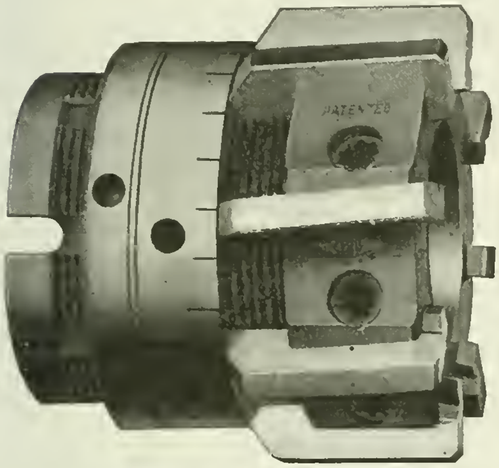
This is the twelfth annual edition of this classified directory of catalogue information. With this issue the size of the book has been changed and the volume is printed on special bible paper and bound in flexible "Atholeather," which makes it easier to handle, although it contains more material than any previous edition. There are three main sections in the book, the first being a classified catalogue section giving information covering the products of manufacturers of various classes of mechanical equipment; the second consists of a general classified directory of manufacturers in the mechanical field, containing a specialized cross-indexed list of mechanical equipment, with the names and addresses of manufacturers; and the third is a consulting

THE BIG THREE



Roughing Reamer. Blades set at right-hand angle. Their sturdiness and rigidity eliminate vibration. Entire tool—head cone, nut, and jam nut—are special, heat-treated alloy steel. Diameter adjustments easily made.

—why Wetmore Cylinder Reaming Sets Speed Up Production

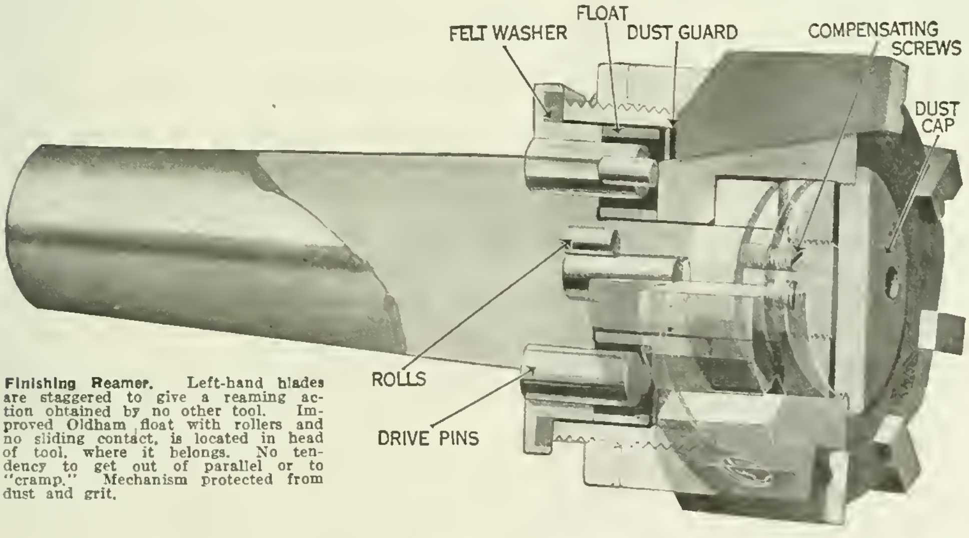


Semi-Finishing Reamer. Left-hand angle blades eliminate digging in and chattering. Adjustments of .001" made rapidly and accurately by means of graduated micrometer cone nut at rear of blades.

Unusual *durability* and *sturdiness*, plus *greater working speed*—that's the combination you get in the three expanding reamers of Wetmore Cylinder Reaming Sets!

Note the extreme ruggedness of the Roughing Reamer (top). It is *guaranteed* to be vibrationless. The Semi-Finishing Reamer (middle), with its left-hand angle blades, eliminates digging in and chattering. It assures a straight, round hole with no scoring. The construction of the Finishing Reamer (bottom) *does away with cylinder grinding.* This feature alone will pay for a set of Wetmore Cylinder Reamers in a short time.

Wetmore Cylinder Reamers are *standard* in many of the largest motor manufacturing plants. A trial in *your* shop, in competition with other reamers, will prove that they save time and money.



Finishing Reamer. Left-hand blades are staggered to give a reaming action obtained by no other tool. Improved Oldham float with rollers and no sliding contact, is located in head of tool, where it belongs. No tendency to get out of parallel or to "cramp." Mechanism protected from dust and grit.

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engineers' directory with a catalogue section, containing a classified list of members of the American Society of Mechanical Engineers engaged in the various branches of consulting engineering practice, as well as catalogue information describing the service of consulting engineers in this field. The classified directory of manufacturers contains over 3000 different subject headings, and the names and addresses of more than 4000 manufacturers.

Mechanical Laboratory Methods. By Julian C. Smallwood. 423 pages, 5 by 7½ inches; 112 illustrations. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $3.50.

This book deals with the testing of instruments and machines in the mechanical engineering laboratory, and with the practice of the laboratory itself. The author, who is assistant professor of mechanical engineering at Johns Hopkins University, has had an extensive experience fitting him for the preparation of such a work as this. The first edition of the work appeared in 1914. This is the third revised and enlarged edition, necessitated by new developments and by the new standards of performance that have been adopted by the power test committees of the American Society of Mechanical Engineers. The book covers, among other subjects, the calibration and testing of scales, springs, gages of various types, dynamometers, engine indicators, meters for fluids and gases, calorimeters, thermometers, pyrometers, and oil and belt testers. Then follows an analysis of combustion and a very complete detailed treatise on the testing of power plant units, including steam engines, steam pumps boilers, steam auxiliaries, gas engines, refrigeration machinery, air machinery and water motors, together with several miscellaneous tests on pumps, hoists, lubricants, and electric motors.

Dyke's Automobile and Gasoline Engine Encyclopedia. By A. L. Dyke. 1226 pages, 7 by 10 inches; profusely illustrated. Published by the Goodheart-Willcox Co., Chicago, Ill. Price $6. (Bound in American morocco, $7.59.)

This is the thirteenth edition of Dyke's well-known automobile encyclopedia. This edition is enlarged and entirely rewritten, rearranged and brought up to date. The book is intended especially for three classes of users—the car owner, for whom it is a valuable reference book; the repair man, who will find in it information on every subject relating to automobile and gasoline repair work; and the student who is seeking to fit himself for the job of automobile mechanic, to whom it is doubtless the most complete textbook available. It is safe to say that no volume has as yet been brought out in the automobile field that contains within a single binding so much information as this work. One of the most valuable features of the book is the index, which contains over 14,000 entries. Every subject connected with automobile operation or repairs is treated and is indexed in three ways: (1) in relation to the construction of the car—that is, with reference to the name of the part; (2) in relation to the operation of the car; and (3) in connection with the make of the car. Thus, information on any subject contained in the book can be found almost instantly. The book contains thirteen principal sections: Assembly of the Automobile; the Automobile Electric Systems; the Storage Battery; Wiring Diagrams; Ignition and Carburetion; Tires; Garage and Shop Equipment; Repairing and Overhauling Engine and Car; Oxy-acetylene Welding, Commercial Cars; Tractors; Ford Car and Tractor; and Data, Specifications, Horsepower, and Useful Information.

NEW CATALOGUES AND CIRCULARS

Laclede-Christy Clay Products Co., St. Louis, Mo., Catalogue of Laclede-Christy stokers.

Twin Disk Clutch Co., Racine, Wis. Circulars illustrating and describing the model B-1, B-10, C-8, and C-6½ twin disk clutches of the heavy-duty type.

Wagner Electric Corporation, St. Louis, Mo. Folder entitled "Operating Characteristics," calling attention to the advantages of the transformers built by the company.

Climax Engineering Co., Clinton, Iowa. Bulletin 1001, showing typical installations of Climax engines in contractors' machinery, including tractors cranes, industrial locomotives, etc.

R. D. Nuttall Co., McCandless and Harrison Ave., Pittsburg, Pa. Booklet 36, containing a series of charts on gear design, and bulletin 34, entitled "Industrial Helical Gears."

Adolph Mushlmatt, Lion Bldg., Fifth and Elm Sts., Cincinnati, Ohio. Folder illustrating and describing the A. M. sensitive drilling machine, an electrically driven portable bench drill.

Link-Belt Co., Chicago, Ill. Calendar for 1923, which can be obtained by addressing the company at 910 S. Michigan Ave., Chicago, on a firm letter-head The calendar measures 15½ by 24 inches

Osborn Mfg. Co., Cleveland, Ohio. Booklet entitled "All in the Day's Work," indicating how the problems of the jobbing foundry may be solved by the aid of roll-over jolt molding machines.

Gas Producer & Engineering Corporation, 115 Broad St., New York City. Folder entitled "On Saving Fuel and Money," calling attention to the fuel-saving possibilities of "Galusha" gas producers.

New Departure Mfg. Co., Bristol, Conn. Folder entitled "Adjustability is Liability." The folder emphasizes the value of ball bearings for avoiding the slipping, sliding, wearing, and overheating likely to occur in ordinary bearings.

National Acme Co., Cleveland, Ohio. Calendar illustrating on sheets for each month the various automatic screw machines, threading dies, and collapsing taps manufactured by the company at its Cleveland and Windsor plants.

Bausch & Lomb Optical Co., Rochester, N. Y. Catalogue illustrating and describing the Bausch & Lomb contour measuring projector for inspecting the different elements of a screw thread or the forms of gear teeth, cutters, etc.

Ingersoll Milling Machine Co., Rockford, Ill. Folder illustrating twenty-two different applications of Ingersoll milling machines, indicating the variety of machines built by the company and the wide range of work for which they are suitable.

Dayton-Dowd Co., Quincy, Ill. Catalogue of centrifugal pumps dealing with the design, specifications, and manufacture of different kinds of pumps built by the company, including a number of illustrations of installations of Dayton-Dowd pumps.

General Electric Co., Schenectady, N. Y. Bulletin 47002, entitled "Panels and Supporting Framework," covering types of panels, panel materials, panel sizes, vertical switchboards, framework for vertical panels, grille work and bench boards.

Monitor Controller Co., Baltimore, Md. Circular entitled "Monitor Thermaload Starter," illustrating and pointing out the advantages of this device. Circular entitled "It must be Right," showing an interesting application of the Monitor controller system.

High Speed Hammer Co., Inc., Rochester, N. Y. Circular illustrating and naming the working parts of high-speed riveting hammers, making it possible to order any part by number. A collection of different types of peens, anvils, and drifts are also illustrated and described.

Crescent Pump Co., 743 Beaubien St., Detroit, Mich. Bulletin 5, illustrating and describing Crescent "Roto-Piston" dry vacuum pumps. Bulletin 6, illustrating and describing Crescent vacuum tools, including chucks, bench blocks, hand lifters, suction cups, old-men, and rivet hold-ons.

E. C. Atkins & Co., Indianapolis, Ind Booklet entitled "Atkins Saws in the Shop," illustrating and describing a number of the products of the company, including hacksaw blades, saw frames, metal-cutting saws, metal-cutting machines of the draw-cut and of the band-saw type, and band-saw blades.

Logansport Machine Co., 529 Market St., Logansport, Ind. Catalogue of "Logan" air-operated chucks and labor-saving devices, illustrating and describing the products of the company, and showing a number of applications of air-operated chucks and holding devices on turret lathes, semi-automatic machines, automatic lathes, engine lathes, drilling machines, and milling machines.

Racine Tool & Machine Co., 259 15th St., Racine, Wis. Circular describing the Racine portable band saw, duplex type, a combination wood- and metal-cutting portable band saw intended for woodworkers, pattern shops, toolrooms, trade schools, and metal workers in general. The circular completely describes the machine and illustrates its application to different classes of work.

Geometric Tool Co., New Haven, Conn. Catalogue of Jarvis high-speed tapping devices, tapping machine, quick-change chucks and collets, and self-opening stud-setter. The catalogue illustrates and describes completely these various devices. Another catalogue recently brought out by the company illustrates and describes the style DS geometric screw-cutting die-heads of the self-opening and adjustable type.

Midwest Steel & Supply Co., Inc., 28 W 44th St., New York City. Architects' and engineers' data book of Midwest steel sections for overhead shafting supports, and for anchorage of piping, cables, monorails, car tracks, and various other equipment. This data book contains 53 pages, 8½ by 11 inches, giving illustrations, tables, and text matter descriptive of the uses of the Midwest box-rails, L-rails, and steel stringers.

Sebastian Lathe Co., P. O. Box 729, Cincinnati, Ohio. Catalogue 27, illustrating and describing the various types of lathes built by the company, including cone pulley and geared-head quick-change lathes, as well as gap lathes, and also stud and manufacturing lathes. Various attachments are also illustrated and described, including taper attachments, draw-in attachments, turret attachments, and milling and gear-cutting attachments.

Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Catalogue entitled "Examples of Turning on the Lodge & Shipley Manufacturing Lathe," showing the possibilities of an engine lathe, fitted with attachments for manufacturing purposes. The catalogue describes the Lodge & Shipley manufacturing lathe in detail, and contains illustrations showing a large number of tooling equipments for different classes of work made from photographs taken of actual set-ups.

Mitchell Engineering Co., Springfield, Ohio. Booklet entitled "A Way to Reduce Polishing and Buffing Costs," illustrating and describing the company's polishing and buffing lathes, including the No. 5 double-spindle machine, which is so arranged that the spindle at each end of the machine is run independently of the other. In this machine the spindles may be run at any speed required, irrespective of the speeds obtainable from the variable-speed motor.

Minneapolis Heat Regulator Co., Minneapolis, Minn. Circular illustrating and describing the Minneapolis thermostatic relay switch, a new type of switch for the thermostatic control of motors, electric heating units, and other electrical circuits. This switch has been developed particularly for use in the automatic control of oil-burning and refrigerating devices, but it has also a wide range of usefulness for the starting and stopping of motors according to temperature changes, and also for remote control work.

Cutler Steel Co., Pittsburg, Pa. Bulletin 221, describing "Duraloy," a chrome-iron alloy intended for any purpose where resistance to oxidation, corrosion, and abrasion is important. This alloy is of particular value for furnace parts and heat-treating equipment, such as annealing and carburizing boxes, baskets, lead pots, and pyrometer protection tubes. It also finds general employment in chemical plants and for pumps where resistance to corrosion is of importance, and for extrusion and drawing dies and other parts where abrasive resistance is of value.

Link-Belt Co., Chicago, Philadelphia, and Indianapolis. General catalogue 400, embracing the entire line of the company's products, containing 832 pages, cloth-bound. In addition to the Link-Belt line, the products of the H. W. Caldwell & Son Co.'s plant of the Link-Belt Co. are also covered. The catalogue includes chains and wheels, power transmission machinery, bearings, hangers, gears, clutches, pulleys, sheaves, elevator boots, buckets and casings, helicoid and other conveyor equipment, steel apron conveyors, belt conveyors, boiler plant equipment, coal tipple equipment, coal storage equipment, locomotive coaling stations, car loaders, locomotive cranes, electric hoists, overhead cranes, friction hoists, foundry conveyors, and equipment for numerous other installations in various industries.

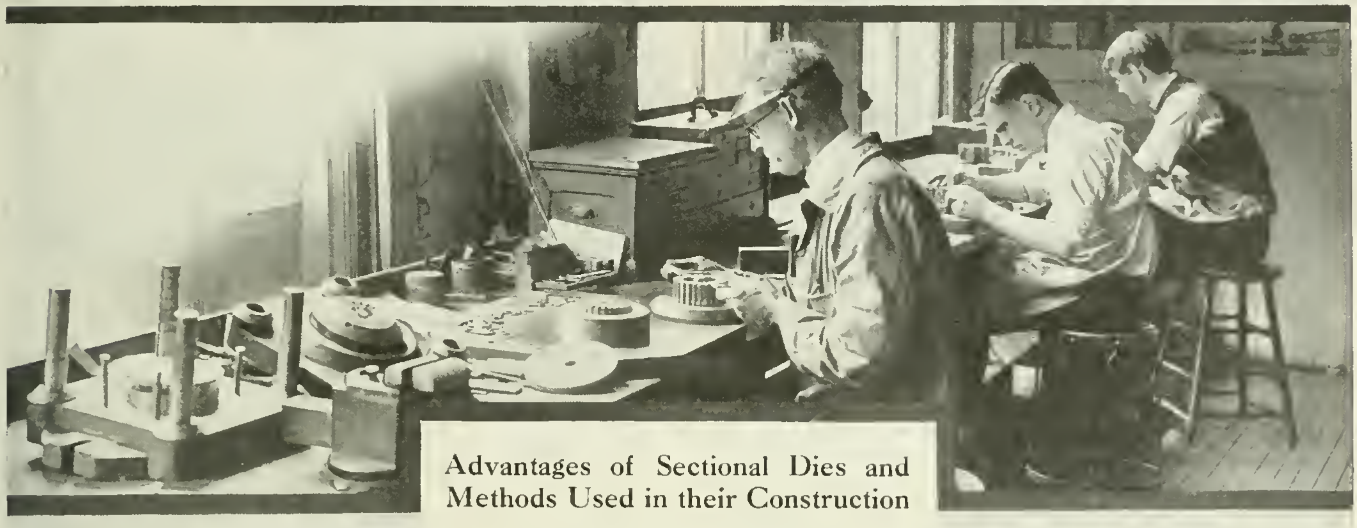
W. S. Rockwell Co., 50 Church St., New York City. Booklet entitled "Elements of Industrial Heating." The purpose of this booklet is to draw attention to the essential factors governing the quality and cost of products subjected to the action of heat in the process of manufacture, and the selection and use of equipment and source of heat necessary to produce better results at lower cost. The influence of heat on the quality and cost of practically all manufactured products, and the comparatively inefficient methods in general use, indicate the necessity of developing a broader view of the industrial heating problem. The book is really an educational treatise on the subject, in that it deals with and contains an unusual amount of information on the design of different kinds and types of furnaces and kindred subjects.

Bullard Machine Tool Co., Bridgeport, Conn. Operator's Handbook for the Bullard Mult-Au-Matic. This book of 93 pages, 6 by 9 inches, contains complete instructions for operating Bullard Mult-Au-Matics, every effort having been made to make these instructions complete and to cover every unit and function of the machine thoroughly. The Mult-Au-Matic comprises six independent individual machine tool units incorporated in one, and coordinated in operation through the introduction of automatic control. A full understanding of the construction, functioning, adjustment, and care of the various units will add materially to the productive capacity of an installation of these machines, and this handbook is intended to make clear every point on which the operator or user would require information. The book is profusely illustrated, and a simple and direct style has been used.

Brown & Sharpe Mfg. Co., Providence, R. I. Screw machine catalogue 23 G, containing 197 pages, 6 by 9 inches, descriptive of the Brown & Sharpe complete line of automatic, wire feed, and plain screw machines, attachments, and tools. A new arrangement has been followed in this edition of the catalogue, the detailed descriptions of the machines being presented in the first part of the book, and condensed tables of general specifications in convenient form for comparative purposes following. Next in order are given complete specifications of all styles and sizes of machines. This grouping of specifications in one section instead of having them distributed throughout the descriptive matter is an advantage, in that it enables the reader to find any desired specification readily. The catalogue contains a large number of illustrations, showing the different styles of machines, as well as detailed views of the various parts and attachments.

JANUARY MACHINERY 1923

Sectional Blanking and Piercing Dies



Advantages of Sectional Dies and Methods Used in their Construction

By FRED R. DANIELS

CERTAIN advantages are claimed for the sectional stamping die over the solid die. In making repairs on dies of this type, it is only necessary to remove the damaged section and replace it with a new part. Other things being equal, this is a decided advantage. Furthermore, difficulties encountered in hardening a large solid die-block are not met with in the case of the sectional die; and each section can be accurately ground and fitted after hardening, thereby correcting errors due to distortion in hardening. In this way, each section can be made identical with every other. In the case of solid dies, errors due to distortion produced by the hardening process are exceedingly difficult to correct.

The accuracy that can be obtained in making sectional dies is also of importance. In order to finish the slots in the solid die accurately, a great deal of difficulty and considerable expense are involved. In fact, the inaccessibility of the surfaces to be finished in a solid die adds to the cost of manufacture sufficiently to balance, in large measure, the expense incident to finishing every member of a sectional die.

It is also said that with the sectional construction the dies can be made thicker than when made solid, which allows for many regrinds and greatly increases the life of the dies The sectional construction is incorporated in the combination blanking and perforating die illustrated in Fig. 1, as well as in the single-action follow-die shown in Fig. 2. Both of these were made by William P. Stein & Co., Rochester, N. Y., whose manufacturing methods are described in this article.

Sectional dies are used extensively in the production of armature laminations for electric motors and generators, and are also applicable to the manufacture of other classes of stampings containing a large number of perforations. The only essential difference in design between the sectional lamination die and the solid die is that the punch holes in the sectional die are formed by sections arranged radially and accurately fitted and assembled on a plate. These assembled sections form the lower die member; the punches, also assembled on a plate, are aligned with the lower die, as in sub-press construction. The present article describes methods used in manufacturing sectional blanking and piercing dies.

The illustration Fig. 1 shows the construction of a typical combination sectional die. The design of the stator stamping produced in this die is indicated in the plan view at the right, and the punch and die sections are shown separately at the left.

Sectional Die Construction

The die sections *A* and punches *B* (there are twenty-five of each), are fastened by machine screws to plates *C* and *D*. The die sections fit around a central die bushing *E*, and a spacer ring *F* is used to build up the die to the level of the fastening lugs on the sections, thereby furnishing a locating surface for the soft steel shrink ring *G* which is assembled around the die sections. By making this ring of unhardened steel, it may be faced off when the length of the die sections has been reduced by grinding to such a degree that there is no longer space for the blanking stripper plate *H* to operate. This plate strips the blanked stock, and is operated by a knock-out mechanism on the press through the medium of plate *I* and the rods extending from it through to the stripper *H*.

The blanking die *J* is fastened to the upper die member by bolts passing through the multiple punch-plate *D* and the plate that carries center-punch *K*. This die has a working clearance for punches *B*. The descent of the press ram causes the blanking die to depress stripper *H* as it blanks the stock, at the same time that the punches perforate the stock and enter the lower die openings. The scrap from the perforating operation is ejected by positive knock-outs which

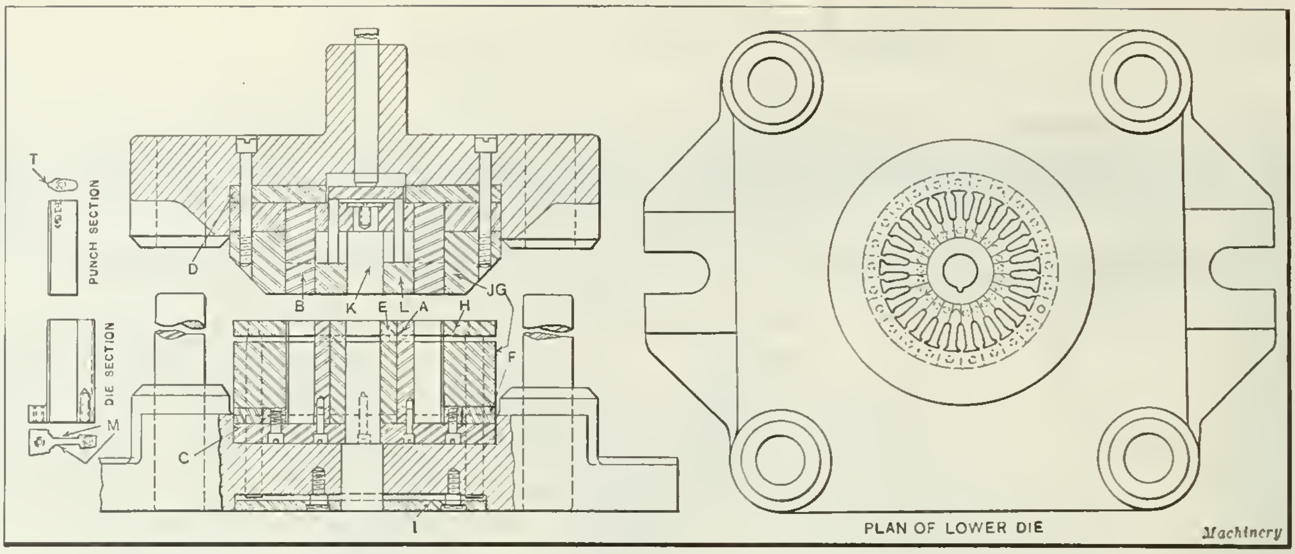


Fig. 1. Sectional and Plan Views of Compound Blanking and Perforating Dies of Built-up Construction

operate in the lower die openings, and the scrap from the center hole drops through the die.

Center-punch *K* is surrounded by a soft steel punch stripper *L*, which operates freely over the center-punch as well as over the punches *B*. Its purpose is to eject the stator stamping from the upper die member, and it is operated by the upper knock-out on the machine. The pins that back up this stripper extend through the center-punch plate and are of such length as to allow an air space between the punch-plate and the stripper. As the punches and the die *J* are reduced by grinding, it becomes necessary, of course, to shorten these pins in order to bring the face of stripper *L* into the same plane as the ends of the punches and die. The punch-block and the die-block are made of cast iron or soft steel, and are aligned by means of four sub-press posts.

It should not be necessary to describe in detail the construction of the follow-die shown in Fig. 2, except to state that the part that is of sectional construction is identical with the combination die, and that the blanking is performed separately in the die at the left. For locating the perforated stock in the second position, after the multiple punches have first operated, a post *A* enters the central hole while the second series of perforations is being made. Then the stock is advanced to the third position for blanking. During this and all subsequent operations, the stock is properly located by post *A* and the centering punch in blanking punch *B*. In this illustration the perforating punches *C* are shown conventionally; however their actual arrangement is very similar to that illustrated in Fig. 1.

In the manufacture of sectional dies the principal operation is grinding, and little else of mechanical interest is involved. In the plant of William P. Stein & Co., the punches and the die sections for lamination dies are made from a high-carbon water-hardening tool steel having a carbon content of from 1.30 to 1.40 per cent. This material is used on account of the extreme hardness and durable quality which it has when properly hardened and tempered.

The bars of steel are cut to the required length to form the die section and punch blanks, and are then milled to shape. Fig. 3 illustrates the form-milling operation by means of which the contour surfaces of the die sections (see Fig. 1) are produced. The operation is an ordinary one, and consists of locating the sections at the proper angle, which is done by employing a universal milling vise with dial adjustment. A No. 2 Cincinnati universal milling machine and a formed milling cutter are used for this operation. An allowance of 0.0075 inch on each surface is made for grinding. Before hardening, both the die and punch blanks are drilled and tapped at one end for machine screws by means of which they are fastened to the plate that holds them in the die and during certain grinding operations. These holes are located by bushing plates which fit on the end of the sections and are located by small pins positioned according to the sectional shape of the work.

Some manufacturers do not advocate the use of a water-hardening steel for dies, principally on account of the difficulty encountered in hardening, but in the case of a sectional die where distortion can be corrected by grinding all over, the experience of William P. Stein & Co. has shown that a water-hardening steel is superior to any other. The engineers of the company state that motor builders

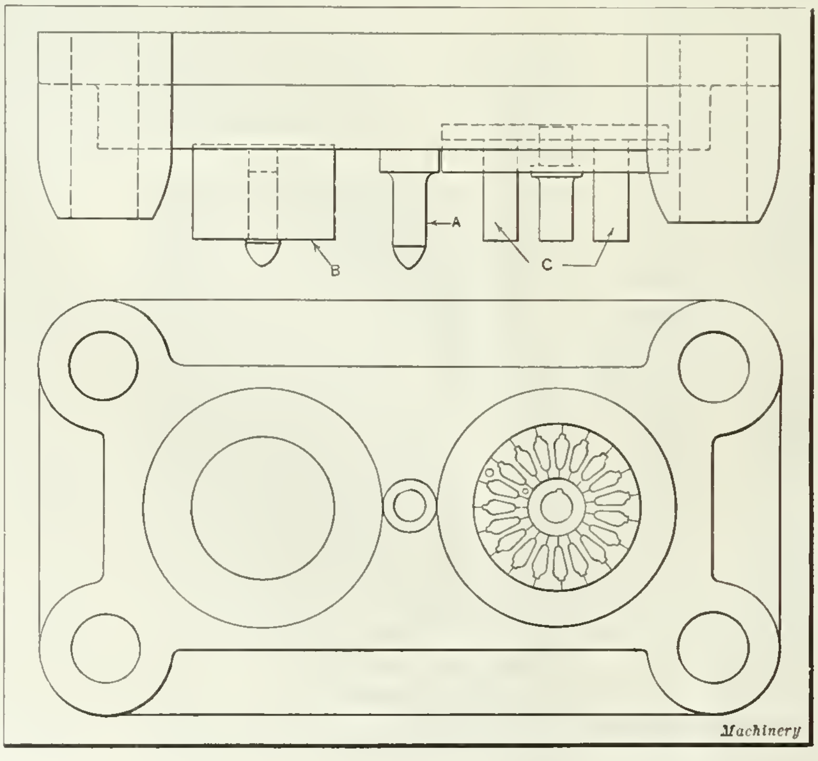


Fig. 2. Follow-die in which the Perforating Die is of Sectional Construction

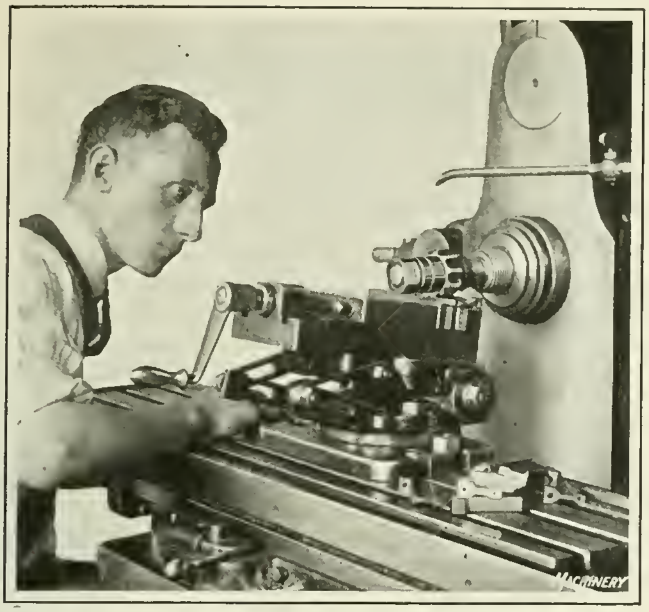


Fig. 3. Form-milling the Sides of the Die Sections

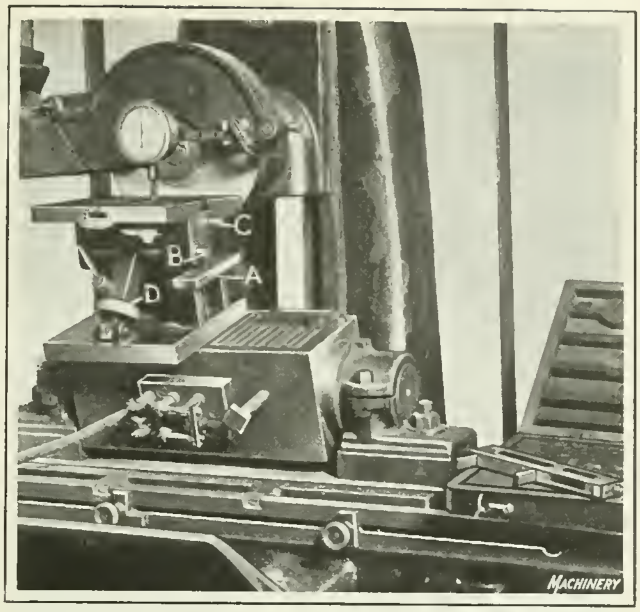


Fig. 4. Grinding Angular Sides of Die Sections

using these sectional dies report that from 50,000 to 100,000 motor stampings have been produced with one set of dies without regrinding. Furthermore, the length of the die sections permits grinding away about 1½ inches of metal, which, under normal conditions, removing about 1/64 inch per grind, would be equivalent to ninety-six regrinds. From this statement of the manufacturers it will be seen that the production from one set of sectional dies may easily run into the millions.

Handling of the parts in the fire, in quenching and tempering, must of course be done by experts. In general, the steel is heated to about 1450 degrees F. and quenched in brine, which gives extreme hardness, but which sets up a severe molecular strain in the material. To relieve this strain, the work is tempered in oil at a temperature of 425 degrees F. for approximately thirty minutes. Any distortion resulting from heat-treatment is immaterial, at this stage of manufacture, as this is afterward corrected by grinding. Each part must pass a scleroscope hardness test before delivery to the grinding department. Not only is it important that the proper degree of hardness be obtained, but also that each punch and die section in a die have the same hardness. It will be readily understood that if any one of the sections is not as hard as the others, a vulnerable spot is produced which wears quickly and consequently greatly shortens the life of the dies.

Close Grinding Limits Necessary

The grinding of the punches and die sections is essentially the same for both the compound and the single-action dies. In both cases, the hardened parts are ground all over so that each section and each die is a duplicate of each other within a limit of 0.0001 inch on every dimension. Between each punch and each die opening, a working allowance is made, equal to 5 per cent of the thickness of the stock from which the stampings are made. That is, for a stamping 0.020 inch thick, there would be a theoretical space all around, between the punches and die sections, of 0.001 inch. On the single-action push-through die, where no ejectors are provided for removing the scrap from the dies, it is necessary to have a slight taper in the die openings. Accordingly, each section going into a die of this kind is ground to produce a hole having a taper of about 0.004 inch per inch of length; that is, 0.002 inch per inch on both contour surfaces of every die section. In other respects, the grinding operations on both the combination and push-through dies are the same.

The die sections and punches are held on swivel-magnetic chucks during grinding, which must be accurately set at the proper angle. This setting is important, as often twenty-five or more sections are used in a die and errors in the included angle of die sections accumulate rapidly, resulting

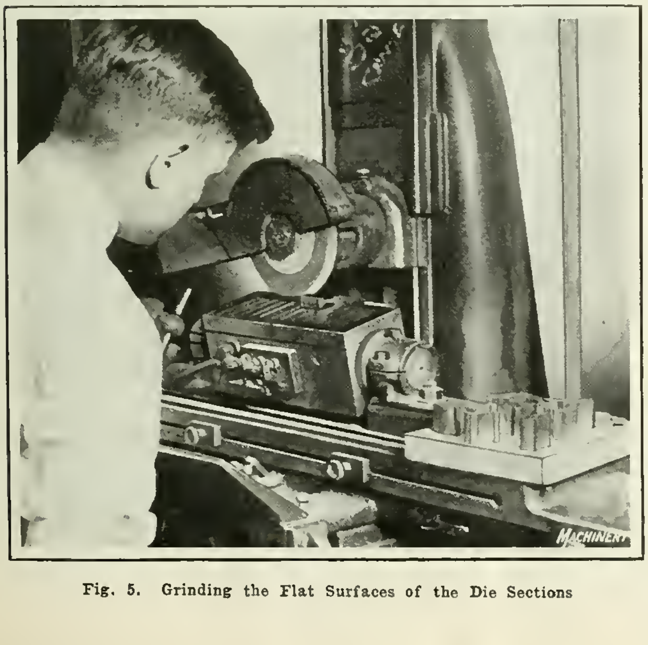


Fig. 5. Grinding the Flat Surfaces of the Die Sections

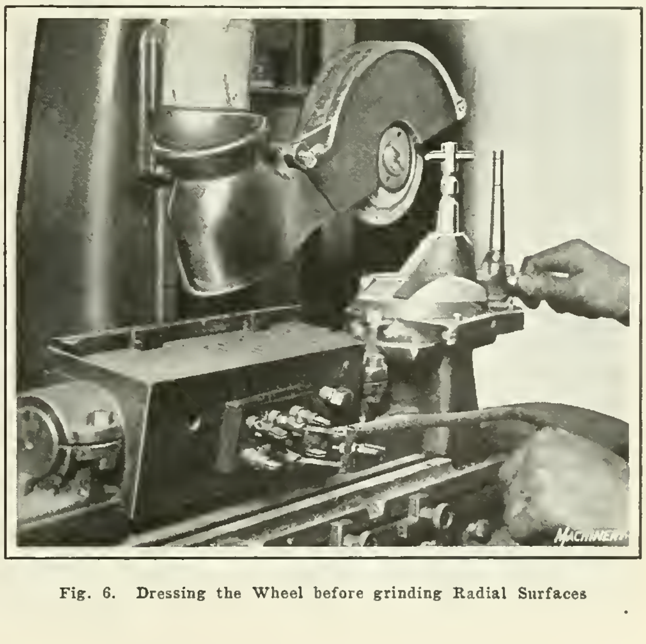


Fig. 6. Dressing the Wheel before grinding Radial Surfaces

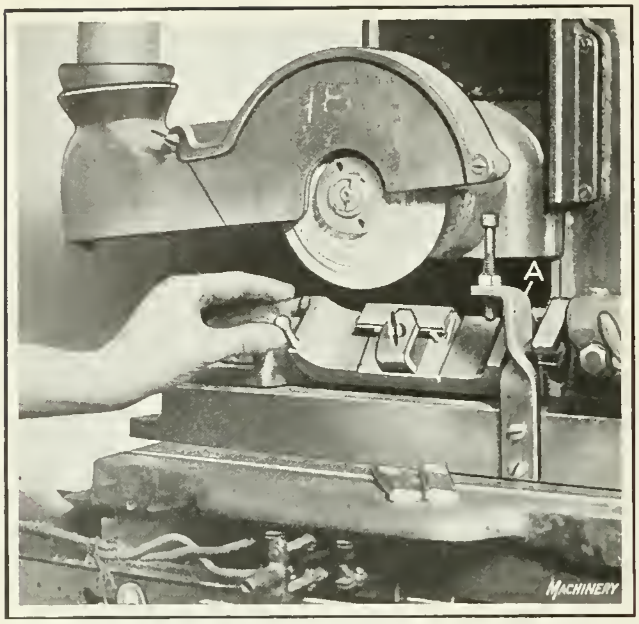


Fig. 7. Cradle Fixture in which the Radial Surfaces of the Punches are ground

in either an over-size or an under-size stamping and other inaccuracies which it is almost impossible to predetermine. Fig. 4 illustrates the method of setting the swivel magnetic chuck to the correct angle. An approximate setting can be obtained by means of the graduated scale on the chuck, but this does not give the necessary degree of accuracy.

Establishing Angularity of Working Surface for Grinding

The angular setting of the swivel chuck is obtained by the supplementary use of a sine angle-plate, a dial indicator, and precision gage-blocks. A Walker magnetic chuck is used, the working surface of which is set at the approximate angle by means of the graduated dial. If it is assumed that there are twenty-five die sections, then the included angle between the sides of each section will be 360 ÷ 25, or 14 degrees 24 minutes. The sine angle-plate, shown on the magnetic chuck in the illustration Fig. 4 is then set to this angle.

It will be seen that there are two hardened and ground measuring plugs on the angle-plate. These are located a unit distance from the center on which the T-slotted table swivels. Measurements can be taken from the under side of shelf *A* over either of these measuring plugs, according to whether the sine of the angle or the sine of its complement is being used in the calculations (the sine of the complement angle will, of course, be the same as the cosine of the angle.)

Since the distance from the center of rotation of the table to the outer periphery of each of the two plugs is unity, then a measurement taken from the shelf over plug *B* will give the sine of 14 degrees 24 minutes, if the distance from the center of rotation to the under side of shelf *A* is subtracted. If the latter distance is known to be 1 inch, then the measurement over the plug should be 1.24869 inches. Similarly, if the measurement is taken over plug *C*, the cosine of the angle will be obtained, and the correct measurement would be 1.96858 inches. To obtain either of these measurements, the holder furnished with precision gage-blocks can be readily set to caliper the required measurement. In adjusting the working surface of the sine angle-plate, a telescopic adjusting screw *D* is employed, and after the measurement has been obtained the position is secured by means of a lock-screw.

A dial indicator is then clamped in any convenient position, as for example, to the wheel guard, while the indicator point is permitted to ride on the table of the angle-plate as the machine table is manipulated. Errors in the original setting of the magnetic chuck are then noted and corrected. The dial indicator used in this work is graduated to ten-thousandths inch, so that very slight errors in the setting of the magnetic chuck can be detected.

Grinding the Die Sections

The setting of the magnetic chuck at the correct angle establishes a working surface from which the desired accuracy in the included angle of die sections and punches can be obtained, but expert workmanship is required to produce this result. The grinding of the sides of the die sections is illustrated in Fig. 5. For this operation a No. 2 B & S surface grinder, equipped with a Walker swiveling magnetic chuck and a No. 80-I Norton alundum wheel is used. A square-faced wheel is used for grinding the angular sides, the surfaces *M*, Fig. 1, and the surfaces forming the fit for the tongue *T* on the punch section.

In grinding the surfaces forming the rounded end of the die openings, the same set-up is used, but the grinding wheel is dressed to the proper radius to give the desired curvature. The preparation of the wheel for this operation is illustrated in Fig. 6, where a radius grinding-wheel dresser, employing a diamond tool, is being used. The length of radial adjustment of this tool permits dressing the wheel to any radius within the limitations of the tool. This grinding operation is performed on a No. 2 B & S surface grinding machine equipped with a swiveling magnetic chuck. Next the outer and inner circular surfaces of the sections are ground, after they have been properly attached to a retainer plate. These operations are performed on a No. 13 B & S cylindrical grinder using a No. 60-1 Norton wheel.

The die sections have thus been ground all over, and, after inspection, are returned to the grinding machines where finish-grinding operations are performed on all contour surfaces to produce a working clearance for the punches. If the dies are of the single-action push-through type, the finish grinding operation produces a taper hole, and in locating the work the set-up shown in Fig. 5 is used, but one end of the sections is raised with a shim of proper thickness. The section shown on the chuck is 1 inch long and a shim 0.002 inch thick is used when grinding the taper; thicker shims are used under die sections of greater length to give the same rate of taper. Die sections for combination dies form straight holes, and for such dies the finish-grinding produces a working clearance for the punches of 5 per cent of the stock thickness. The finish-ground sections, still magnetized, are wrung together after grinding, and a master punch is used as a plug to gage the hole formed by every pair of sections.

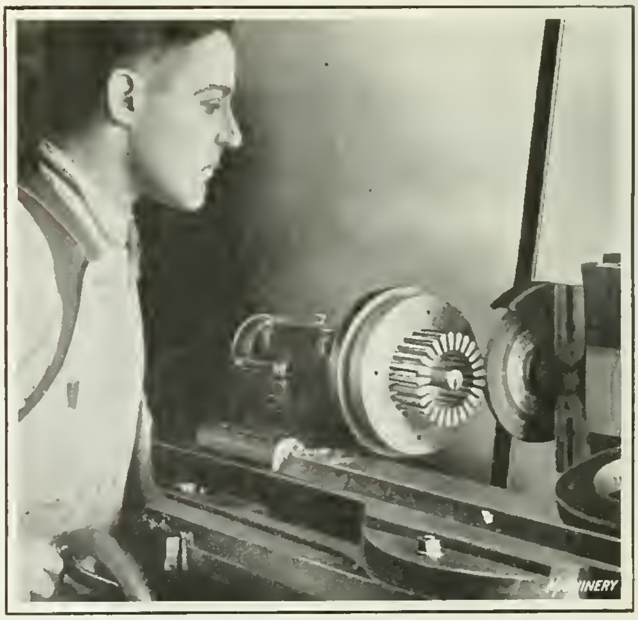


Fig. 8. Grinding the Punches to fit the Die Ring after assembling in the Punch-plate

Grinding the Punches

The sides of the punches are usually angular, as shown in Fig. 1, and they are ground on a swivel magnetic chuck. For grinding the radii at the ends, a swivel-block fixture is used in the manner indicated in Fig. 7. Two punches are shown lying on the table of the No. 2 B & S surface grinder that is used in this operation. The fixture is held on a magnetic chuck and carries a cradle mounted between centers, on which the punches may be located, resting against two pins and secured by a clamp. The operator rocks this cradle back and forth as the table reciprocates until the radius being ground becomes nicely blended with the angular sides of the punch.

The swing of the cradle is limited by two adjustable stops, one at the front shown at *A*, and a similar one at the rear. By simply adjusting these stops, all punches in a set may be ground alike, with a continuous even surface joining the sides. The radii on each side of the tongue at the opposite side of the punch are also ground in this fixture. The wheel has a square face, and by proper adjustment a sharp corner can be maintained at the root of the tongue adjoining each radius. For these operations a No. 80-I Norton alundum wheel is employed.

Another operation on the punches, which is indispensable for the efficient operation of the dies, is grinding the peripheries after they have been assembled in the punch-plate. This operation is performed on a No. 13 B & S cylindrical grinder, as illustrated in Fig. 8. A No. 60-I Norton alundum wheel is used, and the set-up is similar to that used in grinding the assembled die sections; in this case, however, the die sections are ground on both the outer and inner circular surfaces, the inner surfaces subsequently being fitted around the center die bushing *E*, Fig. 1. In grinding the punches to fit the die ring through which they operate, a clearance of 0.0075 inch is provided, that is, the diameter is ground 0.015 inch less than the diameter of the die ring.

Operations on the Punch Stripper

The soft steel punch stripper *L*, Fig. 1, works over the punches, and the holes in it must, of course, be accurately spaced and provided with proper working clearances. The slots are located by first drilling a series of holes, using a dividing head to space their location accurately. A broach of special shape is then used to finish these holes, the work being performed on an arbor press. After broaching, the holes are slotted open at the periphery of the stripper, as illustrated in Fig. 9. The swivel fixture on which the stripper is seated during the operation is rotated from hole to hole in locating the tool centrally in each broached slot. The operation is performed on a No. 2 Cincinnati universal milling machine equipped with a slotting head, and the work is fed backward past the vertically reciprocating cutter by hand. Accurate spacing is the main consideration in machining these slots and the assembled punches serve as a gage. However, there is considerable leeway in regard to the clearance for the punches.

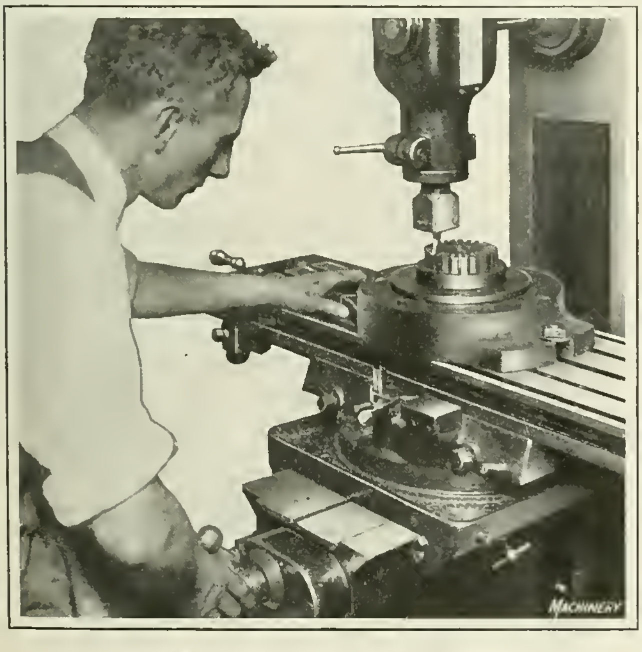


Fig. 9. Slotting the Stripper to accommodate the Key Section on the Punches

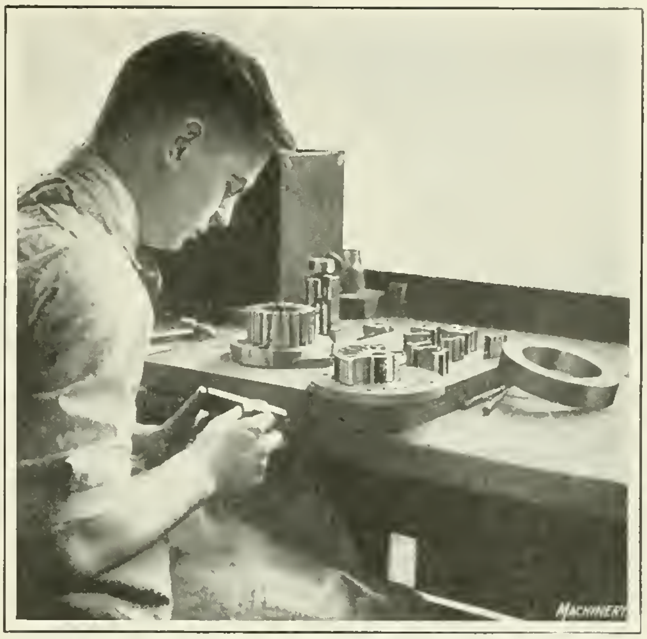


Fig. 10. Fitting the Die Sections preparatory to shrinking on the Retainer Ring

Final Bench Work and Assembling

After all the die sections have been carefully ground, they are delivered to the bench where the final assembling and fitting is done. The center bushing, which is a hardened and ground steel member, is then fastened to the plate on which the circular surfaces were ground, and each die section is carefully stoned and fitted around this bushing by hand. This operation is illustrated in Fig. 10. After the sections have been fitted, the die openings are matched up with the assembled punches, and the die sections fastened to the plate. This operation is of the highest importance, as the efficiency of the die depends largely on the skill with which the die sections are finally assembled.

After the sections have been fastened to the plate, a soft steel shrink ring, shown lying on the bench, is shrunk over the die sections. This die ring is sufficiently narrow to allow space for the operation of the blanking stripper plate *H*, Fig. 1, and is made of machine steel so that it can be faced off as the dies are ground down in sharpening. The blanking die ring *J* is a carefully hardened and ground member assembled over the punches and fastened to the upper die-holder by bolts, as shown in the sectional view.

* * *

In connection with the presidential address of Dean Kimball of the College of Engineering of Cornell University before the American Society of Mechanical Engineers, on the future leadership of the engineer in the world of affairs, it is interesting to note that the Carnegie Institute of Technology has made an investigation as to the positions now occupied by graduates of the institute. This investigation indicates that approximately 67 per cent of the graduates between 1908 and 1921 are now engaged in commercial or managerial work, which is substantial proof of the need of commercial training in engineering college courses. The majority of engineering graduates use their technical education as a means of entering commercial or managerial work.

STANDARDIZATION OF NUTS AND BOLTS

By ANDREW J. SCHWARTZ

The urgent need for standardization of nuts and bolt heads was discussed in April, 1921, MACHINERY, on page 791. At that time an appeal was made for a single standard for the width across flats, or the "short diameter" of bolt heads and nuts, since, as pointed out in that article, there are now seven standards of widths in actual use. There is a wide divergence in these standards; for example, in the table published in the preceding article it will be seen that in the case of a ⅝-inch diameter bolt head or nut, there is a difference of ⅜ inch in the short diameters of the largest and smallest of these standards.

The writer has since given the subject further study and has reached the conclusion that the standard width of bolt and nut adopted by the Society of Automotive Engineers should be taken as an international, or at least a national standard. These proportions of nuts and bolt heads are used almost exclusively in automobile engines, and their reliability has been thoroughly tested under severe conditions in aircraft construction. Furthermore, the saving in material that can be effected by using smaller sized bar stock in the manufacture of bolts and nuts, as well as in the number of wrenches, is considerable.

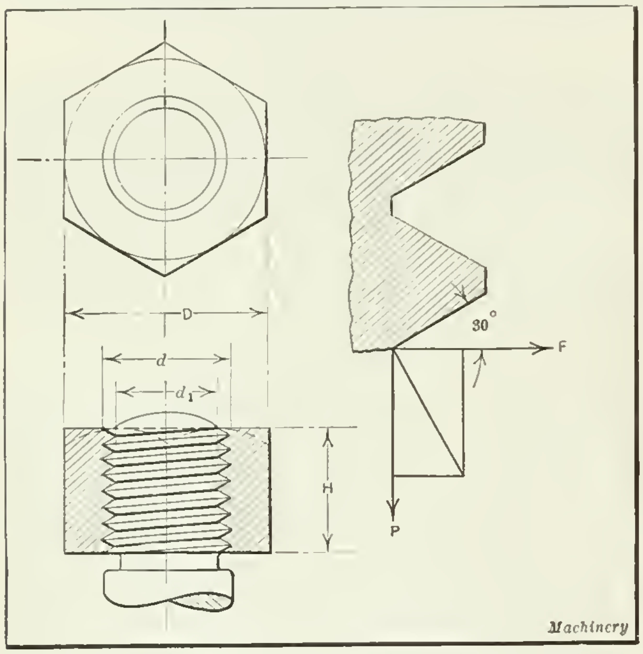


Diagram used in investigating Standards for Nuts and Bolts

Coarse-pitch Threads Give Ample Strength

Some manufacturers would adopt the S. A. E. standard width of head, but object to the fine threads that go with this standard. It can be mathematically shown, however, that if the coarser pitches of U. S. standard threads are used in S. A. E. standard nuts, the latter will still have ample strength, as compared with the bolt. A nut may fail from two common causes—from the threads stripping, and from the nut bursting.

In considering the strength of the threads to resist stripping, it is necessary that the depth of the nut be so established that the shearing strength of the threads will at least equal the tensile strength of the bolt. As the shearing strength of the steel is about 4/5 the tensile strength, the cross-section of the V-threads at the minor diameter of the bolt—that is, the area of the cylinder produced by stripping the V-threads at the root—should be to the cross-section area of the bolt in the ratio of 1 to 0.8. But since the top and bottom of the U. S. standard screw thread has a flat equal to ⅛ the pitch, only ⅞ of this cross-section of the thread is effective to resist shearing.

Referring to the accompanying illustration, H represents the thickness or height of nut, and d the nominal diameter of the bolt. From the preceding statements we have the following:

$$\frac{\pi d^2}{4} = \frac{4}{5} \times \frac{7}{8} \pi d H$$

or

$$0.25\,d = 0.70\,H \text{ and } H = 0.357\,d$$

This formula shows that, provided we have a nice fitting thread, if the thickness of the nut is approximately three-eighths the diameter of the bolt, it will be sufficiently strong to resist stripping the threads.

All threads, however, are not perfect so that the thread is not in shear but rather is in effect, a beam fixed at one end with the load some distance out. Consequently, allowing for poor workmanship and fit, we may say that a nut that is one-half instead of three-eighths the depth of the bolt diameter will be ample to resist stripping the threads.

Diameter of Nut to Resist Bursting Load

If we analyze the combined axial and radial pressures which cause a nut to burst, we can show mathematically what diameter of nut will be sufficient to withstand the forces that tend to burst it.

In the stress diagram shown at the right in the illustration, P represents the load on the nut and F the resultant radial pressure. The calculations show that

$$S = \frac{2f \times 0.7\,d \tan 30 \text{ deg.}}{12H} \times \left(\frac{2D^2 + d^2}{D^2 - d^2}\right)$$

in which

S = unit tensile stress in nut;
f = unit tensile stress in bolt;
d = diameter of bolt;
D = distance across flats; and
H = height of nut.

But the unit tensile stress f in the bolt should equal that in the nut, so that

$$1 = \frac{1.4d \tan 30 \text{ deg.}}{12H} \left(\frac{2D^2 + d^2}{D^2 - d^2}\right)$$

from which

$$D = d\sqrt{\frac{12H + 1.4d \tan 30 \text{ deg.}}{12H - 2.8d \tan 30 \text{ deg.}}}$$

We will now substitute numerical values for a one-inch diameter bolt in the foregoing formulas and derive the distance across flats (1) when the height of the nut H is equal to ½ d; and (2) when it is equal to d.

When H equals ½d:

$$D = d\sqrt{\frac{6 + 1.4 \times 0.5773}{6 - 2.8 \times 0.5773}} = 1\tfrac{1}{4} \text{ inches (nearly)}$$

When H equals d (present U. S. standard):

$$D = d\sqrt{\frac{12 + 1.4 \times 0.5773}{12 - 2.8 \times 0.5773}} = 1.11\,d \text{ or } 1\tfrac{1}{8} \text{ inches (nearly)}$$

The present U. S. standard for the distance across flats of nuts for 1-inch diameter bolts is 1⅝ inches, instead of 1⅛ inches.

The effect of friction, which will lessen the radial pressure F, has not been considered in arriving at these results, but this will have a tendency to reduce rather than increase the diameter of the nut. It will be seen that the short diameter of the nut should vary proportionately with the height H, and need be only ⅛ to ¼ greater than the nominal diameter of the bolt to prevent bursting.

Taking everything into consideration, the author is of the opinion that the width across flats, or the short diameter, and the height of the U. S. standard nut should be reduced to the sizes and standards now used and recommended by the Society of Automotive Engineers.

Electric Stop for Drawing Presses

By GEORGE W. WILDER

THE automatic electric stop described in this article was designed for use on Farrel roll-feed double-action presses which were employed in the production of screw shells such as are used on incandescent electric lamp bulbs and sockets. Each press was equipped with a gang or multiple die designed to blank and draw five shells at one stroke. In drawing the shells from 0.010-, 0.008- and 0.006-inch metal it occasionally happened that the bottom of a shell would be pushed through, as shown in Fig. 1. If the press was not stopped immediately when this occurred, the scrap shells would pile up on the die, frequently stopping the press. In such cases it was necessary to employ a long lever to release the dies. The dies were often broken or otherwise made unfit for future work as a result of this treatment.

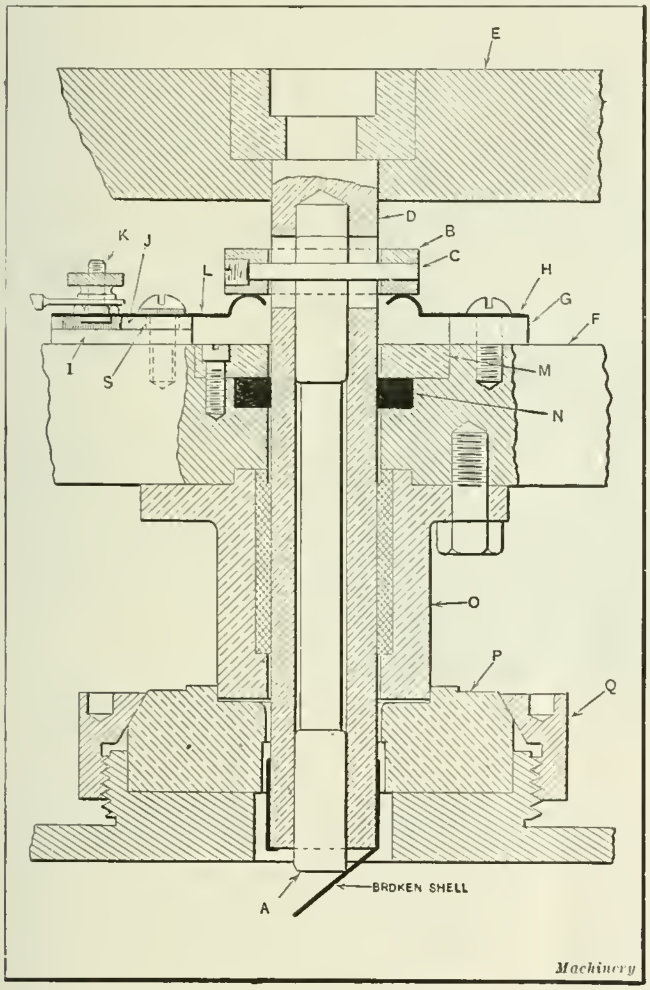


Fig. 1. Shell Blanking and Drawing Die equipped with Electric Stop

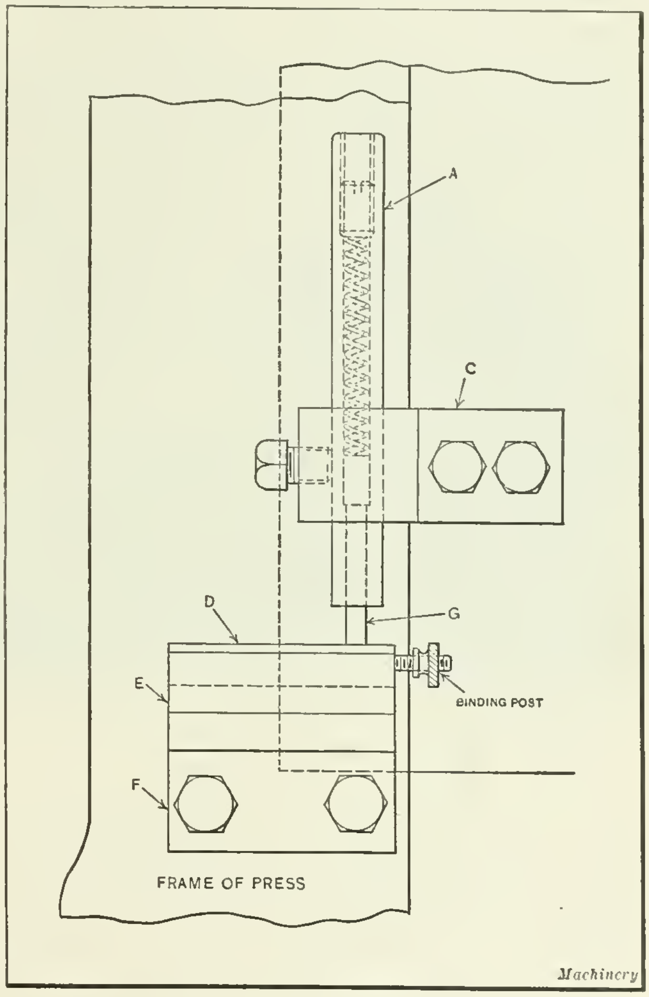


Fig. 2. Make-and-break Contact Device used with Press Stop

The electric stop eliminated this trouble by automatically stopping the press whenever the bottom of a shell pushed through, thus making it possible for one operator to attend four presses, where it had previously been necessary to have an operator for each press. An electric bell was also placed on the presses so that the operator's attention would be called to a machine as soon as it stopped. The construction of the automatic stop is as follows: A collar *B*, Fig. 1, is attached to each of the gang punches, and held to the push-pin *A* by a threaded dowel-pin *C*. This collar is designed to make contact between the brass springs *H* and *L* when the bottom of the shell is pushed through. Spring *H* is fastened to a brass block *G*, which is grounded on the press through the cutting punch-holder *F*. Spring *L* is prevented from grounding on the cutting punch-holder by the fiber blocks *J* and *I*. In order to prevent the screw that holds blocks *J* and *I* in place from making a short circuit between the punch-holder *F* and the contact *L*, an insulating bushing *S* was made of fiber and the screw inserted through this bushing. At the outer end of spring *L* is placed a terminal post *K* to which is fastened a wire. This wire, in turn, is connected in series with contacts *L* on the other four punches of the same press as indicated in Fig. 4.

Make-and-break Contact Device

Each press is also equipped with a make-and-break device, such as shown in Fig. 2. This device is provided with a plunger-holder *A* fastened to the blanking slide by the bracket *C*. When the slide is down within 1/16 inch of the bottom of the stroke, the spring-actuated plunger *G* makes contact with the brass plug *D* which is held in the fiber insulating block *E*. The fiber block is fastened to the frame of the press by the bracket *F*. By completing the circuit in this way, the electrically operated latch shown in Fig. 3 can be tripped only when the press is within 1/16 inch of the bottom of the stroke. The plunger-holder *A* is adjustable, however, so that this distance can be decreased or increased, as the nature of the work may require.

The rod that connects the clutch key and treadle of the press was replaced by the tripping mechanism shown in Fig. 3. The clutch trip lever *U* is connected to the lever *W* by rod *V*. The treadle is also connected to lever *W* by rod *X*. When the treadle is pressed down by the operator's foot in starting the press, lever *W* is caught and held under roll *Y* on the electric latch. The clutch trip lever *U* is thus drawn down so as to clear the clutch key. When the latch is released, the levers fly up into the position shown by the dotted lines. The clutch trip thus engages the key and stops the press. If it is desired to stop the press without releasing the electric latch, all that is required is a slight pull on the hooked end of lever *W* which has an elongated hole in it that permits a lengthwise movement of about ⅜ inch.

Operation of Stop

The operation of the stop is as follows: Referring to Fig. 1, the metal is fed under punch *O* which cuts the blank and holds it in the drawing die *P*; drawing punch *D* then descends and draws the shell. If the bottom of the shell is not pushed out, the press continues to operate. The make-and-break device shown in Fig. 2 makes a contact when the blanking slide is down within 1/16 inch of the bottom of its stroke and continues to maintain this contact until the slide is moved upward about 1/16 inch on the return stroke. The press is so timed that although the drawing slide has a longer stroke, both slides start upward together and maintain the same speed for about ¼ inch of the upward stroke.

It is clear, then, that if the bottom of the drawn shell is not pushed out, the push-pin *A*, Fig. 1, will be held flush with the bottom of the drawing punch. Pin *A* must project from the punch end about ⅛ inch in order for collar *B* to make contact with springs *L* and *H*. As the drawing slide returns, the shell is stripped from the drawing punch by the bottom of the die *P*, and before the push-pin can drop so that it projects ⅛ inch below the punch, the contact made by the make-and-break device shown in Fig. 2 is broken. It requires a movement of only 1/16 inch to break the contact so that it is impossible to trip the press automatically until contact is made again at the end of the next downward stroke.

If the bottom of the shell is pushed out on the drawing stroke, push-pin *A* is permitted to drop and the collar *B* to make contact with the springs *H* and *L*, which results in releasing the electric latch *Y* shown in Fig. 3. When the electric latch is released, the tripping levers on the press take the position shown by the dotted lines, causing the clutch trip to throw out the clutch and stop the press before another revolution is made. Some difficulty was experienced at first from the lubricant used on the metal being forced into the contacts and causing short circuits. A rubber washer *N*, Fig. 1, placed in the punch-block *F* prevented the lubricant from reaching the contact points and thus eliminated this trouble.

When the end of a roll of metal is reached, the contacts act in the same way as when the bottom of the shell is pushed out, and stop the press. The maximum production of 280,000 shells per day was reached and maintained by each of the four presses equipped with this stop, for a period of over four weeks. The presses were operated ten hours per day at a speed of 105 revolutions per minute. The average shutdown time for each press was one hour per day during the period of four weeks.

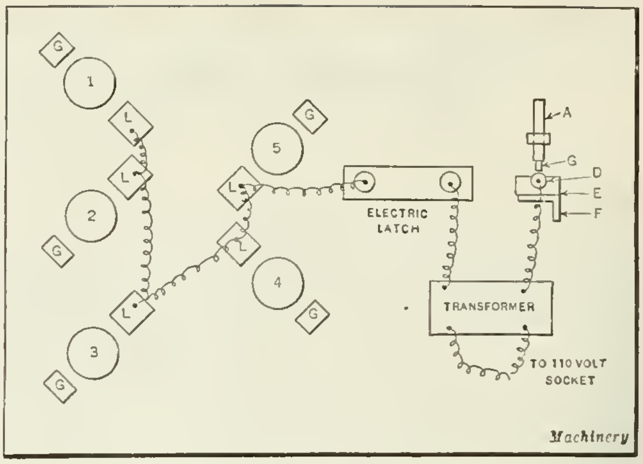


Fig. 4. Wiring Diagram of Electric Stop System on Gang Punch

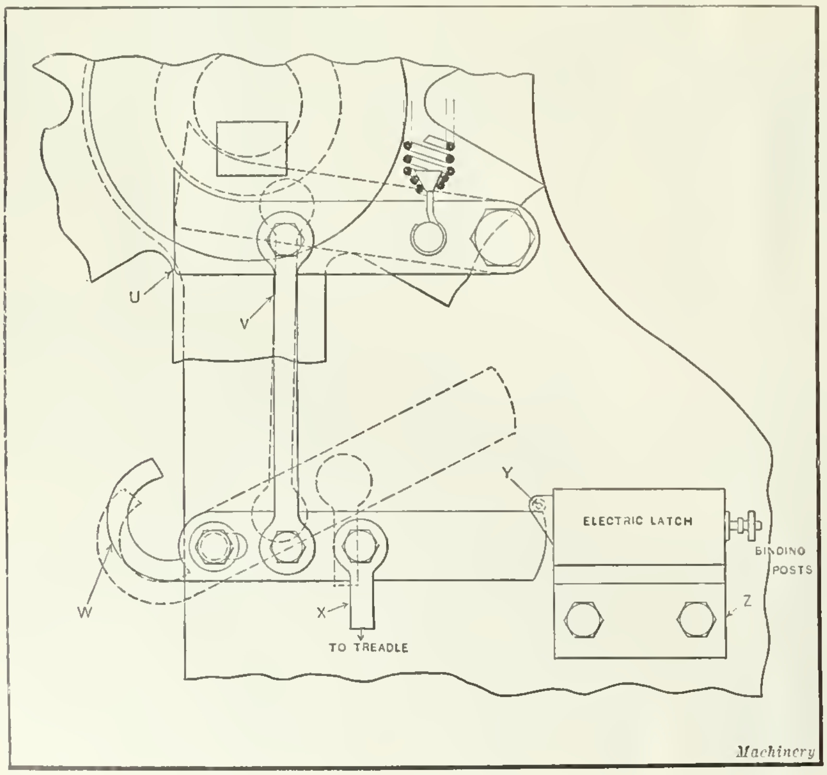


Fig. 3. Press Clutch Trip operated by Electric Latch

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ELECTRICAL DEVELOPMENTS IN 1922

One of the tendencies in the electrical field in 1922 was the increase in the size of individual units for generating electric power. The maximum size reached for steam turbine generators was 62,500 K. V. A. The size of hydraulically driven generators was increased to 65,000 K. V. A., one of this size being built for the power developments at Niagara Falls. The largest transformers ever built are now under construction; these are 80,000 K. V. A. units for use in connection with 220,000 volts circuit. Oil circuit breakers of capacities greater than in the past have been designed, the largest so far built having an interrupting capacity of 600 amperes at 220,000 volts. Important advances have also been made during the year in the application of automatic control equipment. The largest fully automatic single-unit hydro-electric station built during the year consists of a 5000 K. V. A., 2300-volt, 60-cycle hydraulically driven generator. In the electric railway field the outstanding feature of the past year was the renewed interest in railway electrification.

Grinding Large Cylinders

Although the practice of grinding automobile engine cylinders is common, cylinders of large size, such as are used in stationary steam and gas engines and pumps are not generally finished in this way. However, in the cylinder regrinding plant of the Houpert Machine Co., Long Island City, N. Y., large stationary engine and pump cylinders are ground on the cylinder grinding machine illustrated in this article. The machine is made by Mayer & Schmidt of Germany, and the two views, front and rear, show it set up for regrinding a steam cylinder for a Worthington duplex hydraulic pump. These machines have a capacity for handling cylinders up to 32 inches diameter of bore and 80 inches long; the one shown is of medium size, however, being 20 inches in diameter and 44 inches long. For this job a grade 36 H crystolon wheel, 14 inches in diameter and ¾-inch face width was used.

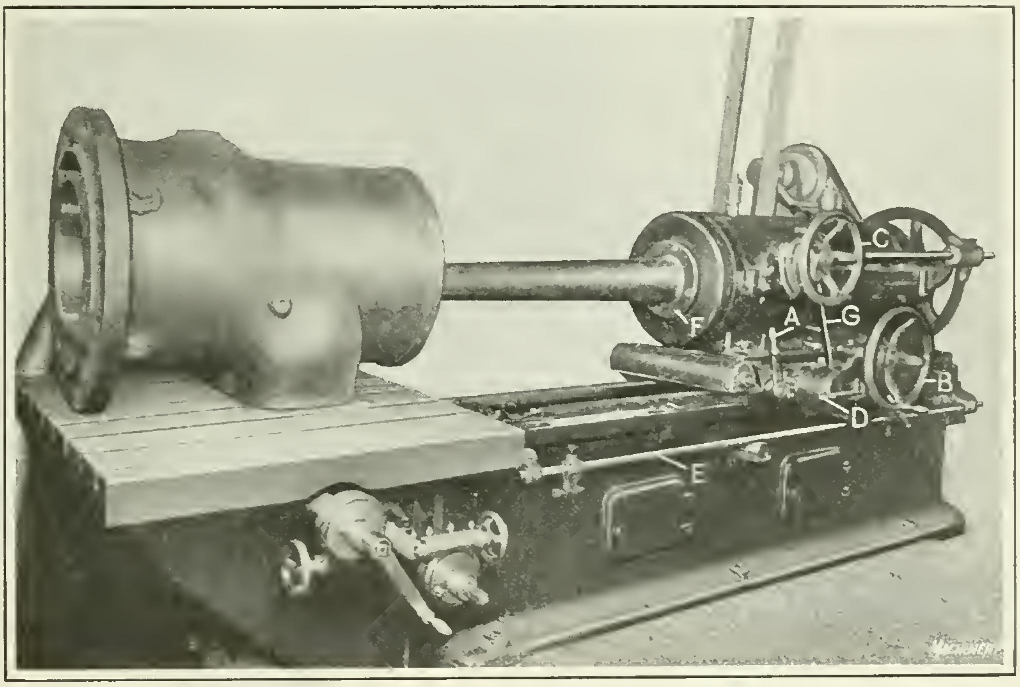

Fig. 1. Front View of Cylinder Grinding Machine with Movable Wheel-head and Stationary Work-table

The machine spindle has a planetary motion, and its radial feed and longitudinal traverse are automatically controlled. The machine differs from familiar types of American-made cylinder grinding machines, first, in regard to its massiveness and capacity, and, second, in the arrangement of the grinding head and work-table. The grinding head, or wheel-head, is moved on the ways of the machine, while the work is held stationary on the table, which is directly the reverse in the operation of American-made cylinder grinders.

A maximum throw of 1¼ inches is obtainable by adjustment of the eccentric. This important part of the machine consists of a long tapered arm *F*, Fig. 1, which is bolted to a sleeve contained within the wheel-head housing. The spindle that carries the grinding wheel extends through the arm and the sleeve, and is mounted on ball bearings. The sleeve inside the housing is located at an angle with the longitudinal center line of the machine, and the exterior surface of the sleeve forms an incline on which a wedge member is advanced to move the spindle radially. This adjustment is effected by turning the handwheel *C*, which revolves a large spur gear at the extreme end of the machine.

On the driving side of the machine, Fig. 2, near the flanged pulley will be seen the part of the wheel-head in which the eccentric driving gears are located. The longitudinal movement of the wedge member, to effect the total radial adjustment of the eccentric, is considerable, and since this wedge member drives the sleeve, it carries a long spur gear, the teeth of which remain in mesh with the driving gears, regardless of the longitudinal position of the wedge member.

Operation of the Cylinder Grinder

The work is first clamped to the table with the bore parallel to the center line of the spindle. Handle *A*, Fig. 1, is then operated to engage the clutch on the driving pulley (see Fig. 2), which drives the eccentric. The arm, extending to the clutch at the rear of the machine, may be seen at *A*, Fig. 2. The wheel-head is then advanced by means of handwheel *B*, Fig. 1, and the table adjusted laterally or vertically until the bore is centralized and the spark shows that the wheel is cutting equally on all sides. The adjustment of the table is effected by means of a crank-handle, and the position of each adjusting shaft is then secured by means of ratchets.

The adjustment for the eccentric throw is made through handwheel *C*, as previously mentioned, this adjustment being used only in setting up the machine. The wheel-head is advanced until the wheel extends nearly through the cylinder being ground, and there also the correct alignment of the cylinder and grinding machine spindle is assured by observing the sparks at various points.

While the wheel-head is at its extreme forward point, the front stop on the feed-rod *E* is set, as well as the amount of feed for the eccentric. The amount of feed for the eccentric per stroke is governed by a connecting-rod *G*, which extends up to a ratchet and a pawl in back of the handwheel *C*, where there is a graduated dial for setting the pawl to give the proper depth of cut in thousandths of an inch per traverse of the wheel-head. The automatic reversal of the wheel-head is accomplished by first engaging the clutch on the feed-shaft (located within the base) by means of lever *D*, so that as the head is fed to the rear, the rear stop on rod *E* can be set to contact with a finger on the wheel-head, at the end of the stroke. This moves the feed-rod and shifts the differential gears that drive the feed shaft.

The differential gear-box is shown in the lower left-hand corner of Fig. 2, and the feed gears are driven by a separate belt from the countershaft. The wheel-head is thus provided with six rates of longitudinal feed, three of which are obtained by the cone pulley and two by the differential. The wheel-head rides on a flat way at the front of the machine, and on a V-way at the rear, which permits sufficient lateral movement so that the wheel will follow the bore of the work without causing the spindle to be deflected. This is important, especially in a machine where a large moving member must maintain accurate alignment with the work.

On the driving side of the machine, Fig. 2, the cone pulleys from which the spindle is driven are shown. The bracket carrying the upper pulley shaft is constructed to serve as a belt tightener, the center-to-center distance of the two pulley shafts being changed by the nut shown between them. It will be seen that there are three spindle speeds available. The driving belt runs on a long drum as the wheel-head travels back and forth on the ways of the machine.

Conclusion

The operation of grinding large cylinders does not differ from that employed for automobile cylinder regrinding, with the exception that the machines operate on a slightly different principle. When cylinders are not too badly scored, four or five cuts will usually be sufficient to clean up the casting; in badly scored or worn cylinders it is sometimes necessary to take from ten to twelve cuts The amount of eccentric feed per traverse may be 0.004 or 0.005 inch, that is, from 0.032 to 0.050 inch enlargement on the diameter for average work. It is difficult to give information regarding the depth of cut or the total amount of metal removed in a cylinder, but these figures will serve as a guide under average conditions, when extreme cases are not encountered.

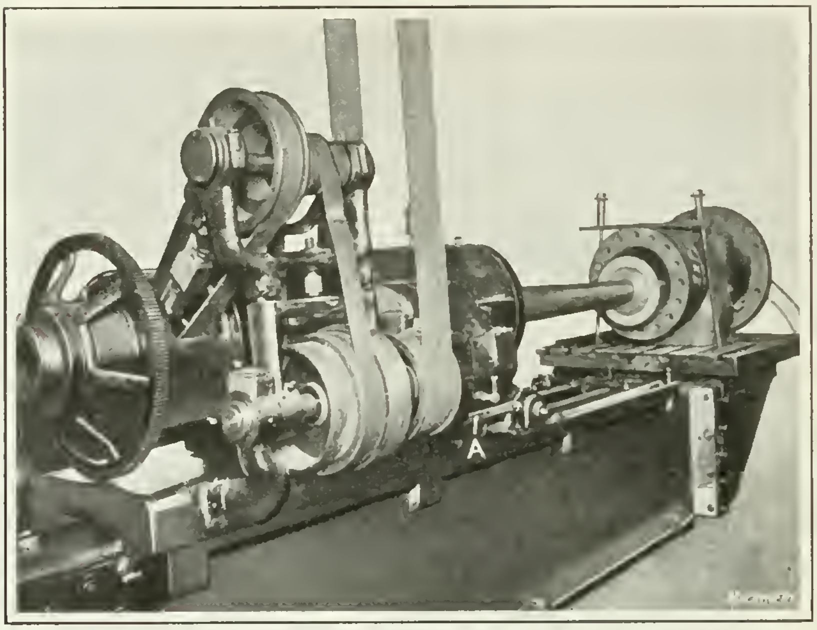

Fig. 2. View from the Rear or Driving Side of the Cylinder Grinder

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POWER PRESS SAFETY CODE

The frequency of two of the most serious and most common types of industrial accidents should be greatly reduced through the application of two safety codes that have just been approved by the American Engineering Standards Committee. The Safety Code for power presses, and foot and hand presses, which has been approved as tentative American standard, is the first national safety code on this subject to be prepared in America. Heretofore each industry has tried to work out its own methods of preventing power press accidents, and in many cases individual plants have attempted to solve this problem out of their own experience without reference to what has been done in other plants.

This code consists of two parts—the first describing standard requirements, and the second consisting of a discussion of press hazards and protective methods and devices. The section on standard requirements covers such subjects as the location and installation of presses, feeding and removing material, making and setting of dies and operating rules. The second part of the code discusses general methods of protection, automatic and semi automatic feeding devices, enclosing guards, hand tools, methods of removing materials, methods of forcibly removing hands, two-hand operating attachments, gage guards, and non-repeat and treadle disconnecting attachments.

ARRANGEMENT OF INFORMATION ON DRAWINGS

By HERBERT W. CABLE

The use of vellum paper sheets with printed titles, border lines, etc., for special tool drawings has become almost universal in large drafting-rooms. The lay-out or arrangement of the printed matter on the sheets is important, and the writer believes that the suggestions given in the following will be of value to those who have occasion to plan the arrangement of such sheets.

It is customary to designate each detail by a number enclosed in a small circle with an index line pointing to the detail on the assembly and detail drawings, and to place a corresponding number in the stock list, which is usually in the upper right-hand corner of the sheet. The numbers should be arranged on the assembly drawing in consecutive order and also in a straight line. This enables the workman to locate readily any detail on an assembly drawing. The various details should be known and referred to by their numbers and not by name.

There should be five columns in the stock list located in the following order: Detail; Amount; Material; Heat treatment; Stock Size Ample space should be provided in the last column for entering the catalogue number, size, and other necessary specifications. The heading only should be printed in the upper right-hand corner of the sheet. Along the right-hand margin line a series of dots should be printed to assist the draftsmen in spacing the lines. This method leaves more space available for the drawing than is the case when boxed in lines are printed down one side of the sheet.

The complete stock list should be given on the assembly drawing whenever feasible, but on complicated drawings a separate sheet may be used. The style of type used should give the printed matter the appearance of hand lettering, and the whole title should present a uniform appearance. Space can be saved by abbreviating or entirely eliminating the word "Number," simply using the word "Part" instead of "Part Number." The title of the drawing can usually be divided into three parts, as follows: The part number and name; the operation number and name; and the name of the tool, jig, or fixture used. Space is usually provided for signatures and the date. The date given should be that on which the work is started.

* * *

The use of ball bearings for railway equipment has long been advocated by those engaged in the ball bearing industry. In Europe, experiments have been made to determine the value of ball bearings for railway equipment, and as a result of these experiments the S. K. F. Ball Bearing Works in Sweden recently received an order from the Swedish State Railways to supply complete ball bearing equipment for 170 railroad passenger cars. This order was placed as a result of ten-year tests conducted on the Swedish state railways

Blank Diameters for Drawn Shells

By W. L. TRYON

DIEMAKERS and tool designers generally find it necessary to determine the diameter of blank required to draw round pieces of various shapes. Some prefer to use formulas in obtaining this dimension, while others find it more convenient to employ a graphical method. Formulas for finding the blank area and diameter of various types of shells will be found on pages 374 and 375 of January, 1915, MACHINERY and in MACHINERY'S book entitled "Die-making and Die Design." However, if the cross-section of a shell does not conform with any of those given in the references mentioned, the formulas or the graphical methods given in the following may be used. Those whose work is not checked by someone else will find it practicable to determine the diameter by one method and then check the result by the other. Both methods are based on the established rule that the area of the blank should equal the area of the shell. It is well to bear in mind that the area of the shell must include that of any holes punched in the shell.

Dividing the Shell into Segments to Find its Outside Area

Every round shell is made up of a series of elementary bodies such as disks, hollow cylinders, etc., the area of whose outside surface may be easily found by the rules of geometry. It is evident that the area of the outside surface of a shell is equal to the sum of the outside areas of its various elementary parts or segments. Therefore, the blank diameter may be obtained from the formula

$$D = \sqrt{\frac{S}{0.7854}}$$

in which D equals the diameter of the blank, and S the outside surface area of the shell.

Elementary segments of shells, together with formulas for finding the areas of their outside surfaces are given in Figs. 1 to 15, inclusive, in the Data Sheet opposite page 354. The actual calculations can be greatly simplified by the use of the tables on pages 48 to 59 in MACHINERY'S HANDBOOK, which give the circumferences and areas of circles. In actual use, all dimensions should be taken to the outside of the shell, although in the present article, for the sake of simplicity, the section of each shell has been considered as a line of no width.

Example of Use of Method

In order to illustrate the use of the formula method, assume that it is required to find the diameter of a blank for a shell having the cross-section illustrated in Fig. 16. The shell is first divided into the elementary segments A, B, C, D, etc., indicated by the dotted lines on the left side of the cross-section. The necessary dimensions of segment A, which conforms to that shown in Fig. 3, are d_1, which equals $1\frac{3}{4}$ inches, and $2h$, which equals 1 inch. From the tables of circumferences and areas of circles, previously referred to, it will be found that the area of a 1¾-inch circle is 2.4053 square inches, and the area of a 1-inch circle 0.7854 square inch. Therefore, according to the rule given in connection with Fig. 3, area $A = 2.4053 + 0.7854$ or 3.1907 square inches. In like manner, following the rules and using the tables as suggested, the areas of segments B, C, D, E, I, and J may be readily calculated, by using the formula applicable to each individual segment. To find the areas of segments F, G, and H, it is first necessary to determine several dimensions.

Finding the Dimensions for Segments F, G, and H

Referring to Fig. 17, in which line LM is an enlarged detail of the line governing segments F, G, and H, line AD is drawn through the centers from which the curved sides of segments H and F, Fig. 16, are struck. Next AB, Fig. 17, is drawn perpendicular to BK and extended to meet line CD which is drawn parallel to BK through center D. Then

$$(AD)^2 = (DE)^2 + (AE)^2 = 4 + 0.0156 = 4.0156 \text{ sq. inches}$$

$$(DC)^2 = (AD)^2 - (AC)^2 = 4.0156 - 1 = 3.0156 \text{ sq. inches}$$

$$BK = DC = 1.737 \text{ inches}$$

Also

$$\text{Tan } b = \frac{AE}{DE} = 0.0625 \text{ inch and } b = 3 \text{ degrees } 35 \text{ minutes}$$

$$\text{Tan } a = \frac{AC}{DC} = 0.5757 \text{ inch and } a = 29 \text{ degrees } 56 \text{ minutes}$$

Then

$$d = a + b = 33 \text{ degrees } 31 \text{ minutes}$$

$$h = DK \sin d = 0.276 \text{ inch}$$

$$KO = KD \cos d = 0.4169 \text{ inch}$$

and

$$x = LD - KO = 0.0831 \text{ inch}$$

The length of arc KL is found by the use of the following formula:

$$KL = MB = \frac{\pi r d}{180}$$

in which d is taken in degrees. Thus

$$KL = \frac{3.1416 \times 0.5 \times 33.517}{180} = 0.2925 \text{ inch}$$

Segment G in Fig. 16 conforms to the shape of the shell in Fig. 8, and it will be evident that f in the latter illustration is the same as BK in Fig. 17, which was found to be 1.737 inches. Also, using the reference letters in Fig. 8 in connection with Fig. 17,

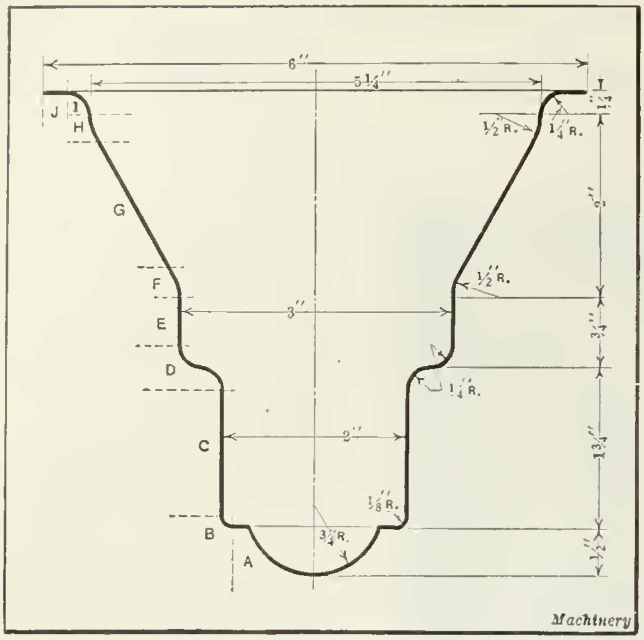


Fig. 16. Cross-section of Shell composed of Many of the Segments contained in Figs. 1 to 15 in the Accompanying Data Sheet

$$\frac{d + d_1}{2} = \frac{(3 + 2x) + (5.25 - 2x)}{2} = 4.125 \text{ inches}$$

and

$$f \times \frac{d + d_1}{2} = 1.737 \times 4.125 = 7.165 \text{ inches}$$

For the case in Fig. 8, it is stated, under the heading "General Rule" that the area of the segment equals the numerical value of the circumference of a circle having a diameter equal to the product of this last formula. Therefore, to find the area of the segment in question, it is necessary to look up the circumference of a circle whose diameter is 7.165 inches As the circumferences in the tables referred to are only given to three places, it is necessary to interpolate for the fourth place. It will be found that the circumference of a 716-inch diameter circle equals 2249.38 inches, and that of a 717-inch diameter circle 2252.52 inches. The circumference of a circle 716.5 inches in diameter equals the circumference of a circle 716 inches in diameter plus one-half the difference between the 716- and 717-inch circles, or $2249.38 + (0.5 \times 3.14) = 2250.95$ inches. As the diameter in question is 7.165 inches instead of 716.5 inches, the corresponding circumference is $2250.95 \div 100 = 22.509$ inches.

In using the tables of circumferences and areas, it should be remembered that for every digit the decimal point is moved in the diameter, the decimal point moves one digit in the corresponding circumference and two in the corresponding area.

Summarizing the Calculations

Having obtained the necessary dimensions for calculating the areas of segments *F*, *G*, and *H*, it is now possible by following the rules for Figs. 1 to 15 and using the tables of circumferences and areas, to determine the areas of all the segments constituting the shell in Fig. 16. The different areas may then be tabulated as follows:

Area of segment *A* (Fig. 3) = 3.1907 square inches
B (Fig. 10) = 1.1777
C (Fig. 7) = 8.6394
D (Fig. 15) = 6.1685
E (Fig. 7) = 4.7124
F (Fig. 13) = 2.8086
G (Fig. 8) = 22.5095
H (Fig. 12) = 4.7721
I (Fig. 11) = 6.7011
J (Fig. 1) = 2.3071
Total area of shell = 62.9871 square inches

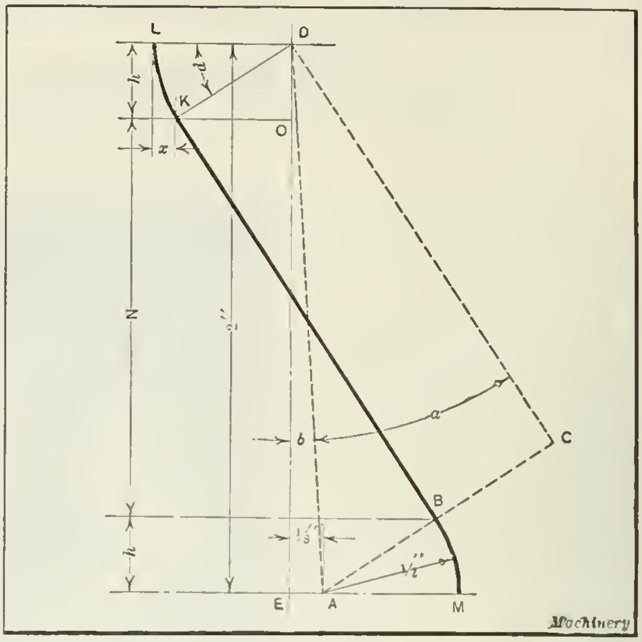


Fig. 17. Lay-out for determining Certain Dimensions required in calculating the Areas of Segments F, G, and H, Fig. 16

Referring to the tables of the circumferences and areas of circles, it will be found that the diameter of a circle having an area of 62.9871 square inches is approximately 8.955 inches and this, of course, is the required blank diameter of the shell illustrated in Fig 16. Any other round shell may be treated in a similar manner.

Determining Blank Diameters by Graphical Methods

Graphical methods of solving the diameters of blanks for shells of various shapes will now be presented, together with proofs. Taking the common shell shown in Fig. 18 as the first example, the procedure is as follows: With line *AB* as a radius and *A* as a center, draw arc *BC*. Then draw arc *CE*, with *D* as a center. This arc intersects line *AB* extended, at point *F*. The radius of the blank required to produce this shell is *AF*; this may be proved by the following calculations: Assume that $AB = \frac{d}{2}$ and $AD = h$. Then the area of the bottom of the shell $= \frac{\pi d^2}{4}$ and the area of the cylindrical segment $= \pi dh$. The latter equation is the same as that given in connection with Fig. 7. Adding the two formulas together, the total area equals

$$\pi\left(\frac{d^2}{4} + dh + h^2 - h^2\right) = \pi\left[\left(\frac{d}{2} + h\right)^2 - h^2\right]$$

In the triangle *ADF*,

$$(AF)^2 = (DF)^2 - (AD)^2 = \left(\frac{d}{2} + h\right)^2 - h^2$$

Substituting $(AF)^2$ for its equivalent value in the formula for the total area, we have:

$$\text{Total area} = \pi(AF)^2$$

As this area equals the area of the blank, if *R* is taken to represent the blank radius, then

$$\pi R^2 = \pi(AF)^2 \text{ and } R = AF$$

To find the radius of a blank for the shell in Fig. 19 the procedure is as follows: With radius *AB* draw arc *BC*. Then with radius *DC* draw arc *CE*, cutting line *AB* extended, at point *F*. The radius of this blank is *FG*, as is proved in the following:

Let $AD = H$, $AB = \frac{d}{2}$, *and* $AG = h$. Then

$$AC = \frac{d}{2} \text{ and } DC = H + \frac{d}{2}$$

$$(AF)^2 = \left(H + \frac{d}{2}\right)^2 - H^2 = dH + \frac{d^2}{4}$$

$$(FG)^2 = (AF)^2 + (AG)^2 = dH + \frac{d^2}{4} + h^2$$

Multiplying each side of the equation by π, we have:

$$\pi\,(FG)^2 = \pi\left(dH + \frac{d^2}{4} + h^2\right)$$

This formula will be found to equal the sum of the formulas given in connection with Figs. 3 and 7, and may be reduced to $\pi(FG)$. This proves the radius of the blank to be FG. Fig. 20 gives examples of other problems which may be constructed and proved in a similar manner.

The construction for finding the blank diameter of the shell in Fig. 21 is as follows: With D as a center, draw arc CE, cutting line AB extended, at point F. Then chord CF is the radius of the blank. Proof:

$$(AF)^2 = h^2 - (h - r)^2 = 2rh - r^2$$

$$(CF)^2 = (AF)^2 + (AC)^2 = 2rh \text{ and } \pi\,(CF)^2 = 2\pi rh$$

As $2\pi rh$ is the area of the shell, according to the formula given in connection with Fig. 5, line CF is the radius of this particular blank.

Shells with Elliptical Cross-section

Fig. 22 shows a shell of an elliptical cross-section. The construction necessary for solving the blank diameter by the graphical method is first to extend AB to C, making $BC = AJ$. Then draw a semicircle ADC with the center at H, and draw BE of any length perpendicular to BK, and BF of such a length that $\frac{BF}{BE} = \frac{19}{16}$. Next draw FD and EG parallel. Then BG is the radius of the blank. Proof:

$$\frac{BG}{BD} = \frac{BE}{BF} = \frac{16}{19} \text{ and } BG = \frac{16 \times BD}{19}$$

Let $AJ = d$ and $BK = h$. Then

$$AB = \sqrt{\frac{d^2}{4} + h^2} \text{ and } BC \times AB = d\sqrt{\frac{d^2}{4} + h^2}$$

By construction

$$(BD)^2 = BC \times AB = d\sqrt{\frac{d^2}{4} + h^2}$$

$$(BG)^2 = \left(\frac{16}{19}\right)^2 \times d\sqrt{\frac{d^2}{4} + h^2} = \frac{256}{361} \times d\sqrt{\frac{d^2}{4} + h^2}$$

In connection with Fig. 6 it is stated that the area of an elliptical shell equals $2.222d\sqrt{h^2 + \frac{d^2}{4}}$, and if R is the radius of the blank, then

$$\pi R^2 = 2.222d\sqrt{h^2 + \frac{d^2}{4}}$$

and

$$R^2 = \frac{2.222d}{3.1416}\sqrt{h^2 + \frac{d^2}{4}} = \frac{256d}{361} \times \sqrt{h^2 + \frac{d^2}{4}} \text{ (approximately)}$$

By referring to the equation in the foregoing for $(BG)^2$ it will be obvious that $R = BG$.

If a shell has an elliptical bottom and a cylindrical body, like that illustrated in Fig. 23, proceed as follows to find the blank radius: Draw arc EC with D as a center and a radius equal to the radius of blank which would be required for the bottom alone; this is found as described in connection with the foregoing example. Then with A as a center draw arc DJ, and with B as a center, draw arc JH cutting

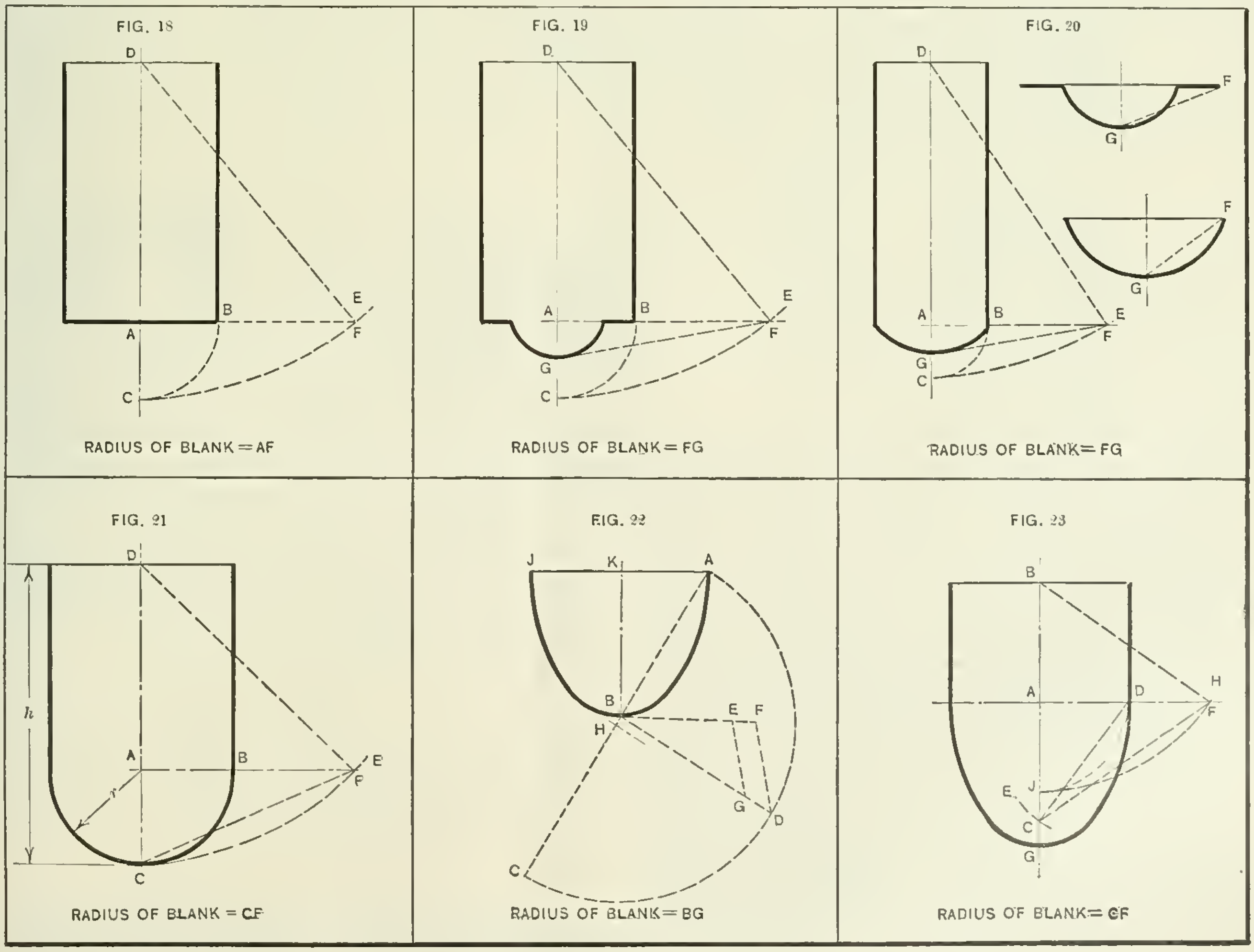


FIG. 18 RADIUS OF BLANK = AF

FIG. 19 RADIUS OF BLANK = FG

FIG. 20 RADIUS OF BLANK = FG

FIG. 21 RADIUS OF BLANK = CF

FIG. 22 RADIUS OF BLANK = BG

FIG. 23 RADIUS OF BLANK = CF

Figs. 18 to 23. Graphical Method of finding Radius of Blank for Different Shaped Shells

line *AD* extended, at point *F*. Length *FC* is the radius of the blank required for the entire shell. Proof:

Let $AB = h$ and $AD = AJ = r$. Then

$$BF = BJ = r + h$$

$$(AF)^2 = (r + h)^2 - h^2 = 2rh + r^2$$

$$(AC)^2 = (DC)^2 - r^2 \text{ and } (AF)^2 + (AC)^2 = 2rh + (DC)^2$$

$$(CF)^2 = (AF)^2 + (AC)^2 = 2rh + (DC)^2$$

$$\pi (CF)^2 = 2\pi rh + \pi (DC)^2$$

As $2\pi rh$ is the area of the cylindrical segment and $\pi (DC)^2$ the area of the bottom segment, *CF* is the radius of the blank required for the entire shell.

Shell Having Two Cylindrical Segments

For shells with more than one cylindrical body segment and various bottom segments, it is first necessary to find a shell of a shape like one previously considered, having an area equivalent to that of the shell for which the blank radius is being determined. Then by finding the radius of the blank for the equivalent shell, the radius of the required blank can be found. The diameter of the bottom segment in question should be considered the diameter of the equivalent shell, and the height of the latter should be found by adding the heights of segments of this diameter which would have areas equal to the segments of the shell under consideration.

Taking the shell in Fig. 24 as an example, the diameter of the equivalent shell would be *AC*, line *ABC* indicating a standard bottom. The body part of the equivalent shell would follow lines *ACFR*. It will be evident that the cylindrical section *ACEG* is common to both shells. Now, on the center line locate point *K* at a height from *J* equal to *CE*. Then bisect *EH* by drawing *LM* perpendicular to this line, and lay out *EO* on line *CF* equal to *EH*. Then draw *KO*, which, extended, cuts *LM* at *N*. Line *LN* is the height of the cylinder of diameter *AC* having an area equal to that of ring *IH*. Next so locate *P* on the center line that *KP* equals *LN*.

For the cylinder *HIQS*, extend *IQ* and locate *T* on the equivalent shell section so that *GT* equals *IQ*. Then draw *KT* continuing to the extension of line *IQ* and intersecting it at *U*. Line *IU* is the height of a cylinder of diameter *AC* which has an area equal to the cylinder of *HIQS*. Therefore, locate *V* on the center line a distance above *P* equal to *IU*, and draw *FR* perpendicular to *FC* through point *V*. Then shell *ABCFR* will have the same area as the original shell, and consequently will require the same blank diameter. The radius of this blank is equal to *BX*, as will be apparent by referring to Fig. 19. The proof of this method can best be given after a discussion of the methods of finding segments of a given diameter having areas equivalent to the segments shown in Figs. 7 to 15, inclusive.

Fig. 25 gives a segment of diameter *d* and height *h*. To find the height *H* of a segment of diameter *D*, which will have the same area as the given segment, first locate point *B* where line *AC* cuts the center line, and draw *BK* through intersection *J*, extending the line until it cuts *CF* extended. Finally draw *KN* parallel to *AC*, which will produce length *H*. As *BGJ* and *BCK* are similar triangles,

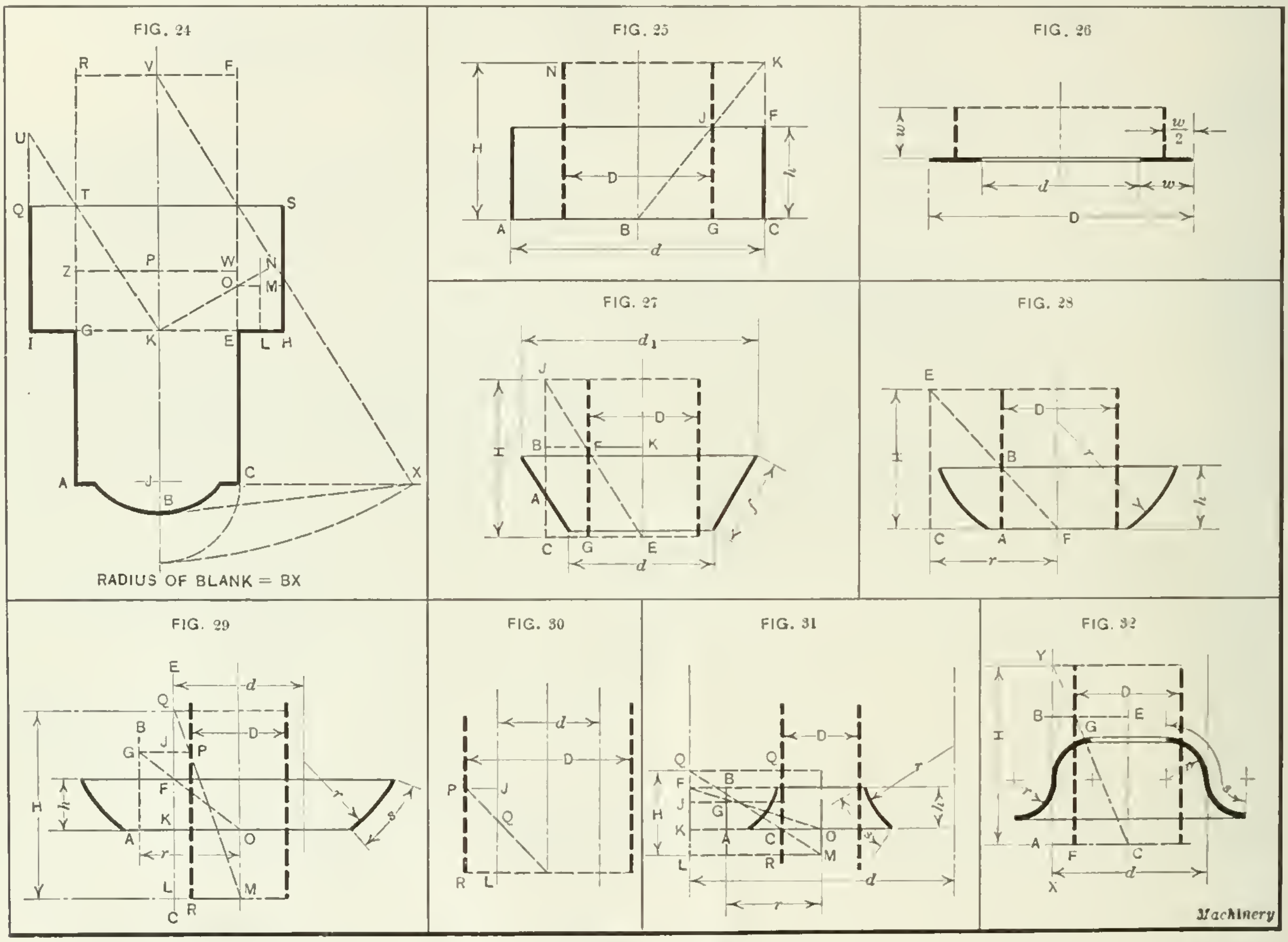
$$\pi HD = \pi hd$$

Therefore, the two cylindrical segments have the same area.

Fig. 26 shows the method of finding the dimensions of a cylindrical segment having the same area as a ring. The area *A* of this ring may be found by the following formulas:

$$A = \frac{\pi}{4} \times (D^2 - d^2) = \pi w (d + w)$$

The second of these two formulas obviously may also be used for finding the area of the dotted cylindrical segment. In finding the area of a complicated shell, this ring segment would be converted into another cylindrical segment having



Figs. 24 to 32. Graphical Method of finding the Diameter of a Cylindrical Segment that will have the Same Surface Area as a Segment of Some Other Shape a diameter equal to that of the equivalent shell, by means of the method used for the case illustrated in Fig. 25. Now, referring back to Fig. 24, cylinder *WFRZ* has the same area as cylinder *HIQS*, and cylinder *EGZW* has the same area as ring *IEGH*, as previously indicated.

Finding the Heights of Cylindrical Shells of a Certain Diameter having Areas Equal to Various Segments

All shells may be solved in the same manner as that outlined for Fig. 24, and for this purpose the construction of cylindrical segments of a given diameter *D* equivalent to the segments shown in Figs. 8 to 15, inclusive, will now be given. A segment of the same shape as that in Fig. 8 is shown in Fig. 27. Intersection *A* of line *BC* is at the middle of the segment side *f*, this side being bisected by line *BC*. The latter must be equal in length to *f* and drawn parallel to the center line. Then draw *BK* and *CE* perpendicular to the center line, intersecting the cylinder of diameter *D* at points *F* and *G*, respectively. Finally, draw *EF* and extend this line and *CB* until they intersect at *J*. Line *CJ* is the height *H* of the cylindrical segment of diameter *D* which has an area equal to that of the segment shown by the full lines. Proof:

$$FG = BC = f$$

$$CE = \frac{d_1 + d}{4} \text{ and } \frac{H}{f} = \frac{d_1 + d}{2D}$$

$$HD = \frac{f\ (d_1 + d)}{2} \text{ and } \pi HD = \pi f \times \frac{d_1 + d}{2}$$

By referring to the formula given in connection with Fig. 8, it will be seen that the areas of both the full-line and equivalent segments are equal.

In Fig. 28, which shows a segment identical with that in Fig. 9, *A* and *B* are the points where the bottom and top edges of the given segment cut the required cylinder of diameter *D*. First draw *CE* parallel to the center line and at a distance from it equal to *r*. Then draw *FB* and extend until it meets *CE*. Then the line *CE* is the height *H* of the cylindrical segment of diameter *D* having an area equal to that of the given segment. Proof:

$$\frac{H}{h} = \frac{2r}{D}$$

$$DH = 2rh \text{ and } \pi DH = 2\pi rh$$

To find graphically the length of a cylindrical segment having the same area as the segment in Fig. 29, which is similar to that in Fig. 12, first draw line *AB* parallel to the center line and at a distance *r* from it. Then through point *F*, where *CE* intersects the upper edge of the segment, draw *OF* and extend it until it intersects *AB* at *G*. Next draw *GP* parallel to *AO*, intersecting *CE* at *J*; so locate the bottom edge of the dotted segment that *KL* equals *s*; and then draw *MP* and extend it until it intersects *CE* at *Q*. Then *LQ* is the height *H* of the cylindrical segment equal in area to the segment indicated by the full lines. Proof:

$$r : \frac{d}{2} = AG : KF \text{ and } JK = AG = \frac{2rh}{d}$$

As $KL = s$,

$$PR = JL = \frac{2rh}{d} + s$$

Also,

$$PR : \frac{D}{2} = QL : \frac{d}{2}$$

Then

$$PR = \frac{HD}{d} = \frac{2rh}{d} + s$$

and

$$\pi HD = \pi\ (\ 2rh + ds\ )$$

This proves that the area of the given segment is equal to that of the cylindrical segment of diameter *D* and height *H*. The segment shown in Fig. 10 is solved in the same manner. Fig. 30 shows the construction to be followed when *D* is greater than *d*. In this case *QL* would again equal *H*.

To find the area of the shell in the diagram Fig. 31, proceed as follows: Draw *AB* parallel to the center line and at a distance *r* from it; draw *OF* to intersect *AB* at *G*; draw *GJ* parallel to *CO*; locate *L* so that *JL* equals *s*; draw *LM* parallel to *CO*; cutting the center line and cylinder of diameter *D* at *R*; and finally draw *MC*, extending it to intersect *FL* extended, at *Q*. Line *LQ* is the height *H* of the cylindrical segment of diameter *D* equal in area to the segment shown by the heavy solid lines. Proof:

$$r : \frac{d}{2} = AG : FK \text{ and } JK = AG = \frac{2rh}{d}$$

$$JL = s \text{ and } CR = s - \frac{2rh}{d}$$

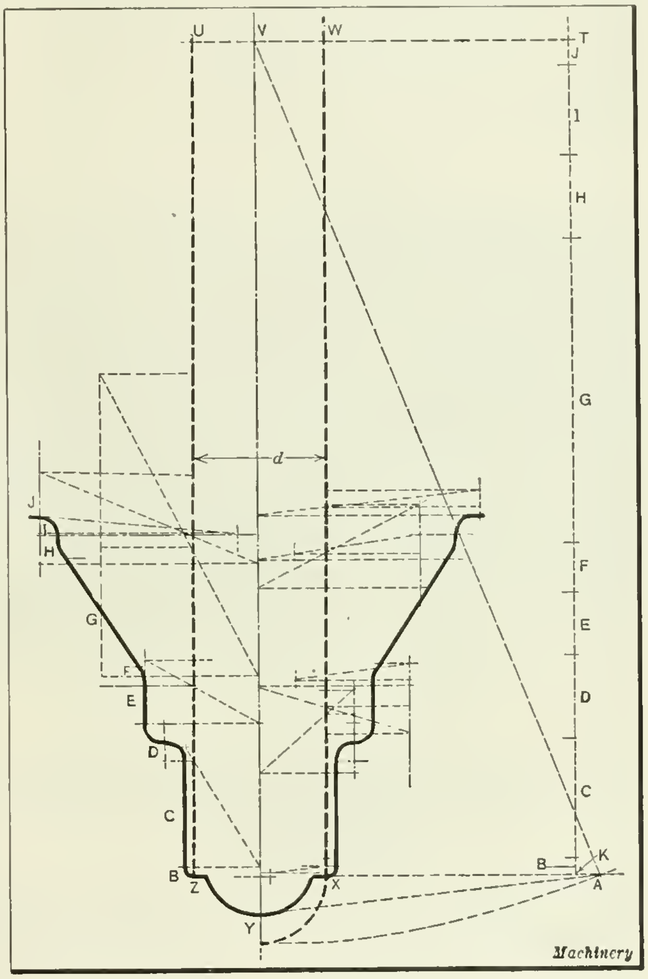


Fig. 33. Method followed in the Graphical Determination of the Diameter of Blank required for a Given Shell

Also

$$LQ : CR = \frac{d}{2} : \frac{D}{2} \text{ and } LQ = H = \frac{d}{D} \times \left(s - \frac{2rh}{d} \right)$$

$$\pi HD = \pi (ds - 2rh)$$

This proves that the area of the dotted cylinder is the same as the given segment, as will be apparent by referring to the formula given in connection with Fig. 13. The segment of the shape illustrated in Fig. 11 could be solved by the same method.

For the segment in Fig. 32, lay out on line *XY* a distance *AB* equal to *s*, which, in turn, equals πr. Then draw *AC* and *BE* perpendicular to the center line and cutting the cylinder of diameter *D* at *F* and *G*, respectively; next draw *CG*, extending it to its intersection with *XY*. Then *AY* is the height *H* of the cylindrical segment of diameter *D* This is proved as follows:

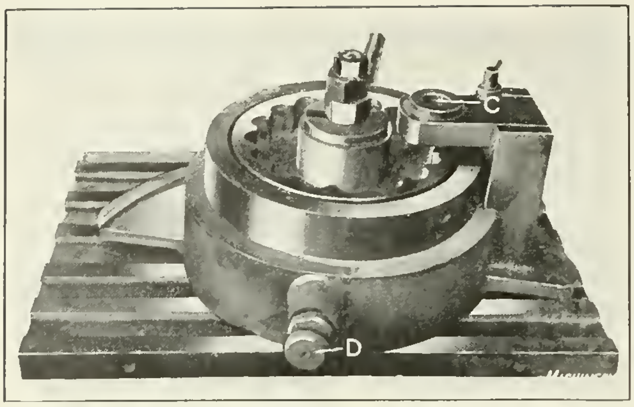


Fig. 1. Ratchet Ring located in Fixture ready for drilling

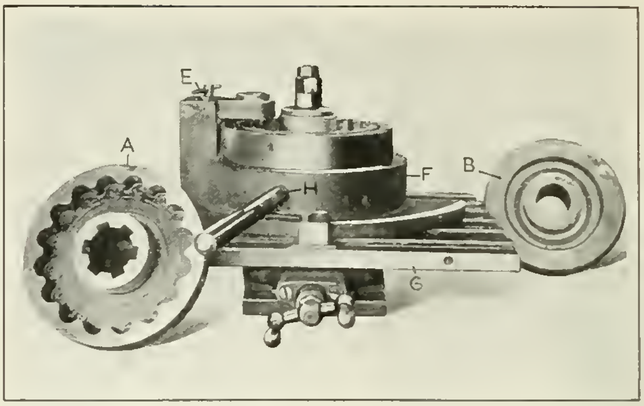


Fig. 2. Finished Ratchet Ring, Fixture, and Rough Forging

$$FG = AB = s = \pi r \text{ and } FG : AY = \frac{D}{2} : \frac{d}{2}$$

$$H = AY = \frac{\pi r d}{D} \text{ and } HD = \pi r d$$

Then

$$\pi HD = \pi^2 r d$$

This proof will be apparent by referring to the formula given in connection with Fig. 14. The construction and proof are also the same for the segment shown in Fig. 15.

Fig. 33 shows a graphical method of finding the radius of blank for the shell indicated by the heavy full line. This cross-section includes most of the segments dealt with, and is an example intended to make clear the use of the constructions employed in the foregoing for finding the blank radius of a complete shell. The equivalent shell will have the bottom *XYZ* and a diameter *d*. The various heights of segments of diameter *d* which are equal in area to segments *B*, *C*, *D*, *E*, etc., are then found by the foregoing methods and summed up on the line *KT* which is drawn outside the figure to avoid confusion. The sum of all the heights of cylinders of diameter *d* having areas equal to the various segments from *B* to *J*, inclusive, equals *KT*. From *T* a line *TU* is drawn parallel to *ZX*. The blank radius of the equivalent shell *UWXYZ* can then be readily found. This radius is *AY*, as will be understood by reference to Fig. 19.

* * *

RATCHET AND PAWLS FOR GEARLESS DIFFERENTIAL

By ROBERT MAWSON

The fixture shown in Figs. 1 and 2 is employed in machining the ratchet ring *A*, Fig. 2. The small fixtures shown in Fig. 3 are used in performing radius-grinding operations on the ends of the pawls which engage the teeth of the ratchet ring. The first operation in machining the ratchet ring is boring the center hole. One of the rough forgings is shown at *B*, Fig. 2. After the central hole is bored, the forging is faced and turned to the finished size. The six splines, as shown in the finished ratchet ring *A*, are then broached. The forging is next placed in the jig or fixture as indicated in Fig. 1.

The work is located in this fixture by the finished central hole, and is held securely in place by means of a nut and washer while holes are drilled in the forging to form the bottom of the ratchet teeth, the drill being guided by bushing *C*, Fig. 1. The upper part of the jig which holds the work is indexed to each drilling position. Accurate indexing is insured by pin *D* which fits into accurately spaced holes in the revolving part of the jig.

After the drilling operation, the jig with the work still in place is fastened to the table of a vertical milling machine equipped with an end-mill. The pin *E*, Fig. 2, is next withdrawn to permit the fixture body *F* to be pivoted on a pin held in table *G*. The pin in table *G* is not shown, but it is so positioned that the milling cutter will round the ends of the ratchet teeth to the required radius when base *F* is revolved or swung back and forth about its axis. The handle *H* is used to rotate or pivot the base *F* on table *G* while rounding the ends of the ratchet teeth. As the work is indexed about the same center for both the drilling and milling operations, a high degree of accuracy is obtained.

Fixtures for Holding the Pawls

The pawls used in the ratchet ring are also made from forgings, one of the finished pawls being shown at *J*, Fig. 3. The first operation on the pawl is that of turning the trunnion ends *K* and facing the sides of the shank at *L*. The pawl is next ground on the end that is in contact with the ratchet teeth when it is assembled in the complete unit. The fixture shown at *R* is used to hold the pawl for the first radius-grinding operation. In this operation, the work is located by means of the turned trunnions and is held securely in place by the set-screw *W*. The grinding is done on a Landis grinder, the centers of the machine being placed in the centers in the ends of trunnions *K*. The grinding wheel on the machine is brought into contact with surface *V* which is ground to the correct radius by rocking the fixture on centers by means of handle *U*.

The forging is next placed in the fixture shown at *M*. The conical pointed screws *Y* are used to locate the work from the centers *K*. Pointed set-screws *N* are then tightened down on the work to hold it in place. The fixture is held between the centers of the grinding machine which enter centers *O* of the fixture. The grinding wheel is correctly set for grinding the ends of the pawl to the required shape or radius. It has been found that this simple method of holding the work results in the production of accurate pawls that are uniform with respect to their important bearing surfaces.

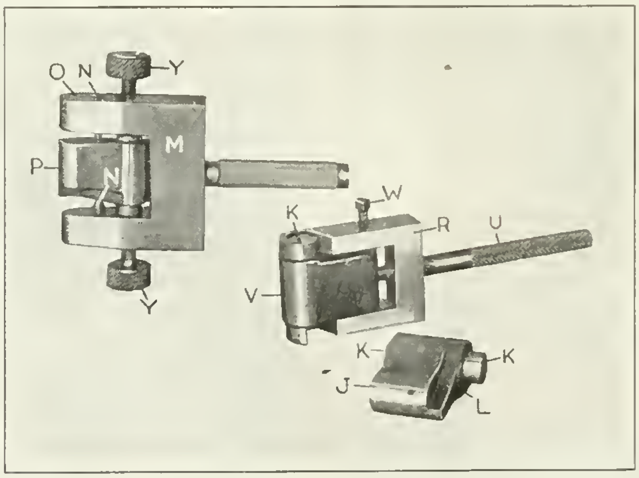


Fig. 3. Fixtures used in Radius-grinding Operations on Ratchet Pawls

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, December 12

NOW that the general election is past, business will, it is hoped, again resume the forward movement which political events have had a tendency to check. With the end of the year approaching, we can look back on what will always be regarded as one of the most trying periods in industrial history. At the end of 1921, employers thought we had reached the turn of events, as a perusal of the trade reviews for that period show. Instead of that, during the first six months of 1922, it was simply a case of marking time, and in that period local firms have had to resort to expedients in the form of economy, which were never before necessary in their history. Since July, however, there has been a gradual picking up in all industries, and some firms are quite busy. Unfortunately the stage has not yet been reached when works can employ a full working force, and while no definite figures are available, it is safe to say that the average engineering shop is running with one-half the normal force.

The Machine Tool Industry

The position of the machine tool industry, beyond a better tone of inquiry, shows little change. A greater number of sales are undoubtedly being made, and the outlook as a whole is more promising. A common experience is that a prospective buyer may have work sufficient to justify the installation of new machines, but the fear that the current activity will not continue causes him to hold back in placing an order. Competition is very keen, and makers have to quote on an exceptionally small margin in order to get business. To what extent the position has improved may be gathered from the fact that a well-known maker recently booked an order for seven machines of a type which for nearly two years has been in only limited demand.

Second-hand machines still bring good prices, as is shown by the fact that a Clyde firm recently disposed of twenty lathes (to be substituted by automatics), all of which were sold within a week at good prices. However, the idea is beginning to prevail that some things are dear at any price and nothing is cheap if it is not precisely what is wanted. The desire to obtain the largest weight for the smallest price is giving way to a recognition that the requirements of a balanced plant and modern production cannot be met except by a machine that is exactly suitable.

This view has reacted also upon machine tool makers, the more progressive of which, such as John Lang & Son, Johnstone, and Dean, Smith & Grace, Ltd., Keighley, have taken advantage of the depression to redesign their lathes. This step is also one of the results of the war. During that strenuous manufacturing period, lathes were working to their limit, operated very largely by those who, previous to the war, had never seen a lathe. These circumstances really afforded a good opportunity for accumulating valuable data and information on the performance of machines under the worst working conditions, and the lessons learned have been embodied in new designs.

Ton prices, although not very accurate for purposes of comparison, serve well enough in a general statistical sense. An all-around price per ton (2240 pounds) for lathes would be about £140 (about $630, present exchange), planers £84 ($378), radial drilling machines £125 ($562), grinding machines £230 ($1035), shapers £110 ($495).

The small tool trade is usually one of the first to reflect any improvement in the engineering field as a whole, and makers report the upward strike of the trade curve well maintained. Foundries are also busier and are both giving and taking an increased amount of business.

Exports and Imports

Exports of machine tools for October rose, as compared with the previous month, from 883 to 1525 tons, and from £115,895 to £158,371 in total value. The improving tendency from the lowest point of the depression has now continued for three months. Imports have also risen slightly—from 231 to 311 tons and from £34,410 to £41,312 in total value. The values per ton have fallen—on exports from £131 to £104, and on imports from £149 to £133. The ton price of imports for the month shows the wide variation of from £74 per ton for tools imported from Germany, to £203 per ton for those imported from the United States.

The Railway Field

Railway requirements are likely to loom large in the future. Plans are being made, under government guarantee, in connection with unemployment relief, for extensive developments in the railway field. The Underground Railways contemplate a total expenditure of £17,000,000 on schemes to be carried through in conjunction with the government proposals for dealing with unemployment. With government encouragement and the end of the complications and troubles resulting from the regrouping that has been going on, there is no doubt that the railways will now enter more freely into the market than they have done during the last few years. Overseas prospects in the railway field are most encouraging; several orders for locomotives have been placed, the estimated total value of which is £250,000, and other substantial orders are in prospect.

The Automobile Industry

With regard to the automobile industry, it is of special interest to learn that there are signs of a real revival in the demand for high-grade heavy commercial cars from overseas, and in particular from South Africa. An excellent home trade during the coming season, especially for light cars, is fairly well assured. Manufacturers are making ready to meet the demand. Additional operatives are gradually being taken on, and in some cases night shifts are being worked. Large contracts are being placed for motor accessories, which have given a filip to the sheet-metal and light brass trades.

Labor Conditions

Although unemployment in the engineering industry was great during last month, the returns again show a slight improvement over the previous month. Wales is the only area that showed an increase in its unemployment returns. The demand for skilled operatives shows a notable increase. Constructional engineers are asking for more labor, particularly in the preparatory stages of manufacture. Many requests are also made for labor in the rolling stock industry, and lately there has been a call for skilled toolmakers, tool setters for multiple spindle automatics, and so on.

Shipbuilding

Local shipbuilding conditions encourage the view that the trade improvement is of a definite character. During the first eight months of this year, only twenty-one new vessels were placed on the Clyde, but since the stabilization of wages was assured three months ago, no less than forty-seven have been ordered.

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COST FINDING AND COST CUTTING

A great deal of money and effort are expended annually in the industries for finding and recording costs; but how much practical use is made of these data in actually reducing costs? The late Mr. Gantt, an acknowledged authority and expert on industrial management, told how in one of the plants he visited he found a cost-keeper and four attendants occupied in recording costs. Elaborate card-index files lined the walls of the office, and the system used for finding and recording costs was excellent. But when he asked, "How do you use these data in effecting cost reductions?" he was told that nobody ever referred to the data, or to the monthly or quarterly cost report so carefully compiled. The information was collected systematically and efficiently, but no practical use was made of it.

It is unfortunate that so much of the cost-finding activity is merely a form of accounting which brings no results whatever in cost cutting. What industry needs more than anything else are adequate methods for reducing costs, not merely for finding and recording costs. A great amount of energy is expended on cost recording, and if only part of this effort were directed toward reducing costs, the aggregate savings in the industries would run into very large figures. The report on "Waste in the Industries" prepared under Mr. Hoover's direction by the Federated American Engineering Societies clearly shows this.

Cost-finding systems have their place in every industrial establishment, but there are numerous instances in which elaborate cost systems are maintained at an expense out of all proportion to their real usefulness. More use should be made of the cost-accounting department in the practical operation of shops and factories. Superintendents and foremen should be educated to understand what the recorded figures mean, and their active cooperation enlisted in devising ways and means whereby costs can be reduced and comparisons definitely set up. Wherever this is done, a cost-accounting system becomes a means to an end rather than an end in itself. It becomes an asset, rather than a further addition to the overhead.

* * *

DETERMINING THE REAL VALUE OF MACHINE TOOLS

A new machine tool stands on the floor of the builder's shop. It represents not only a quantity of metal, plus the time necessary to produce a machine; but also mechanical ability of the highest order, years of thought and experience, scores of ideas that have been tried out—some found wanting, others found to be practicable. It is acknowledged to be superior to machines of its kind previously built. How can its value be determined?

A common method of figuring the value of the machine is to add together the labor and material cost, its proportion of overhead, and a moderate manufacturing profit. Here is a fairer method: Assuming that each operation for which the new machine is adapted had previously cost fifty cents, and that this cost is reduced by the new machine to thirty cents, we have a saving of twenty cents on every piece produced. Assuming further that the production per year of the machine it superseded was 7500 pieces, the production cost of these pieces would be reduced by $1500. The true basis of value for this machine, therefore, is its ability to save $1500 in the production cost of a year's output.

Each machine in operation represents service rendered by the builder that is worth $1500 a year to each user until superseded by another machine of greater efficiency, and the builder is entitled to payment for his skill and experience on that basis. Great fortunes have been made by users of machines that have effected similar savings; but the builder has seldom received his proportion unless protected by strong patents which are difficult to obtain. Experience, skill, perseverance and similar valuable qualities are not patentable.

We know of a manufacturer of world-wide fame who encouraged a machine tool builder to develop and perfect a machine that saves him many thousands of dollars annually, and when the machine was perfected, took over its manufacture himself. The famous manufacturer paid a moderate profit on the machines he bought, but nothing for the thought and skilled experience involved in developing them, nor for the experimental work, which cost about $30,000.

* * *

UNNECESSARY ACCURACY

Some manufacturers have but a vague idea of the accuracy really necessary in machining the parts composing the products they make, and frequently call upon the machine tool builder and the maker of small tools and other equipment, for much greater accuracy than the product requires.

A well-known manufacturer of engine lathes recently had an opportunity to quote on several machines, but the prospective customer required the builder to guarantee the accuracy of the lead-screws to within 0.0001 inch per foot. There are no lathes made for commercial use that have lead-screws of such an extreme degree of accuracy. Only specially ground lead-screws, made and measured by laboratory methods, would conform to such a requirement. Even ground taps, that are considered the last word in thread accuracy, are guaranteed to be accurate only within 0.0001 inch per inch, which is less than one-tenth the accuracy required in the lead screws referred to. Buyers of equipment should consider more carefully the accuracy that is commercially possible as well as practically required in shop practice, before specifying such extreme requirements.

In another case, a manufacturing concern rejected a large order of taps on the ground that they were not sufficiently accurate in the lead. Subsequent investigation disclosed the fact that the screws for the holes tapped by these taps, had limits of accuracy from six to ten times as great as the accuracy required in the taps.

American builders of machine tool equipment and small tools are capable of producing machinery of any degree of accuracy required for practical purposes. Were it necessary, they could produce machinery and tools of a much greater accuracy than the current commercial practice; but why increase the cost when there is no useful purpose to be served? Accuracy is a relative term; mechanically, there is no such entity as absolute accuracy. Gage-blocks are made to be accurate within 0.00001 or even 0.000005 of an inch, but no one would think of requiring such accuracy in ordinary commercial work. Unnecessary accuracy is expensive and wasteful.

The Machine Tool Salesman

By a Machine Tool Sales Manager

THE rapid increase in the number of specialized machine tools imposes a greater responsibility and calls for greater knowledge on the part of the machine tool salesman. Not so many years ago the salesman was required to know only standard machine tools, and the thoroughness of his knowledge of standard tools was often worthy of admiration. He knew the merits, and even the dimensions, of the machines he sold; he also knew his competitors' machines, and could make comparisons in a very effective manner; he was thoroughly equipped to sell along the lines in which selling was conducted at that time.

Then came a new period in machine shop practice. Out of the standard tools grew many new types of specialized tools, with a narrower field of application but an increased usefulness, because of increased productivity. The machine tool salesman could no longer talk about these tools by comparing the diameters of the front spindle bearings; he had to talk production methods, and tool and fixture equipment. With this change in the character of the tools came also a change in the buying methods of the industries using machine tools. Instead of waiting for buyers to come and seek this class of machinery, the makers had to go out on an educational campaign and instruct the buyers as to the field of application of the new machines.

The Fields for Standard and Special Machines

There always will be a field for standard machine tools. In fact, many machines that were originally regarded as specialized, have become so general in application that they are now considered standard. The multiple-spindle drilling machine and the centerless grinder are good examples. Some machine tool men believe that specialized tools do not encroach upon the field of standard tools, but merely increase the scope and size of the machine-using industries. This opinion is based on the frequently observed fact that whenever a machine tool user has developed his plant to a point where he requires specialized tools, he also becomes the consumer of the products of a number of smaller concerns who serve the larger plant. Perhaps the best known example of this is the number of tool shops that owe their existence to the demand for jigs and fixtures to be used with high production and specialized machine tools.

From the selling standpoint, it is evident that new types of specialized machines add to the burden of the machine tool salesman. He has the new tools to sell in addition to the standard tools. The new machines require more sales effort and more investigation of shop methods and production systems than standard tools. The machine tool salesman, to a large extent, must create his own market for specialized tools. To be thoroughly successful, he must have the same knowledge of standard tools as the machine tool salesman of the past; in addition, he must have an equally thorough knowledge of new types of specialized machines. To gain this knowledge without close application and study, is impossible— a continuous study to keep posted on the progress taking place is necessary.

The Successful Salesman Must Be a Hard-working Student

The knowledge of the contents of his catalogue was a valuable part of the equipment of the machine tool salesman of the past. Today, one meets many salesmen who have never read thoroughly the catalogues of the tools they sell. They have merely looked through them, with emphasis on the "through.' Many salesmen have never really studied the catalogues of the machines they sell or worked out the selling points to such a degree that they are able to make effective use of them.

Standard tools form the basis of specialized tools, and without a thorough knowledge of standard machines and their operation, there is no basis on which to build a selling knowledge of specialized tools. Now, how can a salesman obtain this fund of knowledge without which he will never be really successful? Failure to study the catalogues of his firm is not the only error of omission on his part. There is a great deal of valuable information in the trade journals that would be useful to him. How many salesmen make it a part of their routine duty, for example, to read MACHINERY? Do they read it with a view to permitting nothing of value to escape them, or do they occasionally see a copy, look through the New Machinery and Tools Section and skim through the advertisements here and there?

The articles describing the processes and equipment used in manufacturing plants are among the best sources of information for the machine tool salesman. There is no part of the magazine that he can afford to miss. It is not the intention of this article to censure the salesman, but rather to point out to him the position of great responsibility that he occupies as regards both his customers and the concern he represents. The points emphasized in this article are mentioned because it is believed that the salesman is not always fully aware of his responsibility and his opportunities. A systematic method of study would result in a threefold benefit—to his customer, his firm, and himself—by increasing efficiency and production, augmenting sales, and adding to his own income, as well as strengthening his reputation as a salesman and his standing in the industry.

How the Salesman can Save Overhead Costs

Every manufacturer can cite examples showing how time and effort could have been saved by an alert salesman. One item of overhead cost that reaches a large total is the cost of sales correspondence. Most sales managers know that it is an everyday occurrence to receive letters from the sales force requesting information that is given in the catalogue, and that has been in the catalogue for years. The cost of answering a letter on a technical subject has been estimated at about $1.50. The most expensive part of the matter, however, is the loss of time that could be better spent.

Those concerns who make specialized production machinery find that the greatest delay and expense is incurred in securing full and complete information to enable a production estimate to be submitted. The information required relates to quantity produced, method in use and reason for using this method, feeds, speeds, present production time, kind of material used, previous and subsequent operations, and all other factors that have a bearing on the work to be produced. The machine tool builder looks to the salesman to obtain this information. Many letters are often necessary before the complete information has been obtained, and many hours of engineering time are wasted because some information that should have been included is missing, or because some of the data submitted are incorrect. Accuracy in submitting information to the home office is one of the most important things in the salesman's report, but unfortunately, accuracy in detail is not one of the most common characteristics in otherwise successful salesmen.

Unnecessary Calls by a Factory Representative

Another source of unnecessary sales expense that could be saved by a competent salesman is the premature or useless traveling of special men from the shop to assist the salesman. The reason for sending a man from the factory is to help the salesman in a situation that requires the experience of an engineer. Many manufacturers find that a salesman will call for assistance from the plant in supplying information to the customer that he already has or easily could obtain. Quite often the salesman makes no attempt to obtain the information for himself, and merely makes an appointment for the factory man.

There is frequently a lack of mutual appreciation on the part of the factory engineer and the machine tool salesman. When the engineer studies a piece of work to determine the best way of producing it on his machine, his efforts usually result in a device or an idea that—it appears to him—should have an irresistible effect upon the prospective customer. If the prospective buyer is not convinced to the extent of placing an order, the engineer is prone to believe that the salesman is at fault because he himself has failed to understand the engineering advantages, or to stress their value to the customer. The engineer believes that if he had only been present his ideas would have been accepted.

The salesman, in turn, is prone to regard the engineer as a source of unlimited mechanical ideas, and frequently asks him to work out more and more ideas that constitute merely a useless overhead expense. The salesman's objective is an order, and he is willing to abandon any feature that fails to impress his prospect and to call for some different engineering ammunition. The engineer, again, frequently fails to explain his plans so that the salesman is able to transmit them to the customer. Often a few lines in a letter are supposed to convey an idea that exists mainly in the engineer's head. How can the salesman be expected to carry on his sales work if he receives only a few lines in a letter, but not the ideas?

Both the engineer and the salesman are necessary in their respective fields, and their work should be dovetailed. They should cooperate and each should be willing to do his utmost to provide the other with all the information that he needs in order to do his work properly.

For the education and instruction of their salesmen, some machinery firms conduct salesmen's meetings where the tools to be sold are studied and the selling points discussed. Other firms assign to each salesman a particular class of tools, and at periodical meetings the men review each other's territory and suggest tools and methods of meeting the production problems of prospective customers. Both are good systems, because back of them is the idea of furthering the education of the salesman.

The machine tool salesman is earnest and sincere. He realizes that his success, the customer's success, and the firm's success are all interdependent, and that if he regards all problems from his customer's viewpoint, he will be able best to further his own and his firm's interests. But like so many other men in all walks of life, he sometimes forgets that he must continually go to school. It is to emphasize this point that this article has been written. The salesman who succeeds is the one who keeps everlastingly at it.

MACHINE TOOL STATISTICS FOR 1921

The accompanying table gives a summary of the machine tool statistics for 1921 as compiled by the Bureau of Census at Washington. Comparative figures for 1919 are also given. The table shows that the value of the machine tools built in 1921 was not quite one-third the value of the machines built in 1919. More detailed statistics will be published later in regard to a number of factors affecting the industry, but the present table gives, in a comprehensive manner, the main facts relating to the number of machines built and their value. In several instances, it will be seen that the number of machines built did not decrease in the same ratio as the value, due to the price reductions made in 1921.

COMPARATIVE STATISTICS OF MACHINE TOOLS IN 1919 AND 1921

(Compiled by the Bureau of Census, Washington, D. C.)

	1921		1919		Per cent of Decrease (Value)
	Number	Value	Number	Value	
Boring machines:					
Horizontal	632	1,340,106	826	4,437,937	69.8
Vertical	266	1,840,792	607	4,329,654	57.5
Drilling machines:					
Multiple-spindle	676	1,106,097	1,440	1,998,594	44.7
Radial	2,243	1,548,058	2,732	5,702,134	72.9
Sensitive	1,154	226,801	5,993	1,974,917	88.5
Upright	1,493	593,956	6,477	1,754,463	66.1
Grinding machines:					
Cylindrical.					
Plain	2,022	1,841,701	8,359	12,011,923	84.7
Universal	1,105	480,584	1,792	2,066,166	76.7
All other	17,919	1,147,460	2,735	1,725,252	33.5
Lathes:					
Engine	5,117	5,229,884	17,188	23,239,849	77.5
Turret	1,087	1,580,842	4,657	10,140,582	84.4
Bench and all other	1,063	1,872,928	7,186	4,094,346	54.3
Milling machines:					
Hand feed	468	233,945	......	*	......
Power feed					
Plain	536	812,346	4,635	6,171,040	86.8
Universal	494	1,092,234	3,163	5,580,044	80.4
Vertical	212	415,275	1,304	2,755,943	84.9
All other	463	1,269,458	2,378	4,019,338	68.4
Presses:					
Punching	20,045	7,284,166	32,168	5,400,044	34.9†
All other	3,783	1,643,244	3,618	956,855	71.7†
Bending machines	54	164,315	153	941,739	82.6
Broaching machines	530	616,933	549	1,395,300	55.8
Gear-cutting machines	840	1,736,667	2,688	5,845,565	70.3
Hammers, pneumatic and other	3,550	1,113,704	38,535	4,951,974	77.5
Planers	176	1,271,824	1,482	8,128,655	84.4
Pipe machines	1,192	570,509	4,118	2,481,441	77.0
Portable tools	......	4,411,409	......	10,907,928	59.6
Screw machines	2,661	2,839,667	6,227	9,625,046	70.5
Shapers	1,418	1,020,342	4,515	4,230,695	75.9
Shears	3,347	906,722	1,367	1,566,467	42.1
All other machine tools	......	5,362,711	......	31,313,335	82.9
Parts and attachments	......	8,936,547	......	‡	......
All other products	......	7,257,934	......	32,652,932	77.8
Total value		67,769,161		$212,400,158	68.1

Machinery

*Not reported separately in 1919. †Denotes increase. ‡Included in "all other products" in 1919.

* * *

The investigations on molybdenum as an alloying element in steel, conducted at the Ithaca, N. Y., field office of the United States Bureau of Mines, in cooperation with the Vanadium Corporation of America, will be continued. The object of this work is to add to the technical information on the value of molybdenum, one of the few elements entering into alloy steels of which the United States possesses an abundance of high-grade ore, readily mined and handled. Though there are limitations to its use, it is plainly of great value in steel that is to be heat-treated to produce superior qualities. Molybdenum is slowly taking rank along with nickel, chromium, and vanadium as an alloying element for high-grade steel.

Rolling Threads in Screw Shells

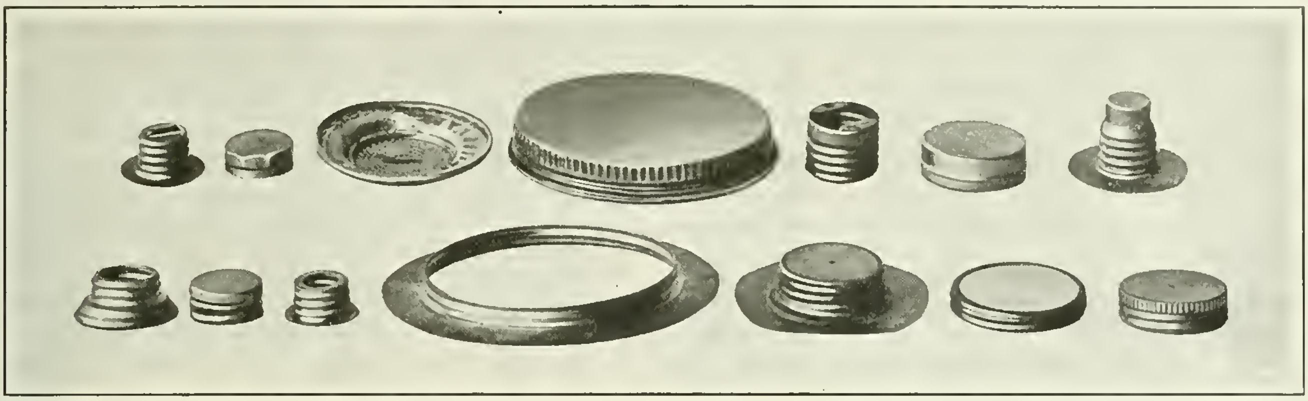


Fig. 1. Examples of Caps and Shells with Rolled Threads, Beads, Curled Edges and Knurled Parts

THE final operations in the manufacture of jar caps, salve and pill boxes, electric lamp light sockets, bottle caps and similar articles include threading, knurling, beading, curling, and trimming; these operations are performed by rolling. For handling work of this kind, a special automatic machine, illustrated herewith, is manufactured by the V & O Press Co., Glendale, L. I. Some idea of the nature of the work for which these machines are used may be obtained from Fig. 1. The operation of the machine is simple, as indicated by the two set-ups shown. The operations (exclusive of trimming) are accomplished by two rolls, over one of which the previously drawn shell is passed and held while the other is advanced to bear firmly against the work. A third roll is required for trimming.

The machine is provided with an automatic feed in the form of a chute or magazine which has a top guide bar that is adjustable for various diameters of work and an adjustable bottom for various lengths. A slight change in the bottom member of the chute adapts it for flanged work, such as is shown in the middle of the bottom row, Fig. 1.

The machine shown in Fig. 2 is set up for handling caps with a curled edge for Mason jars. The flanges that are required on such work to form the curled edge overlap when placed in a chute of this kind, some flanges being on one side and some on the other of the preceding cap. A common trouble arising from this condition is due to the interference of the flanges, which prevents the work from being passed directly to the chucking roll. This is taken care of in this machine by an oscillating movement imparted to the lower end of the chute, which is produced by a cam beneath the machine and a connecting arm *A*. The arm carries two cam rolls, one of which rides on the periphery of the cam, producing the oscillation, while the other bears on the side of the cam. A latch *C* holds the lowermost cap in position in the chute; this latch is depressed at the upward movement of the chute and permits the work to be brought in position for rolling. The chucking or lower roll *B* may be designed to meet the requirements of varying classes of work.

The operations performed on the Mason jar cap are threading, coarse knurling, and curling the edge, all of which is done in one pass of the work through the machine. The threads and knurled part of the chucking roll are somewhat smaller in diameter than the work, to permit the caps to be readily stripped. The curled edge is produced by a groove in the chucking roll and a corresponding flange on the upper roll *D*. The rolls are brought together by cam action

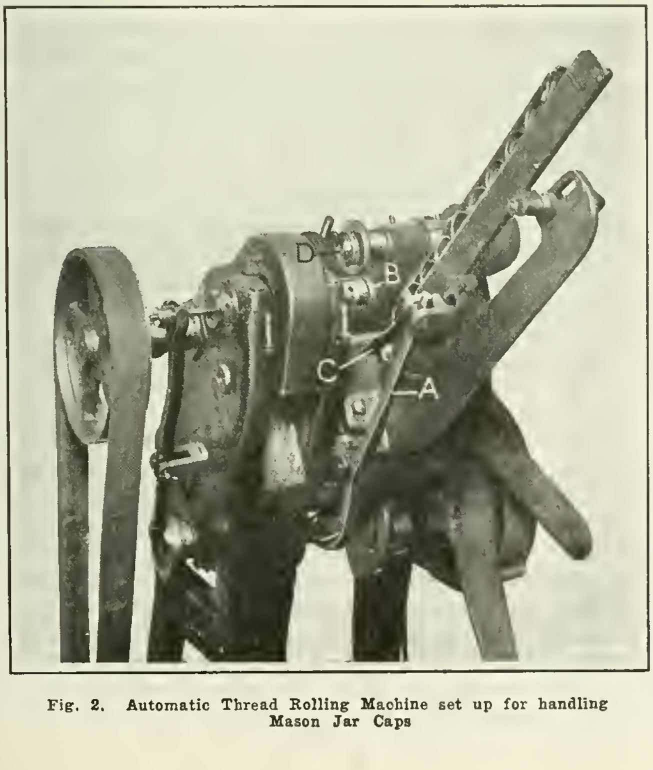


Fig. 2. Automatic Thread Rolling Machine set up for handling Mason Jar Caps

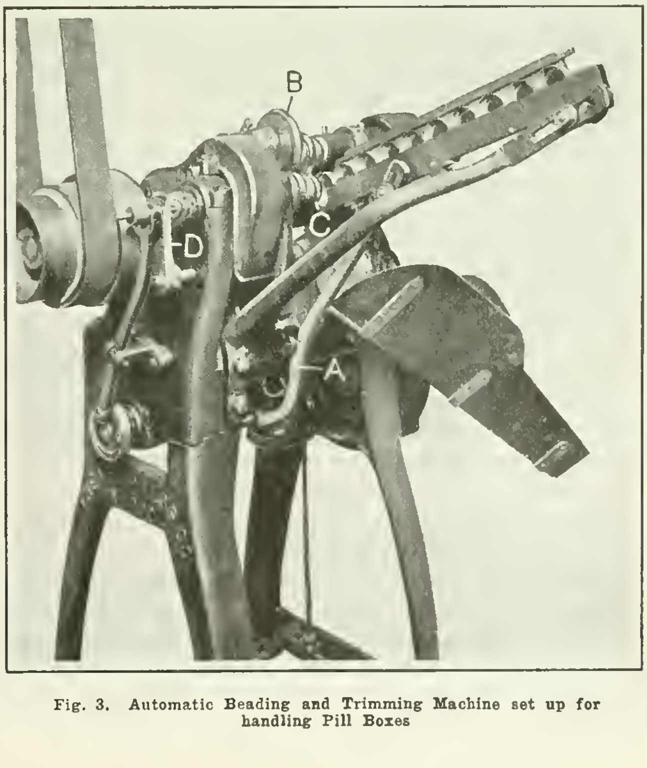


Fig. 3. Automatic Beading and Trimming Machine set up for handling Pill Boxes

through the medium of a toggle-lever connection at the rear of the machine. The cam is adjustable, making it possible to vary the number of revolutions during which the rolls maintain pressure on the work. The upper roll is carried on an auxiliary shaft that has bearings in a rocker arm, the latter being connected to a toggle mechanism. This roll has a flange of large diameter which acts as a stop for the work on the chucking roll and prevents it from being incorrectly located.

As soon as the rolling operation has been completed, the rocker arm recedes and the ejecting mechanism or knock-out is brought into operation. The knock-out consists simply of a rod passing through the spindle of the machine which strikes against the inside of the work and is actuated by a side cam and lever on the side of the machine. The shaft that carries all the cams is driven from the main driving shaft by gearing located at the opposite end of the machine. This drive is connected and disconnected by a pin clutch operated by a foot-treadle. The jar caps are made of 0.010-inch sheet tin, and are knurled, threaded, and curled at the rate of sixty per minute.

Combination Beading and Trimming

These machines can be adapted for various shapes of work and provided with special auxiliary tools for handling the more special work. Much difficulty has been experienced in the past in attempting to bead and trim work of this kind in one operation, but Fig. 3 illustrates how the machine may be successfully employed for accomplishing this result.

Parts having a bead, like a pill box, are representative of the work handled with the set-up shown. Suitable rolls for producing the bead are used, and they are operated similarly to those previously described. The magazine feed or chute is also of the same design and in this illustration is shown in the position occupied just prior to depositing the work on the chuck. An auxiliary rocker arm is incorporated in the design of this machine; the rocker arm carries the trimming roll *B* which is brought into operation after the pill box has been beaded. Rolling the bead takes up some of the stock from the edge of the shell and is likely to leave it somewhat irregular, necessitating a trimming operation; consequently, the rolling must be performed first.

The scrap produced by trimming the work must be removed from the nose of the spindle; for this purpose a stripping device operating in conjunction with the regular knock-out is used. A sliding collar *C* fits over the spindle and is operated by a yoke connected to the shaft on which finger *D* is attached. When the knock out advances, the stripping mechanism is also advanced, and it is afterward returned to its normal position by means of a spring on the short stripper shaft. The scrap and the trimmed and beaded work are deposited in a sheet-iron chute or trough which delivers the work to a receptacle at the extreme end and permits the scrap to fall through an opening left at the vee where the sides of the chute nearly meet, thus eliminating the troublesome operation of later separating the scrap from the work. These pill boxes are made from 0.010-inch sheet tin at a rate of fifty five per minute.

Automatic machines of the type here illustrated will handle work from ½ inch to 4 inches in diameter, up to a depth of 3 inches. By the use of rolls of the proper design, irregular shaped shells may be rolled. The design of the work affects the production rate, but on the simpler designs a production of up to 100 per minute is obtainable.

* * *

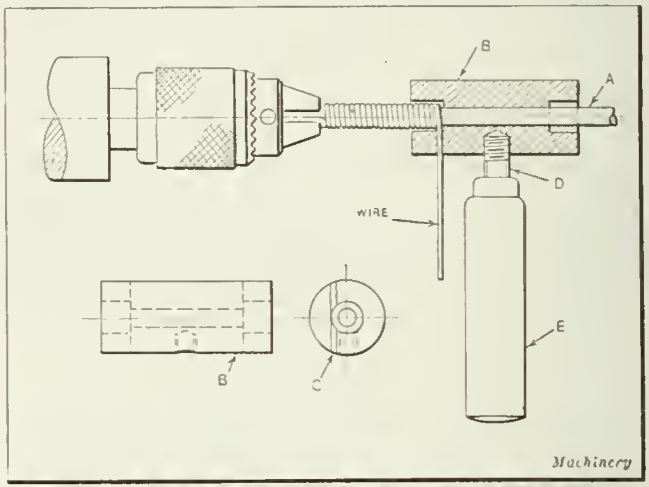
Extensive additions and improvements are to be made at the Altoona shops of the Pennsylvania Railroad. The plans include the construction of two large buildings in connection with the Juniata Works. One shop will be entirely devoted to repairing and building locomotives, and will cover an area of 340 by 670 feet; in addition, a reinforced concrete storehouse will be erected, three stories high, with basement, 60 by 400 feet.

TOOL FOR WINDING RESISTANCE COILS

By C. E. STEVENS

Resistance coils of various diameters and lengths were required in the manufacture of electric toasters and similar appliances. In order to determine the best method of producing these coils, several different coil-winding tools were tried out by one manufacturer, and the type of tool finally adopted is shown in the accompanying illustration. This tool not only produced accurate coils but increased production as well.

The arbor *A* is placed in the chuck of a small speed lathe, the length or distance that it projects from the end of the chuck being the same as the length of coil to be wound. The winding bushing *B* is of tool steel or drill rod, and is hardened. The small hole extending through the bushing is made a slip fit for the arbor *A*. and the two ends of the hole are counterbored to a diameter equal to the diameter of the arbor plus twice the diameter of the resistance wire from which the coil is to be wound. A slot *C* is cut in the end of part *B* as shown. This slot is 0.002 to 0.005 inch wider than the diameter of the wire and extends to the bottom of the counterbore. Both ends of part *B* are slotted, the slots being located opposite each other so that the block can be used to wind springs having either left- or right-hand spirals by running the spindle in the required direction. A small stud *D* is screwed in the center of the bushing to hold the wooden handle *E*.



Method of winding Resistance Coils

In winding the coil, the end of the wire is placed between the jaws of the chuck, and the lathe spindle is given two or three turns by hand to start the coil. The tool body *B* is then placed over the coil so the wire rests in the slot as shown. The lathe is then started, and by pressing the tool toward the chuck, the coil is wound close and will snap or break off when the end of the arbor is reached. A different bushing or tool and arbor is necessary for each diameter of coil. If the tool *B* is made a good running fit on the arbor, and is properly counterbored at the end to fit the outside diameter of the coil, the lathe spindle can be run at any desired speed.

* * *

The work of the British Engineering Standardization Association, as reviewed at the annual meeting of the organization, is steadily progressing. Seventy-two standard specifications, new or revised, were issued during the past year, and there are now nearly 2000 engineers who give of their time and experience to the standardization work in Great Britain. About $75,000 was expended on this work by the association itself during the year, of which the industries in spite of the business depression, contributed over $40,000, the remainder being appropriated by the British and the Dominion Governments.

American Machine Tools in France

By a French Machine Tool Dealer

THE outstanding factor in the machine tool situation in France is the interest in American tools which has been noticed during the last six months, although orders were not forthcoming to any great extent, owing to the high prices. Special interest was shown in small tools, such as drills, reamers, and cutters made from carbon steel. The quality of the steel is the main reason for the demand for American tools of this type. Chucks and other accessories have also been in demand. American small tools made from high-speed steel, on the other hand, find no sale, because they are too high-priced for the French market, with the exception of entirely special tools. The sale of American machine tools and small tools during the last few months was somewhat aided, temporarily, by the exchange situation, there being a period when the value of the franc rose appreciably, although it soon fell again. Importers of American machine tools also made great sacrifices in order to meet the prices of French tools. In a few cases the American manufacturers cooperated generously with the French dealer and shared in the sacrifice.

Effect of the Wiesbaden Agreement

Under the Wiesbaden agreement, materials and equipment are obtained from Germany for the rehabilitation of the devastated regions. Manufacturers in the devastated area, whose plants were demolished, obtain from the French Government, upon application to the official Mandataires, who acts as an intermediary between German manufacturers and French buyers, a kind of scrip, which is good only for the buying of German products. This practically removes the manufacturer in the devastated region from the market, as far as American or domestic French machinery and equipment are concerned. Furthermore, the German machines are imported into France at the minimum rate of duty, and are therefore obtained by the French customer at a very cheap price, eliminating practically all competition. Even in cases where American machine tools might be preferred, the French buyer cannot afford to sacrifice the advantage of buying the German machines under the Wiesbaden agreement at a very low price.

General Conditions in the Machine Tool Market

The competition offered by French and German manufacturers is very severe, and the few firms in France that are still exclusively handling American machinery and tools find it difficult effectively to meet this competition on account of the differences in price between American and European machines. If the price of American machine tools is assumed as 100 per cent, French machines, many of which are now of very good quality, sell at 60 per cent, and German machines as low as 40 per cent. German competition is especially severe in molding machines, and there is a strong possibility of such machines being built in France, unless American manufacturers in this line constantly develop new designs, so that they are always in the lead.

The stock of second-hand machinery, especially of the less high-grade types, is still great, but is gradually being absorbed, mostly by machine shops of the secondary class, garages, and repair shops; not infrequently also the larger shops have been forced by economic conditions to purchase machines of this class against their own best judgment. The automobile business is recovering, and this has created a fair demand; but this is offset to some extent by the fact that some of these shops have disposed of surplus machines. The demand for automatic machinery and high-production machines in general is increasing.

If the exchange rate should settle down to ten francs to the dollar, American machine tools could be sold in France to some extent, as there exists a definite demand for high-class American tools and only the price stands in the way of sales. The classes of machines mainly required are automatic screw machines, universal milling machines, universal grinding machines, gear-cutting machinery, high-production bolt and nut machinery, small tools made from a high-grade carbon steel, and precision tools. On the other hand, the domestic and German competition in lathes, shapers, all classes of drilling machines, lathe and drill chucks, and hoisting equipment, makes it very difficult to sell machines and equipment of these classes in France.

The Manufacture of American Tools in Europe

A few American manufacturers have started to manufacture machine shop equipment in France. In some cases some of the parts are made in America and shipped to France, part of the work and the assembling being done there. In other cases, the entire manufacture is carried out in France. This applies to electric shop trucks, grinding wheels, and die-heads, and is likely to extend to drill chucks. In the metal-working field outside of the shop equipment field, there has been even more activity along these lines, as in tube manufacture, agricultural machinery and tools, and structural steel sections.

The article published in September, 1922, MACHINERY, by A. L. Valentine on the manufacture of American machines and tools in France, contains correct conclusions. In many lines of tools, the American manufacturer cannot successfully compete unless he has a French license operating a factory that at least partially manufactures and assembles his product in France. The main reasons are that the duty on imported machinery and tools is very high and likely to be higher if the foreign competition with the new French industries becomes too severe; the labor obtainable in France is much cheaper than American labor, because the cost of living there is not as high as in America; and the unfavorable influence of the exchange rate could be largely overcome by manufacturing in France.

The many costs that would be avoided are obvious. Raw materials of good quality are obtainable in France. Quicker deliveries could be quoted, and the representatives in France would not be required to carry such large stocks as is now necessary. In the small tool field, particularly, this becomes a very important item, because, unless small tools are carried in stock by the French dealer, there is no possibility of sales. It would take too long to order from the United States.

Cooperation with Dealers in France

The dealers already familiar with the European market could take the selling problem entirely off the hands of the French licensee, who, operating along the same lines and with the same equipment as the American manufacturer, could devote his entire energy to the manufacturing problems. A good organization could be built up in France entirely by native French engineers and workmen, who will be found to carry out any laid down program in a manner that would meet all requirements.

Meanwhile, American manufacturers who wish to maintain their sales and keep their name before the French buyer can greatly aid the dealers in American machine tools by sending them machinery and tools on consignment, to which a fixed rate of exchange should apply at any time. Present conditions do not permit the dealers to add any appreciable amount to their already large stocks, unless the American manufacturer cooperates with them in this manner.

Were this generally done, it would be possible for the French dealer to continue his sales work and to bring before the French buyers of machine tools and equipment the new developments that are continually being made in America. Firms that have constantly represented none but American machine tool builders would then be encouraged in the continuation of this policy, and would be ready to further the sales of American tools as soon as changed conditions bring about an increased demand.

* * *

MECHANICAL ENGINEERS' ANNUAL MEETING

At the annual meeting of the American Society of Mechanical Engineers, which was held in the Engineering Societies' Building, 29 W. 39th St., New York City, December 4 to 7, special sessions were devoted to management, materials handling, machine shop practice, education and training for the industries, research, steam tables, fuels, railroads, general machine design, power engineering, safety engineering, standardization, ordnance, aeronautics, and forest products. In addition, there was an evening session on engineering and economics at which addresses were made by Wesley C. Mitchell, director of research, National Bureau of Economic Research, on "Making Goods and Making Money"; and by E. M. Herr, president, Westinghouse Electric & Mfg. Co., on "The Human Problem in Industry." A valuable contribution to the discussion on Mr. Mitchell's paper was made by Ernest F. DuBrul, general manager, National Machine Tool Builders' Association. Copies of these and other papers and discussions presented before the meeting may be obtained by addressing the American Society of Mechanical Engineers, at its headquarters given above.

The President's Address

The president of the society for the past year, Dexter S. Kimball, Dean of the College of Engineering of Cornell University, chose as the subject for his address "National Leadership." He pointed out that the ultimate criterion by which any civilization will be judged will not be its armies or navies, its great edifices, nor its wealth, but the degree of well-being—physical, mental, and spiritual—that it bestows upon its people. He stated that our civilization differs from those that have gone before mainly in our power to produce the necessities of life—to feed, clothe, and house the multitude. This power has come through the use of what we call the "scientific method," by which we aim finally to replace the words "I think" with the words "I know" in all our activities. The success of this method in conquering nature and turning its resources to useful purposes has been most remarkable, and it has become increasingly clear that physical, mental, and spiritual well-being depend primarily upon the industrial background, and that the benefits of modern industrial methods must be more widely distributed.

"If I read the ideals of American democracy aright," said Dean Kimball "we are committed in this country to an endeavor to secure universal well-being. The benefits that have accrued to all classes of people are beyond question, and they are the more apparent when comparison is made either with older forms of civilization or even with other nations. The general level of comfort and education is unquestionably higher than has ever been attained." Yet the advantages due to this industrial development have brought with them many problems that are not yet solved.

No one would presume to say that the engineer alone can solve the industrial riddle, but it is clear that he can make a very great contribution to the solution.

Helical Gearing for Planers

At the machine shop session Forrest E. Cardullo of the G. A. Gray Co., Cincinnati, Ohio, read a paper on "A New System of Helical Involute Gearing for Use on Metal Planers," in which he gave particulars of a system of helical gearing designed by him for use on planers, in which the directions of rotation and the helical angles of the several gears are so chosen as to counterbalance and minimize end thrust, advantage being taken at the same time of the end thrust to counterbalance the side thrust of the cutting tools. The tooth form adopted is an involute having a 14½-degree pressure angle, a pinion addendum of $3/2p$ inches, and a pinion dedendum of $1/2p$ inches, p being the normal diametral pitch. The advantages of this form of tooth for the work in question were enumerated and dimensions of a pinion, gear, and rack designed according to the principles set forth in the paper were given in tabular form.

Spherical Gears

A paper entitled "Spherical Gears" was read by Charles H. Logue, consulting engineer, Syracuse, N. Y., in which it was stated that the basis for a study of all gears whose pitch surfaces are in rolling contact is found in the study of the bevel gear. By acquiring this point of view, not only are the elementary features of bevel gear design brought out and applied to spur gears, but also the real connection between the two types is shown. This is essential to a complete understanding of either.

Testing Involute Spur Gears

A paper on the subject of testing spur gears was read by M. Estabrook, of the Niles-Bement-Pond Co., New York. In this paper some of the more commonly used methods of testing or inspecting spur gears were briefly reviewed, and two new devices for testing gears were described; namely, the Saurer gear-testing machine, a Swiss development by means of which the accuracy of the tooth curves, spacing, and eccentricities can be determined with a high degree of precision; and the odontometer, an American instrument for quickly and accurately testing gears for tooth curves and spacing, and which can be used during the processes of manufacture, making it possible to locate troubles in the machines or tools.

Hydraulic Variable-speed Drive for Machine Tools

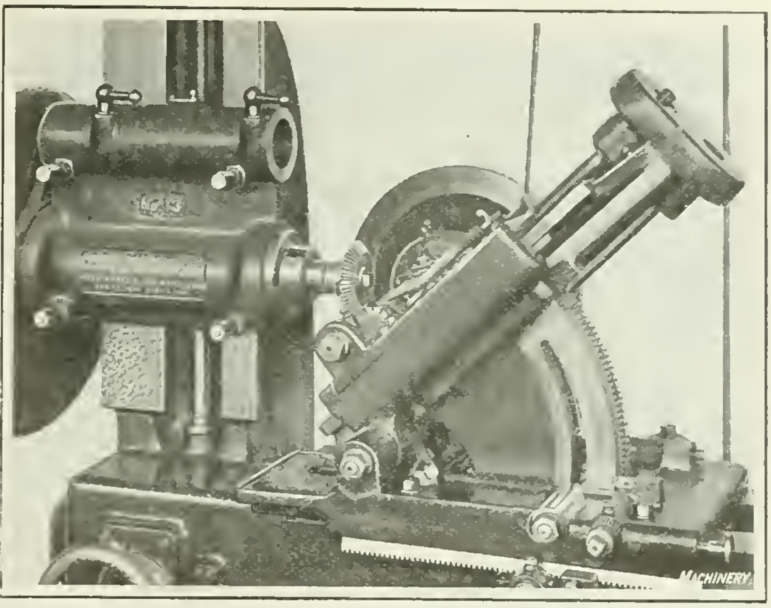
A paper entitled "Applications of Hydraulic Transmission Variable-speed Drive to Machine Tools and Manufacturing Processes" was read by Walter Ferris of the Oilgear Co., Milwaukee, Wis. Hydraulic transmission has been in course of development as a variable-speed drive for twenty-five years, and has often been applied to gun control, turret control, and steering gears on naval vessels during the last fifteen years. Its accuracy and flexibility of speed control, mechanical efficiency, durability of mechanism, and ability to stand abusive accelerating and stalling loads without overheating, are well established, yet this type of drive has never attained extensive introduction in the industries, where its most extensive field seems to lie. The author described and illustrated a number of applications of the "Oilgear" to machine tool driving, broaching, and hydraulic presses.

Power Required for Cutting Metals

An investigation into the power required for cutting metals, by Fred A. Parsons, of the Kempsmith Milling Machine Co., Milwaukee, Wis., gave results of an investigation extending over a period of more than ten years, the purpose of which has been to determine the fundamental laws governing milling, turning, planing and drilling operations on the various metals and alloys used in machine construction. The author's results were presented in the shape of formulas and tables by means of which the power required to machine metal in any given case may be calculated.

Cutting Bevel Gears with Formed Cutters

By FRANKLIN D. JONES



SOME automatic gear-cutting machines of the formed-cutter type are designed for cutting either spur or bevel gearing. Such machines are so arranged that the cutter-slide can be set parallel to the work-spindle for spur gears, and at an angle for bevel gears. While bevel gears are often cut by means of formed milling cutters, this method is not very accurate, because it is impossible to do more than approximate the converging form of tooth when a cutter that merely reproduces its shape is used. In fact, when bevel gearing is cut by this method, it is usually necessary to correct the teeth by filing.

Although these milled gears are sufficiently accurate for many purposes, especially when the speeds are relatively low, they are unsatisfactory for high speeds and where accurate tooth curves are of importance. For cutting small and medium-sized gears of the better grades, the general practice is to use a generating type of machine, whereas for very large bevel gears, the templet or form-copying type is in common use.

Determining Formed Cutter to Use for Bevel Gears

A Brown & Sharpe automatic gear-cutting machine adapted for cutting either spur or bevel gears is shown in the heading illustration set up for cutting a bevel gear. The formed cutters used for bevel gears are similar to spur gear cutters, except that the thickness is less. A thinner cutter is necessary, because it must pass through the narrow space between the inner ends of the teeth. Standard Brown & Sharpe cutters are of such thickness that they will cut face widths up to one-third the length of the pitch cone. These cutters are made in series of eight for each pitch, the different numbers being selected with reference to the number of teeth in the gear and the pitch cone angle. If the number of teeth in a gear is divided by the cosine of the pitch cone angle, the result represents the number that determines the selection of the cutter. After the gear blank and cutter have been mounted on the machine, the cutter is set in a central position by means of a special gage used for this purpose. Gears that are cut with a cutter off center will run more quietly in one direction than in the other.

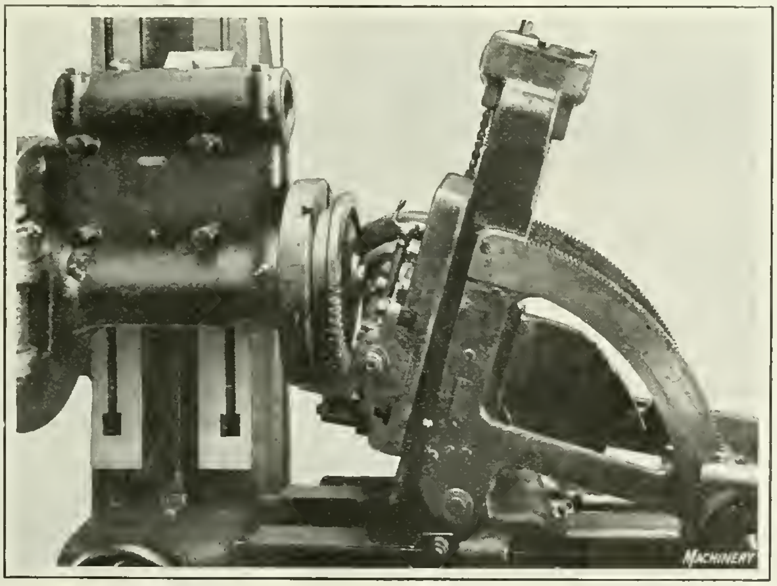


Fig. 1. Cutting Bevel Gears of the Ring Type

Setting Cutter-slide at Required Angle

When bevel gears are cut on machines of the generating type, the cutting angle is determined by subtracting the dedendum angle from the pitch cone angle. When a formed cutter is used, however, better results are obtained by subtracting the addendum angle from the pitch cone angle. When this cutting angle is used, the bottom of the tooth space does not incline toward the apex of the pitch cone, but is parallel to the face of the mating gear. The object of modifying the cutting angle slightly when a formed cutter is used, is to obtain a tooth shape which more nearly approaches the correct form. The cutter-slide (see the heading illustration) is set to conform to the cutting angle by means of graduations on the side of the segment.

Adjustment of Cutter

The total depth of the tooth space for a bevel gear is measured at the large end of the tooth, and at right angles to the pitch line, that is, along the back edge. A simple method of adjusting the cutter for depth is as follows: A gage is first used to scribe a line along the back edge, representing the bottom of the tooth space. This gage may be a small fixed type or an adjustable design with micrometer graduations. The cutter carriage is moved along the bed, and the work-spindle slide adjusted downward until the cutter has been fed into the blank to the depth indicated by the line.

The cutter used for bevel gears cannot be thicker than the spaces between the small ends of the teeth. Hence, if the teeth were finished with a cutter set in a central position relative to the blank, the spaces would be too narrow at the large ends and the teeth too wide or thick.

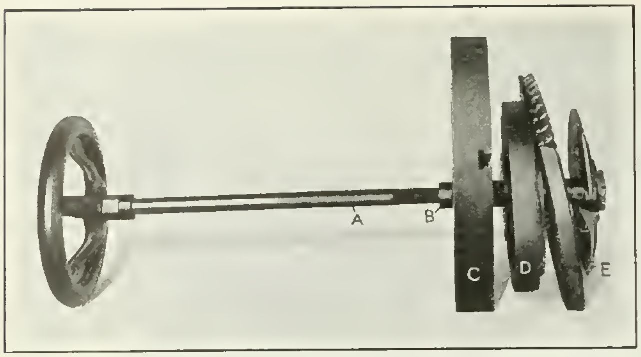


Fig. 2. Equipment for holding Ring Gears

To prevent this, it is necessary, in cutting bevel gears, to set the cutter slightly off center, first in one direction, for finishing the teeth on one side, and then in the opposite direction for milling the teeth on the other side. Before the cutter is offset for this purpose, however, the tooth spaces may be roughed out with the cutter in the central position. According to one rule, this should be done when cutting cast-iron gears coarser than 5 diametral pitch, and the central cuts are usually considered an advantage for nearly all steel bevel gears. As the method of determining the amount of offset has been described previously in MACHINERY, and is also explained in MACHINERY'S ENCYCLOPEDIA, (Vol. III, page 327), it will not be included in this article.

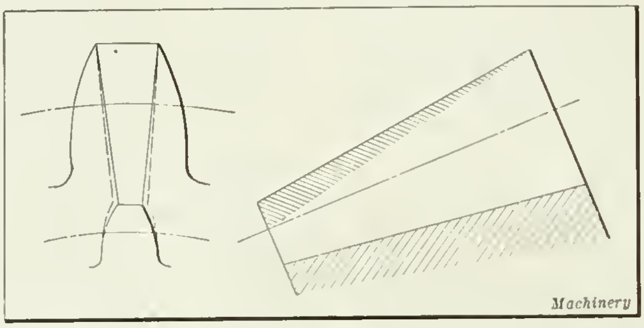


Fig. 3. Diagram showing Part of the Gear Tooth that is corrected by filing

Since the shape of a formed cutter for bevel gears can be correct only for one section of the tooth, the cutter outline is based on the tooth shape at the large end; consequently the small end of the tooth is too thick above the pitch line and it does not have enough curvature, as indicated by the dotted lines in the end view of a tooth in Fig. 3. If the cutter outline conformed to the shape of the teeth at the small ends, too much metal would be removed from the large ends above the pitch line. Therefore the cutter is shaped to suit the large end, because then it is possible to correct the teeth by removing the surplus metal at the small end.

This error in thickness above the pitch line, which progressively increases from the large to the small end, is corrected ordinarily by filing the teeth. The triangular area indicated by the fine shade lines shows what part of the tooth surface should be corrected by filing. No metal should be removed at or below the pitch line, because if the gear has been milled properly the pitch line thicknesses at both large and small ends will be correct.

Method of Holding Bevel Gears of the Ring Type

A Brown & Sharpe automatic spur and bevel gear-cutting machine is shown in Fig. 1 roughing out the teeth of bevel gears for automobiles. These gears are of the ring form, and are held by a special device, the arrangement of which is shown more clearly by the detailed view, Fig. 2. The draw-in bolt *A* passes through the spindle of the machine, and the threaded end engages the long sleeve *B*, which passes through faceplate *C*, work-holding plate *D*, and clamping plate *E*. The gear fits over a shoulder on plate *D*, against which it is firmly held by plate *E* when the handwheel on the draw-in bolt is used to bind the parts together. These ring gears have fifty-five teeth of 4 diametral pitch, are made of 3½ per cent nickel steel, and are cut at the rate of thirty-three gears in nine hours. The cutter speed employed for cutting these bevel gears is 130 revolutions per minute with a feed of 12 inches per minute.

Milling Bevel Gear Segments

The automatic gear milling machine shown at work in Fig. 4 is a cam-controlled type adapted for cutting spur or bevel gearing as well as for various other special operations. This machine is made by the Bilton Machine Tool Co., Bridgeport, Conn. The particular operation illustrated is that of cutting spark and throttle control segments. The cutter is mounted on a horizontal spindle carried by a vertical slide attached to the end of another slide or ram which is free to move horizontally and is actuated by a cam at the rear. At the top of the vertical slide there is a form or templet which is held in contact with a finger at the front end of a pivoted lever arm. This contact between the form and finger is maintained by compression springs located in the head of the ram beneath the vertical slide cap. The lever arm carrying the finger is operated by another cam at the rear, and it controls the vertical position of the cutter-slide.

When the machine is at work, the lever arm moves the cutter down to the working position; then the horizontal ram is given a forward feeding movement by a "stroke cam" of the right throw. When this occurs, the path followed by the cutter depends on the shape of the form at the top of the vertical slide; for instance, if a straight horizontal surface is in contact with the finger on the lever arm, the cutter will move parallel to the axis of the work-arbor, as when cutting spur gears. By using an angular form, as shown in Fig. 4, the cutter-slide is given a combined horizontal and vertical movement, as required in cutting bevel gears. At the end of the cutting stroke, the cutter is lifted to clear the blank, and during the return stroke, the work is indexed automatically. The index mechanism is first unlocked, and then the indexing ratchet turns the work-spindle until it is again locked for cutting the next tooth space. These indexing movements are con-

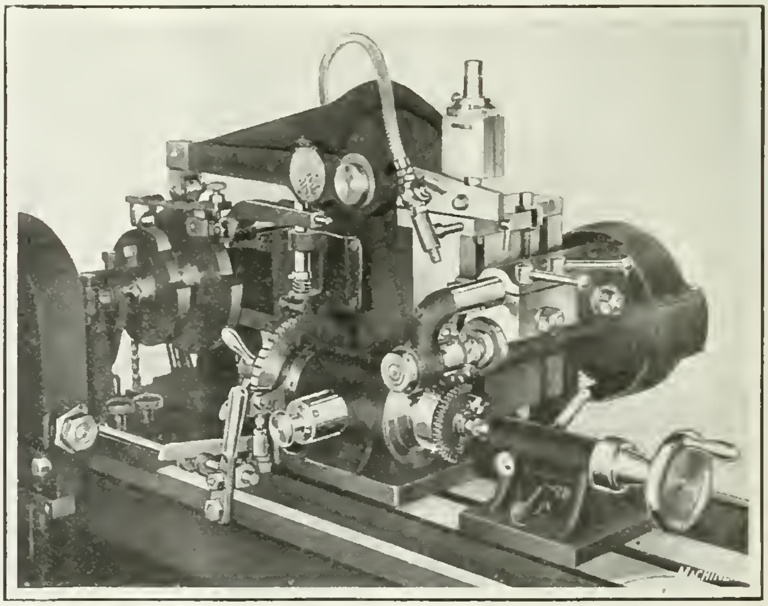


Fig. 4. Cutting Bevel Gear Segments

trolled by additional cams at the rear. The depth of the cut may be regulated by a micrometer adjustment for the finger that bears against the form at the top of the cutter-slide.

The bevel gear segment shown on the machine in Fig. 4 has twenty-two teeth, 1/4 inch face width, and an angle of nearly 8 1/4 degrees. These segments are cut at the rate of 3 1/2 minutes each, which includes the changing time. The segment is mounted on an arbor passing through a special sleeve held in the headstock spindle by a draw-bolt. A horseshoe washer bears against the outer face of the hub, and permits the work to be readily inserted or removed. The arbor is keyed to the sleeve to prevent it from turning when the inner draw-bolt is tightened, and the sleeve is keyed to the headstock spindle to insure accurate registration. The gear blank is locked circumferentially by a stud and set-screw on one side, which forces the opposite side against a stop-pin.

A method of cutting two bevel gear segments at one time is illustrated in Fig. 5, which shows a Gould & Eberhardt machine. The cutter-slide of this machine feeds vertically along the face of the column and carries two cutters, as shown in the illustration. The bevel gear segments are held on pivoted arms that form part of the fixture, and these are indexed in unison for milling each successive tooth space. These cast-iron segments have eleven teeth of 5 diametral pitch, and 1 1/4 inch face width. They are cut at the rate of nine per hour. No attempt was made to produce accurately formed teeth, since this was not necessary.

Cutting Double-angle Bevel Gears

An unusual gear-cutting operation, also performed on a Bilton machine, is shown in Fig. 6. The work is that of cutting double-angle bevel gears. The first part of the gear has an angle of 15 degrees, which changes to an angle of 29 degrees. This double angle is readily milled during one passage of the cutter, by using a double-angle form at the top of the vertical slide. When the cutter is milling the 15-degree section, the 15-degree part of the form is sliding under the finger of the lever arm. Then, as the 29-degree edge of the form, which inclines upward to the left, comes into contact with the finger, the cutter moves down along the corresponding section of the gear. A special stroke cam having the necessary throw is used to feed the ram forward. When the last cut is completed, the feeding mechanism on machines of this type is tripped automatically. The double-angle gears are made of cold-rolled steel and have twenty teeth. Ten gears are cut per hour, which includes changing time. The machine illustrated is one of a battery of four run by one operator.

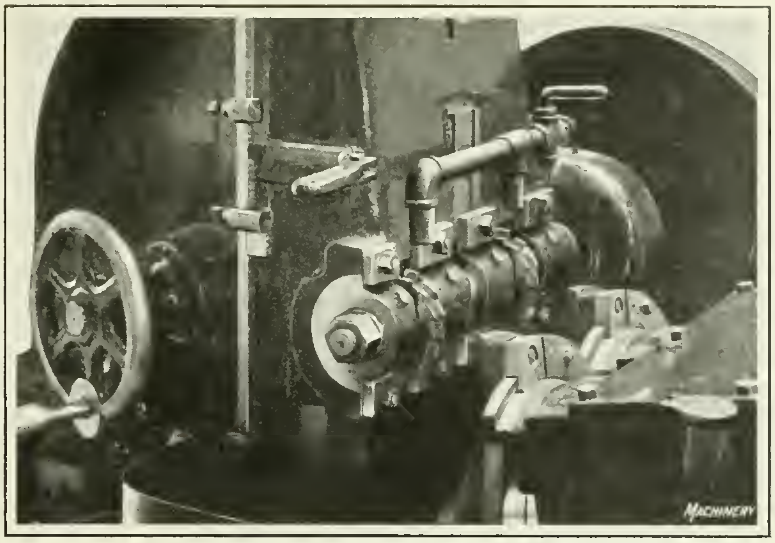


Fig. 5. Cutting Two Bevel Gear Segments simultaneously

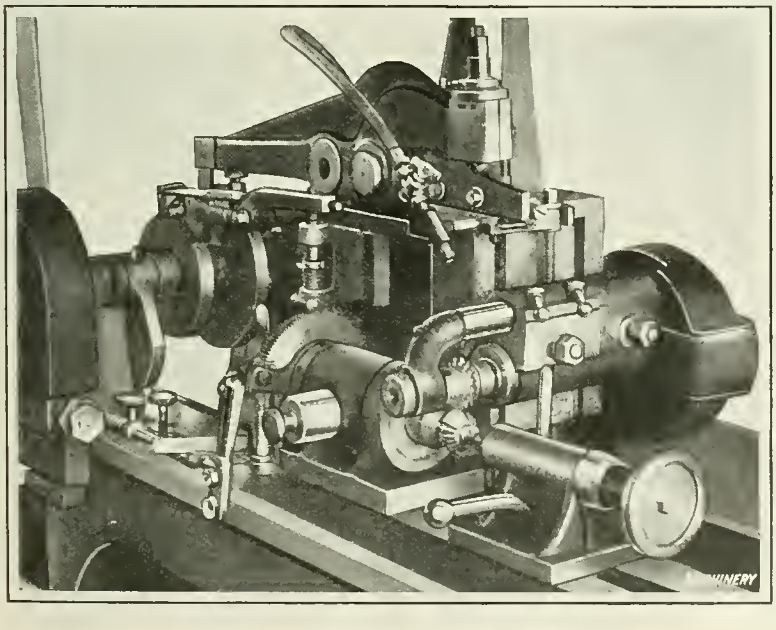


Fig. 6. Cutting a Double-angle Bevel Gear

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THE VALUE OF STANDARDIZATION

In a brief summary prepared by P. G. Agnew, secretary of the American Engineering Standards Committee, 29 W. 39th St., New York City, thirteen specific points are brought out on the value of standardization in the engineering industries, as given in the following:

1. It enables buyer and seller to speak the same language, and makes it possible to compel competitive sellers to do likewise.
2. In thus putting tenders on an easily comparable basis, it promotes fairness in competition, both in domestic and in foreign trade.
3. It lowers unit costs to the public by making mass production possible, as has been so strikingly shown in the case of incandescent lamps and automobiles.
4. By simplifying the carrying of stocks, it makes deliveries quicker and prices lower.
5. It decreases litigation and other factors tending to disorganize industry, the burden of which ultimately falls on the public.
6. It eliminates indecision both in production and utilization—a prolific cause of inefficiency and waste.
7. It stabilizes production as well as employment, by broadening the possible market, and by making it safe for the manufacturer to accumulate stock during periods of slack orders to an extent that would not be safe with a product that was not standardized.
8. By focussing on essentials, it decreases selling expense.
9. By concentrating on fewer lines, it enables more thought and energy to be put into designs, so that they will be more efficient and economical.
10. By bringing out the need of new facts in order to determine what is best, and to secure agreement on most questions, it acts as a powerful stimulus to research and development.
11. It is one of the principal means of getting the results of research and development into actual use in the industries.
12. It helps to eliminate practices that are merely the result of accident or tradition, and that impede development.
13. By concentration on essentials and the consequent suppression of confusing elements intended merely for sales effect, it helps to base competition squarely on efficiency in production and distribution and on intrinsic merit of product.

Buying Tool Steel Performance

By CHARLES M. BROWN, Vice-president and Sales Manager, Colonial Steel Co., Pittsburg, Pa.

Should tool steel be bought on the basis of specifications of its chemical composition? This is the question that the author of this article answers. Is the value of a tool steel to the buyer measured by any other standard than by performance, and can performance be made to depend directly upon analysis and composition? The author discusses this subject thoroughly, and answers the questions raised definitely. He shows that composition or analysis alone does not determine the merit of a steel, and points out that it is much easier for the steel manufacturer to make a steel of a given analysis than to make one that will measure up to certain performance requirements.

THERE is a growing feeling among buyers and users that tool steel ought to be standardized. They want to know more about the varying qualities and differences and reasons why there are so many kinds. And, most of all, they want to find some way of discriminating between competitive makes without the burdensome, annoying, and costly method of trying it out in actual performance. Before saying offhand that this can or cannot be done, there should be a clear understanding of what is expected and demanded of any tool steel after it is ordered.

What does the tool steel manufacturer actually sell? We venture to state that in the majority of cases he does not sell steel at all. In fact, he is often inclined to feel that he is not in the steel business as it is usually known. What he is really engaged in selling is "tool performance." It is the trade custom and has been for many generations, to supply tool steel suitable for the purpose for which it is intended, and the standard trade guarantee is based on this condition. While the order specifies so many bars, and that many bars are actually delivered, this is not what the buyer actually seeks. What he does demand is that a certain specific job requiring tools shall be done successfully in his shop. As a consequence, any successful selling force must have a thorough knowledge of metal-working and machine shop practice. It must be competent to advise and criticise the design and making of tools of every kind; understand the operation and control of gas, oil, and electric heat-treating furnaces; know the proper temperatures for hardening every kind of steel, the best medium and the most successful ways for quenching, and the infinite variations in tempering; and even the setting up and operation of machine tools. All this experience and knowledge —intensified service—is purchased when an order for tool steel is placed with a dependable manufacturer of tool steel.

Should a Buyer Specify the Analysis of Steels?

If tools from a certain brand of steel do not give satisfactory results, the buyer feels justified in demanding an adjustment, unless the seller can prove that the difficulty arises from something in their design, machining, hardening, tempering, or the way in which the tools are put to work, and not in the steel itself. It is then that the tool steel salesman is really called upon to deliver what he has all the time been expected to, and that is, tool performance. Such being the case, it is only right for the salesman to ask the buyer, at the time of ordering, for what purpose the steel is to be used, and then name his price on the grade that he considers will give a satisfactory performance. Almost all tool steel catalogues urge the buyer to specify on every order the purpose for which the steel is to be used. This is not done with a view to manipulating prices or juggling brand names, but rather to make it possible for the tool steel manufacturer to carry out the contract as he is expected to.

The absolute essential, then, before attempting to standardize tool steel or to draw any specification that places limits on analysis or methods of manufacture is to decide definitely what is expected and demanded of the steel after it has been delivered. If the buyer is going to demand a satisfactory tool performance, what will he gain by telling the manufacturer how much carbon or how little phosphorus to put in the steel? On the other hand, should the buyer be willing to relieve the tool steel manufacturer of all responsibility for tool performance, he can simplify his purchasing by adopting an analysis specification; but that is all he can do, for analysis is an indication only and not a proof of quality. This can be seen by considering what the tool steel manufacturer has to do before he decides his product is satisfactory.

Development of High-speed Steels

The differences between the grades and varieties of tool steel are of two kinds: First, those due to the materials used, and second, those due to the methods employed in manufacture. The difference in materials used largely accounts for the various kinds of steel, such as high-speed steel, alloy tool steel and carbon tool steel; and the difference in methods affects the same kinds or grades of steel, as made by different manufacturers. Ancient tool steel was all straight carbon steel, or if it contained any alloy that fact was not known. It is possible that the superior merits of some ancient sword blades are due to the fact that the ores from which they were manufactured contained small percentages of tungsten. The first advance of any practical value over straight carbon steel, and the first successful attempt at combining an alloy or other metal with iron to obtain improved cutting qualities was the manufacture of self-hardening steel by Robert F. Mushet in 1868. This steel contained a comparatively high percentage of carbon, in addition to a high percentage of tungsten. From this tungsten self-hardening steel there has since been developed the more complex high-speed steels of today, which are a combination of iron with chromium, tungsten, vanadium, and occasionally small quantities of other alloys.

As a result of the great increase in cutting qualities of tools made from high-speed steel, many experiments have been made to determine the value of combining other alloys with iron for tool steels, and as a result there are now being produced alloy tool steels containing tungsten, chromium, vanadium, nickel, molybdenum, and other alloys, either singly or in combination. Straight carbon tool steel is a different and more complicated class, and we have a great variation in quality due to differences among manufacturers, both in the raw materials used and in the methods of manufacture. Some carbon tool steel is made from very pure puddled iron, commonly known as "muck bar"; some from puddled iron and tool steel scrap melted together; and in still other cases it may be made entirely from basic open-hearth scrap in the form of plate shearings or punchings, or from low phosphorus and sulphur basic open-hearth bar remelted in the crucible pot.

Process of Manufacture

In the manufacture, the first step is melting, of which there are three processes—the crucible, which is the oldest; the open-hearth, either basic or acid; and the more recently developed electric process. Large quantities of tool steel are being produced, and have been for years by the open-hearth process. Many think of tool steel as that which is used for metal-cutting purposes only, but there are quantities of other hardened and tempered tools and implements that were formerly made from crucible steel and are now almost entirely made from open-hearth steel. Among these are such tools as plowshares, mowing-machine knives, oil-well drilling tools, mining drills, saws, hatchets, and axes. Wherever the demand for tools and implements has grown to such an extent that a large tonnage of steel is required, it is invariably found that the crucible process is too costly. By careful experimentation and the application of the same care in the manufacture that is applied in melting steel by the crucible process, open-hearth steels of high quality have been developed, and it is probable that this change to a steel which can be melted at a lower cost, will be made wherever the demand is great enough.

> **It is essential before attempting to standardize tool steel, or to draw up any specifications that place limits on analyses or methods of manufacture, to decide definitely what is expected and demanded of the steel after it is delivered. If the buyer's one aim is simply satisfactory tool performance, what does he gain by telling the manufacturer how much carbon or how little phosphorus to put in the steel? On the other hand, if the buyer is willing to relieve the tool steel manufacturer of all responsibility as to tool performance, he can simplify his purchasing by adopting an analysis specification; but this does not insure performance, because analysis is an indication only, and not a proof of quality.**

The electric process is the newest, and while it has made rapid strides and is successful in many instances, it has not yet been proved that steel melted by this process is as suitable for many purposes as steel melted by the crucible or the open-hearth process. The crucible process is, by comparison with other methods of melting, a hand process and deals with very small units, every lot being melted in units of about 100 pounds which constitute the contents of each crucible. Everything about the process requires close attention. It is, however, strictly a melting and not a refining process, and steel taken out of the furnace will be no purer than that put into it. Consequently, the mere fact that steel has been melted in a crucible does not of itself insure good quality. It must be good before it is melted. Most manufacturers consider that puddled iron or muck bar is the best raw material from which to melt tool steel.

Disadvantages of the Open-hearth and Electric Processes

The disadvantage of the open-hearth process is that, because it has almost universally been used by the steel trade as a tonnage producer, with quality but a secondary consideration, the majority of experienced open-hearth steel men have concentrated their attention on those refinements and processes that tend to give additional tonnage, and have not directed their minds to those refinements that would tend to produce better quality. The fact remains, however, that the tool steel manufacturer, because of his experience gained in the manufacture of steel by the crucible process and his knowledge of the dangers to be met, can produce a really high-grade steel by this process.

The disadvantage of the electric process for tool steel manufacture seems to lie in the fact that the temperatures produced by the electric arcs are extremely high, much higher than is desirable for melting, and as a result some part of the bath is subject to overheating during the melting with a consequent effect on the quality. This is particularly noticeable with plain carbon steels having no addition of alloys that possess higher heat-resisting qualities than iron.

Experience and Carefulness Necessary in Producing Tool Steels

After melting and casting, the ingot must be reduced either to a finished bar or to a billet of a size that can be rerolled. On account of the high carbon content, this operation must be carried out with the greatest care; if at all overheated in forging or rolling, the steel is spoiled. After reducing to billets, it is customary to smooth off the surface either by grinding, or by using pneumatic chipping chisels. All roughness, surface cracks, and seams, if not removed, result in seams in the finished bar. The billets are then rolled into finished sizes, or hammered down. Here again the heating has to be conducted with great care, and, as before if overheated in the process of rolling, or final forging, the steel is spoiled. The usual final step in the manufacture is annealing, and this is a matter of the greatest importance. Steel that is over-annealed is very difficult to harden, and steel that is under-annealed is not only difficult to machine, but besides does not give the maximum production when used in the form of hardened and tempered tools.

All these operations may not be carried out exactly in the same way in different mills, and there are intermediate steps in caring for or protecting the steel, which may vary. Experience and the greatest possible care at all times are necessary to produce a steel that will stand the abrupt transformation that it undergoes in hardening and tempering. Even should two organizations possess the same degree of skill and experience, they will not apply this to the same degree. Great differences will therefore exist in the thoroughness or expertness with which these operations are carried out, and so quality differences are bound to occur in different makes of tool steel. As previously mentioned, these are due, first, to the difference in the materials used, second, to the different methods of manufacture, and third, to the extent to which care is applied in the making.

Standardized Compositions of High-speed and Alloy Tool Steels

At present alloy tool steels and high-speed steels are largely standardized. Carbon tool steel is not, because there are too many variables in practice and too wide differences in the requirements that must be met in tools for different purposes. Alloys have very definite characteristics which they impart to the steel, and so it is possible to measure the results obtained by the use of steel containing them. Furthermore, alloy steels are used for comparatively few kinds of tools or operations, and for this reason it has been possible to watch and check up the results. Where it has been proved that the addition of a certain alloy gives improved qualities to the steel, a specification demanding that alloy in an amount definitely fixed within reasonable limits can be made. It is a mistake, however, to suppose that the inclusion of a small percentage of any known alloy will overcome all the troubles in the use of tool steel and the hardening and tempering of tools. But for the sake of simplicity, a standardized schedule dividing steel into types according to the presence of one or more alloys is feasible. In fact, this has already been done to a large extent.

High-speed steel is now made in two general types, the first of which is most common and has a composition about as follows: Carbon, 0.55 to 0.75 per cent; manganese, 0.20 to 0.40 per cent; silicon, 0.10 to 0.30 per cent; chromium, 3 to 4 per cent; tungsten, 16 to 18 per cent; and vanadium, ½ to 1 per cent. There are many different makes of high-speed steel that conform to the standard composition given.

The second type has the same general composition, except that the amount of tungsten is lower, running from about 12 to 14 per cent, and the amount of vanadium higher, being from 1½ to 2 per cent. This type is not so commonly known, but can be obtained in several brands.

Manganese has a marked effect on steel, and as a result the following standard composition has been pretty generally followed for oil-hardening tool steels: Carbon, from 0.80 to 1 per cent; manganese, 1.25 to 1.75 per cent; and silicon, 0.25 to 0.40 per cent. There are other standard types of alloy steel, including one containing a very small percentage of chromium, which is used in the manufacture of carbon twist drills. Another alloy tool steel containing about 1½ per cent tungsten is increasing in favor among tap manufacturers. Others are less widely known; for example, vanadium tool steel, which was made standard by the United States Shipping Board for rivet driving sets.

All these standard types of steel contain one or more alloys on which they depend for marked and valuable characteristics. While different results are obtained from different brands, due to the difference in methods of manufacture and the care with which they are applied, all steels conforming to these types are very similar in characteristics and, generally speaking, will respond to the same method of heat-treatment. A specification of analysis should, therefore, secure a reasonable uniformity of composition, which would, in turn, make possible the adoption of definite methods of heat-treatment.

Conclusion—Working Qualities Versus Analyses

The great bugbear in the trade, however, is the fetish of analysis which many seem to feel can be relied upon to determine whether steel is of satisfactory quality or not. As a matter of fact, this is at present a great drawback to the progress toward standardization which is all the time going on, because analyses do not insure working qualities. The writer maintains that the successful specification must designate some method by which the following qualities of tool steel can be determined: (1) machineability; (2) dependability in hardening and tempering; and (3) ability to do the work for which it is purchased. These are practical things that in the long run always determine which tool steel shall be purchased. There is no benefit in drawing up an analysis unless all three of these things can be definitely procured.

The writer maintains that the choice of manufacturing process should be left to the manufacturer. As an economic proposition, it is desirable that steel be produced by the least expensive method. Hence every manufacturer should be left free to develop any process by which he can turn out a steel that will best meet the three requirements just stated, and should not be confined to fixed methods simply because these have been used in the past; any attempt to so confine him is merely going to hinder the normal development and progress that would otherwise be made.

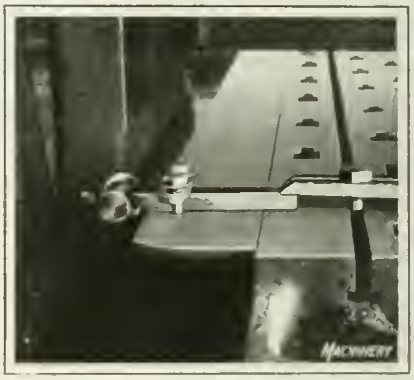
What the buyer wants is tool performance, and this must never be lost sight of. If he draws up an analysis that is broad enough to include all the kinds of steel that will give good results for the purpose for which it is intended to be used, he has not changed the situation much. But, on the other hand, if he draws up a specification of analysis that is rigidly narrow, he will reduce production to a price basis without respect to quality, because the easiest thing for the tool steel manufacturer is to furnish steel to any given analysis if he makes up his mind to do it. By the use of the electric furnace and manipulation of the slag, it is possible to reduce sulphur and phosphorus contents to any practical limit desired, but it does not follow that steel so made will meet the three requirements that we have stipulated as the basic tests for any tool steel. It is ten times easier to furnish a steel to a given analysis than it is to meet any one of the many shop requirements that ordinarily have to be met.

INCREASING THE WIDTH CAPACITY OF A PLANER

By DONALD A. HAMPSON

A number of castings required in the construction of a machine were found to be so wide that they could not be planed in the largest machine available, which was a heavy 48-inch planer. It was found possible, however, to so arrange all castings on the planer table that the wide portion would be located next to the table surface. When so arranged, the wide part had a height of a little over 2 inches at each side of the table. The castings were a little over 49 inches wide at this point, in the rough, which meant that the distance between the planer uprights should be at least 49½ inches so as to clear the work when the machine was in operation.

In order to determine if grooves could be planed in the uprights to give the required width, test holes were drilled through them just above the table. These holes showed that sufficient thickness of metal would be left in the uprights even after grooves of the required depth were planed. As all the work done on the planer was light, compared with that for which the planer was originally designed, it was decided to cut the uprights away to a depth of ¾ inch. Naturally, such a procedure would not have been considered for an occasional job, and it was only done in this case because the work promised to be steady throughout the year.



Tool-holder clamped to Table for planing Grooves in Uprights

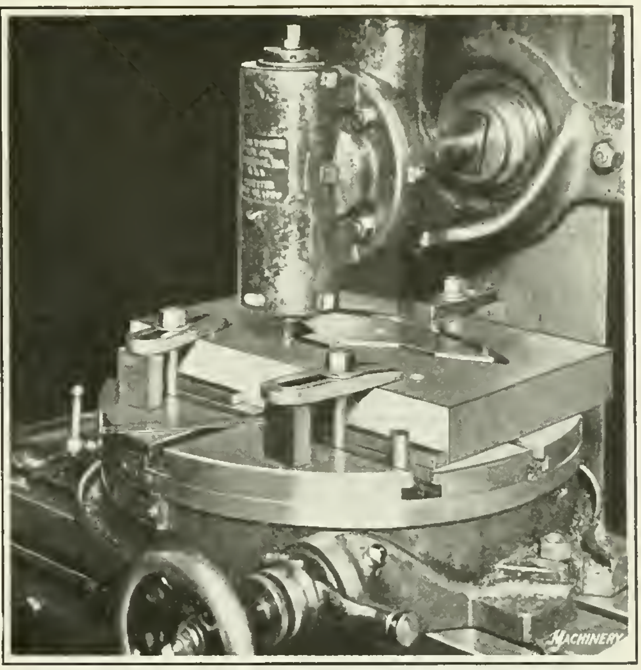
The next thing to decide was how to do the cutting. To remove cast iron to the amount of 1½ by 2 by 54 inches, is not an easy task, especially if a nice looking job is desired. The accompanying illustration shows how this was accomplished. An Armstrong special planer tool-holder was stripped of its head and fitted with one of soft steel carrying a ⅝-inch tool bit in the cutting end. The head was provided with a shoulder and lock-nuts, so that it was a tight fit in the shank but could still be turned with a 20-inch wrench.

This tool was securely clamped to the table, as shown in the illustration. By sweeping the head through an arc, turning it slightly at the forward end of each stroke, it was possible to cut the metal away quite rapidly. After cutting each arc-shaped groove, the tool was moved outward ¼ inch. It required two and one-half days to complete the work, three vertical settings being necessary to make a cut in the uprights of the required depth and height.

* * *

SALES OF MACHINE TOOLS IN JAPAN

The total sales of machine tools in Japan amount to about 30,000,000 yen (approximately $15,000,000) annually. Of these machine tools, about one-third are made in Japan, and two-thirds are imported. In 1920 the total imports of machine tools were just a little short of 20,000 tons. Of the imports in that year, over 80 per cent came from the United States and almost the entire remainder from Great Britain. The imports from Germany, Sweden, France, Switzerland, and Belgium were but slightly over $50,000 in total value. These figures were obtained from a machine tool dealer in Japan, and are based on Japanese government statistics. Figures for 1921 are not yet available, but there was a decided falling off in imports in that year.



Dies for Die-castings

Specific Examples of the Design and Construction of Dies for Making Die-Castings of the More Intricate Types
Second of a Series of Articles

By A. G. CARMAN, Chief Metallurgist
Franklin Die-Casting Corporation, Syracuse, N. Y.

To give some idea of the general principles followed in the design and construction of dies used in the die-casting process, a number of representative dies and castings produced by them will be considered in this article. The first example embodies the general principles governing the construction of dies for producing wheels having raised letters, figures, or characters on their periphery, such as are used in printing presses and tabulating, counting and adding machines, etc.

Fig. 1 shows the two parts of a die used in producing a zinc-base register collar, the upper half of the die being on the right, and the lower half on the left. The casting produced is shown beneath the lower half of the die. Referring to the upper half of the die, *C* represents the slides, ten in number, which carry the numbers and graduations for the periphery of the casting; *D*, the plates having slots in which pins in slides *C* operate to move the slides radially in and out before and after the casting has been formed; *E*, a stationary core with a small core in the center to form the small hole in the center of the casting. Two ejector-pins *F* extend through the core *E* and four ejector-pins *G* act on the rim of the casting. All the ejector-pins are rigidly fastened to an ejector-plate in the upper part of the die and are operated by the two pinions *J*.

In the lower half of the die is an opening *L* for the admission of metal from the pressure chamber of the casting machine to the depression in the die. The darkened area surrounding the depression and extending to the edges of the die is air space milled in the plate to allow the air in the depression of the die to escape. Ten dowel-pins serve the purpose of aligning the two parts of the die, and by passing through holes in the slides *C* lock them and hold them firmly in position while the casting is being formed.

In the lower right-hand corner of Fig. 2, is a detail view of the register collar made by this die. To the left are the plan and elevation of the die. The heavy dark line shows the parting line of the die, and the dotted-line section the casting depression. Letter *L* indicates the channel for the admission of the metal. The stationary core *E* fits into the slotted ring *A*, and this, in turn, fits into the slotted ring *B* in such a way that the slots in *A* and *B* form a continuous radial slot for the cores *C*. The cores *C* are made in two sections and pinned together, as indicated in the detail view of this part. Thus in case the numerals or graduations become injured, it is necessary to make only one new part and not the whole core. The cores *C* are placed in the casting position by rotating the lever *D* clockwise and are withdrawn by a counter-clockwise movement of the lever. *H* represents the ejector-box to which ejector-pins *F* and *G* are attached, and *J* the ejector pinions used to advance the ejector-pins to remove the casting from the die.

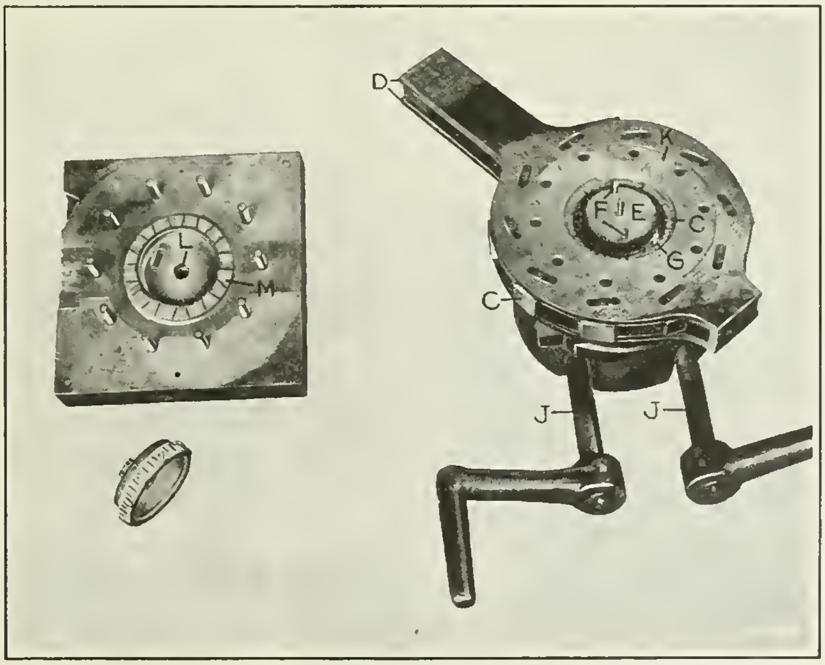


Fig. 1. Die used to produce a Zinc-base Register Collar with Raised Figures on the Periphery

Another die requiring special construction in order to produce a zinc-base casting having an under-cut and external threads is illustrated in Fig. 3. At the right is shown the lower half of the die, at the left the upper half, and at the extreme left the casting. Letters *A* and *B* indicate two cores operated by the pinions *C* and *D*. The cores are fitted with stop-collars which allow them to just meet inside the die and produce a continuous hole through the casting. Another core *F*, operated by the pinion *E*, is also

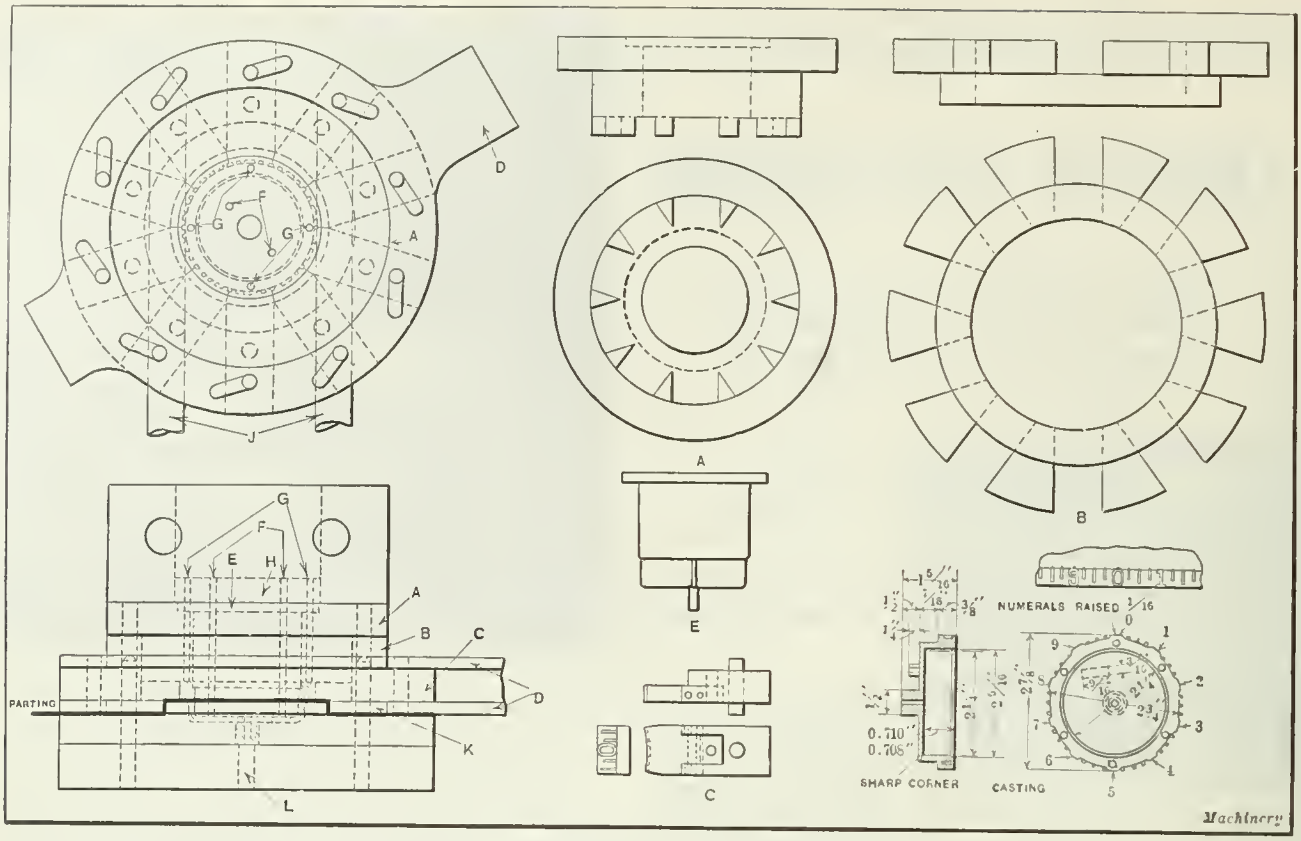


Fig. 2. Detail Views of Die Parts and Casting illustrated in Fig. 1 and Assembly View of Die

provided with a stop-collar that allows the core to just meet core *B*, thereby making a hole in the casting that connects with the hole made by cores *A* and *B*. The large core *G*, operated by the pinion *J*, produces the hollow interior of the casting. The distance this core may advance into the die is regulated by two stop-pins located one on each side of the core.

Two slide cores *L* and *M* operated by toggle levers, form part of the ends and the external threads of the casting. When the die is closed, these two cores are held firmly in their proper place by the dowel-pins that pass through holes in the cores. A stationary core *O* produces the opening in the side of the casting. Five ejector-pins *P* and *Q* are attached to an ejector-plate, two pins engaging the lower part of the casting and three the upper part. The metal enters the die through the opening *S*, and the air in the die passes out through the air space represented by *T*. The die halves are aligned by means of the four dowel-pins on the lower plate. Fig. 4 shows detailed sectional views of the casting. Section *A-A* shows the portion of the casting formed by the cores *A*, *B* and *F* in Fig. 3. Cores *A* and *B* meet to form a continuous passage through the casting, and *F* meets *B* as mentioned to connect the opening in the smaller section with that in the larger part of the casting. Section *B-B* shows the under-cut previously referred to and the external threads cast on the circular flange on one side of the casting.

Fig. 5 shows the plan and elevation of the die, the heavy line representing the parting line of the die and the dotted-line section, the casting depression. On account of the recess previously referred to, the main core *G* is made in two sections, as indicated by the dotted line *H*. The two parts of the core are moved jointly into position by the pinion *J* before the casting has been formed, but only that part of the core below the line *H* is withdrawn from the casting by pinion *J*. The part of the core above the dotted line *H* remains in the casting and is ejected with it, being removed later.

In the next installment of this series of articles, dies for venturi tubes for gas engine mixing chambers and dies for door checks will be shown. The metals used for die-castings will be dealt with in another article, completing the series. In connection with the article on metals used for die-castings, definite compositions will be given, and the possible limits of accuracy for different types of die-castings will also be stated. Other information of value to those who contemplate the use of die-castings in their products will be included.

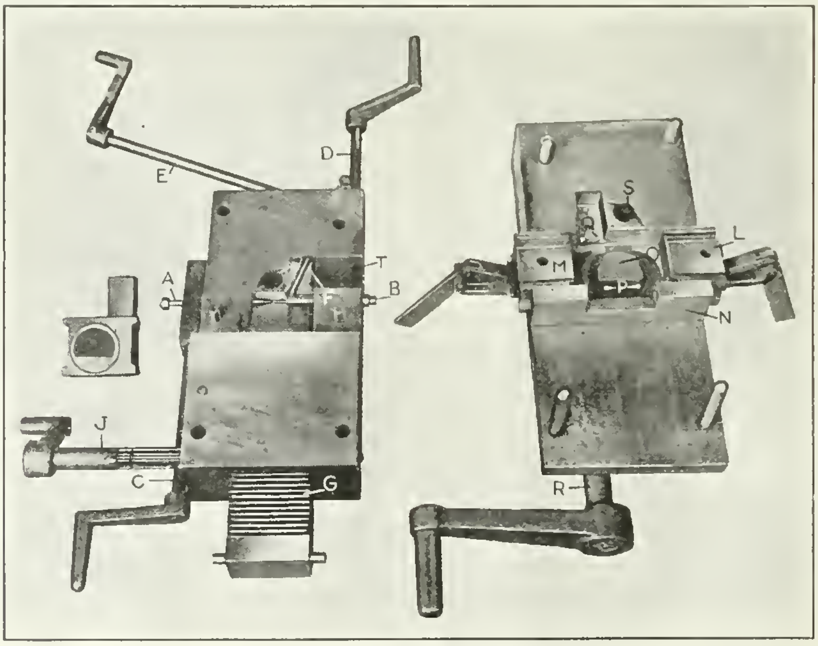


Fig. 3. Die for producing a Zinc-base Instrument Housing

STANDARD TESTS FOR LEATHER BELTING

Standard specifications have recently been adopted for leather belting by a joint committee of the United States Bureau of Standards and the Leather Belting Exchange, of which Louis W. Arny, 417 Forrest Building, Philadelphia, Pa., is secretary. This is the first standard that has been adopted for defining a belt of first quality. The question of quality in leather belting resolves itself into a question of the selection of the part of the hide from which a belting strip shall be cut in order to give the best results.

The new specifications, known as Federal Specifications for Leather Belting, provide for four tests that may be applied in any physical laboratory, covering average tensile strength, stretch, elasticity, and piping. The requirements provide that the average tensile strength of five samples of single belting must be 3750 pounds per square inch, or more, and the minimum strength of any one of these five samples must be 3000 pounds per square inch of cross-section.

With regard to stretch, the average elongation of the five samples at a tensile stress of 2500 pounds per square inch shall not exceed 15 per cent. The belt shall also be suspended in a vertical position, and sufficient weight, including the weight of the clamp, shall be attached to the lower clamp to produce a tensile stress of 750 pounds per square inch of the average cross-section. After fifteen minutes suspension, a section 10 feet long shall not exceed 10 feet 7.2 inches in length (6 per cent stretch).

With regard to elasticity, the clamps used in the previous test shall be removed and the sections allowed to lie loosely on the floor for seventeen hours; after this time the length between the gage marks shall not exceed 10 feet 1.6 inches (1 1/3 per cent stretch). With regard to piping, the specifications require that the leather shall not show wrinkles (commonly called piping) on the grain side when bent through an angle of 180 degrees, grain side in, over forms specified for different grades and thicknesses.

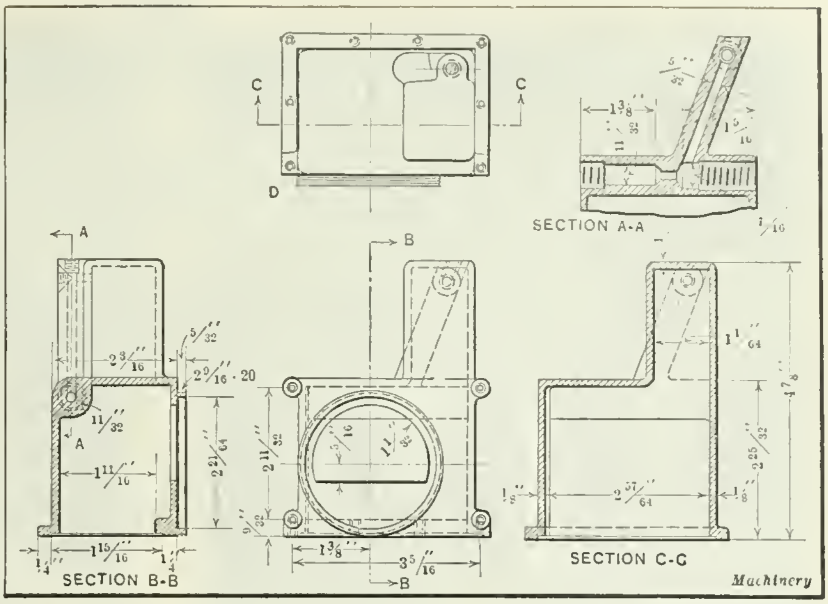


Fig. 4. Detailed View of the Casting made in the Die illustrated in Fig. 3

These four tests will show whether any inferior stock has been used. An unusually high tensile strength, coupled with an excessive stretch and low elasticity, would indicate inferior stock, which would be confirmed by the piping test. A moderate tensile strength, slightly above the specifications, with a stretch within the limitations and an elasticity as stated, indicates a first-class material. These tests differentiate between first and second quality material in leather belting. A copy of the specifications should be in the hands of every concern whose belting purchases are of sufficient importance to make the subject worth while investigating, and may be obtained by addressing the Leather Belting Exchange, Philadelphia, Pa. A number of the leather belting manufacturers already are making belting to comply with these specifications.

* * *

MOTION PICTURES FOR INSTRUCTION PURPOSES

A new lecture course on industrial processes is offered this year for the first time by the Department of Management of the School of Commerce of New York University. The subject matter of the new course is presented entirely by means of motion pictures with supplementary information supplied by the lecturer. This is believed to be the first course of its kind ever given in which moving pictures are used exclusively throughout the entire course. The students are shown many of the more usual processes, machines, operations, and assembling methods found in modern industrial plants. Each picture is accompanied by an adequate explanation of the principles involved. Starting with the basic industries, such as coal and iron mining, and steel making, the course presents in detail the various stages through which the raw materials pass until converted into finished products. One of the pictures relates to the making of a locomotive, beginning at the iron ore mine and following the material through blast furnace and steel mill, forge and foundry, until it reaches the locomotive shop, where machining and assembling operations are shown in detail, and the finished engine finally left on the tracks, ready for its trial run.

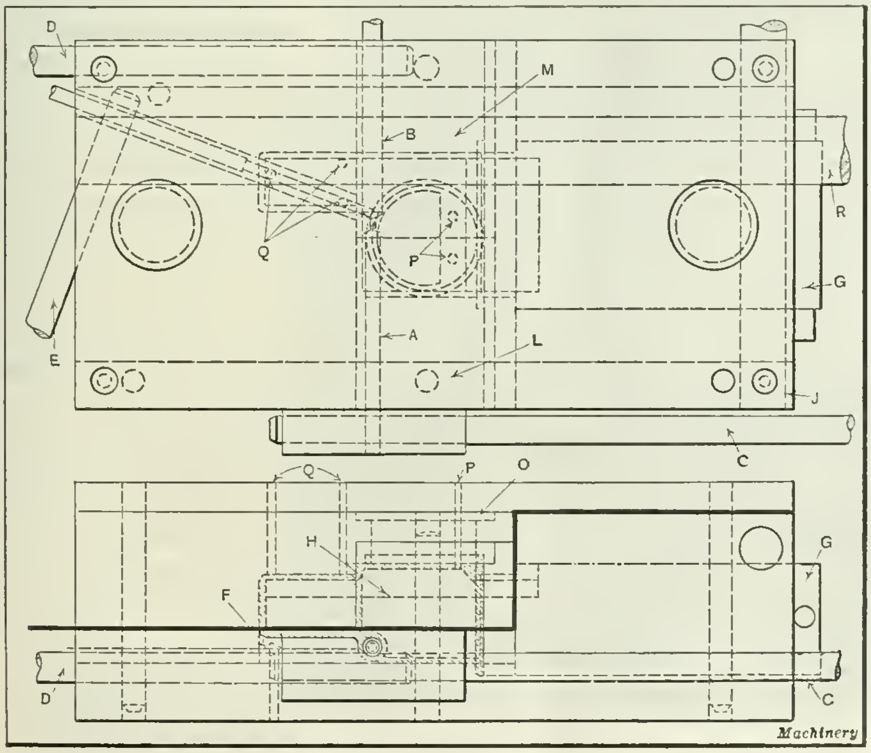


Fig. 5. Assembly View of the Die illustrated in Fig. 3

Polishing Wheels

The Manufacture of Compress Polishing Wheels—Third Article of a Series

By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y.,
and President of the Metal Finishers' Equipment Association

THE compress polishing wheel, as mentioned in one of the preceding articles in this series (see November MACHINERY), is a type of wheel in which the material, usually leather or canvas, is placed crosswise of the face of the wheel instead of the wheel being made up of parallel flat disks. The wheel consists of an angular ring, made up of rectangular pieces of material arranged radially and compressed to form a ring or "cushion" of polishing material one or more inches in depth. This cushion is assembled with side plates engaging annular recesses in the compressed ring. The side plates, in turn, are riveted to a hub. The manufacture of compress polishing wheels involves a number of methods that are quite different from those used in making polishing wheels of the solid type. The article in December MACHINERY referred to the solid disk type; the present article will deal specifically with the manufacture of compress polishing wheels.

The material from which the compress polishing wheel is made, even though it may be of the same general quality as that used for a disk wheel, has a decidedly different effect in polishing than the same material in a wheel of disk form. Practically all the materials used in solid disk wheels, such as leather, canvas, walrus hide, sheepskin, felt, and paper, may be used in the construction of compress wheels, but leather and canvas are by far the most commonly used. The object of the use of the different materials is to secure different degrees of density or "cushion" in the face of the wheel. Walrus hide, for example, is more porous and softer than leather, but a compress canvas wheel can be made which has practically the same density on the face as a disk walrus wheel, and which will do the same work equally well or better. Prejudice among old-time polishers is practically the only reason why other materials than leather or canvas are used in the manufacture of the compress style of wheel. The manufacturing process is essentially the same, no matter what the material used.

The leather used in the manufacture of compress polishing wheels is of various kinds. The softer wheels are made from thick, very porous bullneck leather, while the harder wheels are made from thin leather from which both the grain and the flesh side have been removed, and which has the greatest density. It is important that the density of the leather be uniform throughout the entire face of the wheel, and a great deal depends upon the intelligence and experience of the sorter of the leather in selecting that quality which is best adapted for the work to be performed. In addition to the quality of the material, the amount of compression to which the wheel is subjected during its manufacture governs to a large extent the density or "cushion" of the finished wheel.

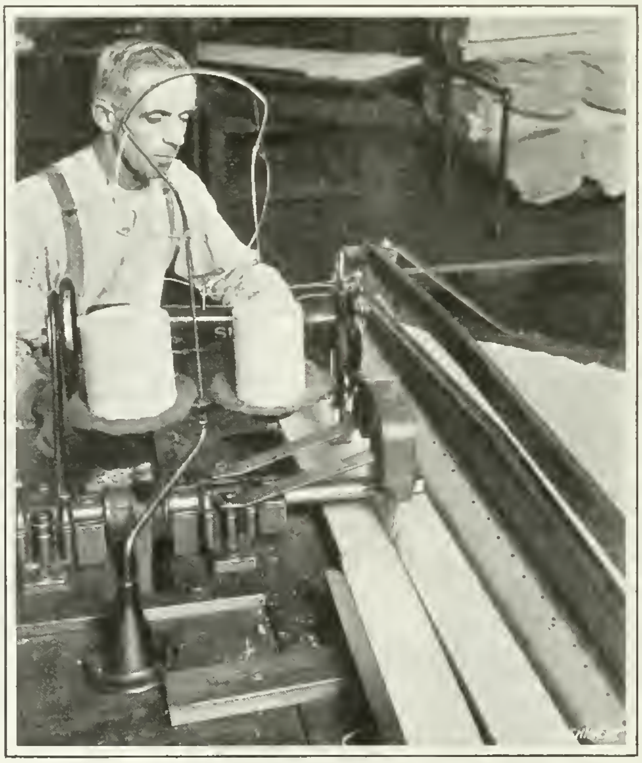


Fig. 1. Sewing the Edges of Strips of Canvas together for Compress Polishing Wheels

The Manufacture of Canvas Compress Wheels

In making canvas compress wheels, the canvas is arranged in layers of suitable thickness for handling during the manufacturing process and cut diagonally into strips, on the bias, so to speak. This step brings the yarns in the canvas at a 45-degree angle to the face of the wheel and avoids any possibility of raveling, which would occur if the weave lay square in relation to the face of the wheel. This position of the material also contributes to the cushion of the wheel.

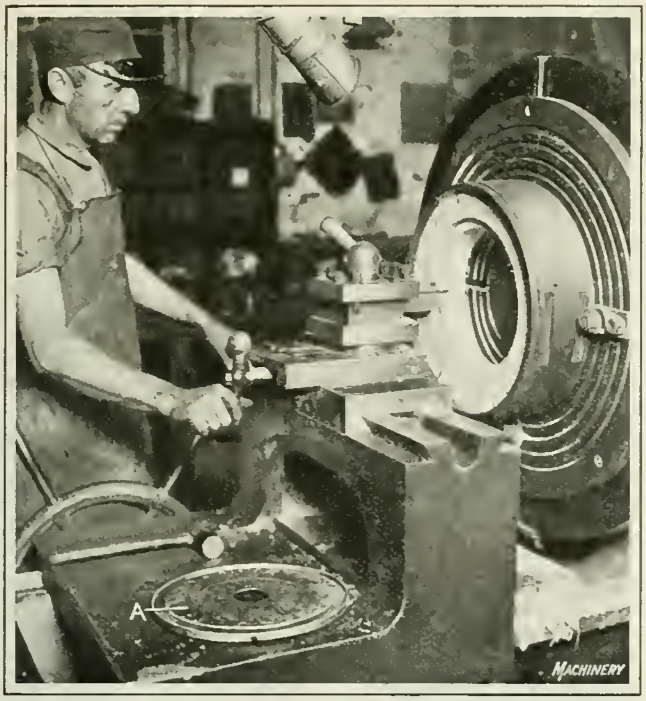


Fig. 2. Machining the Groove to receive the Edge of the Side Plates

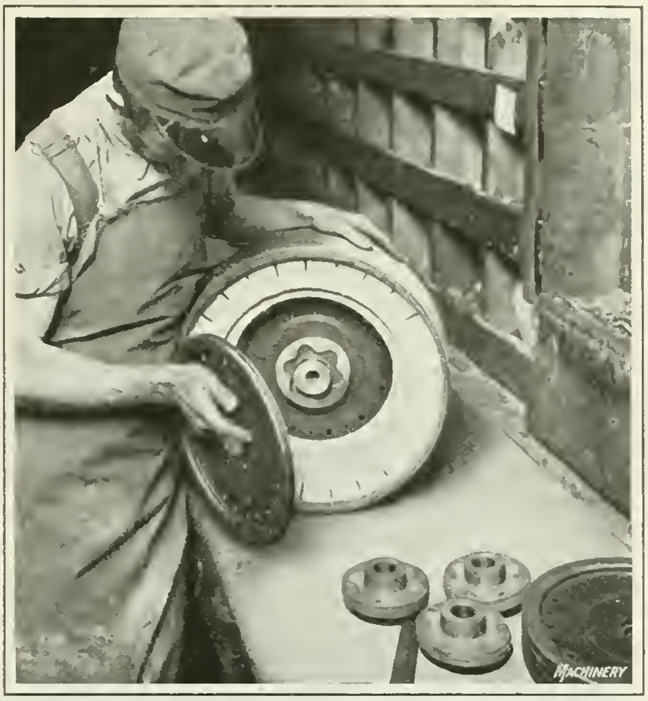


Fig. 3. Assembling the Side Plates and the Cast-iron Hub

The strips of canvas are sewed on the edge to retain the plies in position during the manufacturing process as shown in Fig. 1, and then the strips are cut into blocks of the proper length and width. The blocks are assembled into a circle considerably larger than the finished diameter of the wheel is to be, and after being reduced by compression to the proper diameter, plates with channels on the outer edge are introduced into grooves turned in the sides of the circular canvas cushion near the inner edge. A hub is inserted between the plates, and then the whole mass is forced together in a hydraulic or heavy power press. The plates are next riveted together, balancing tubes are inserted, and the wheel removed from its compression holding apparatus. It is now ready for tooling to shape in a lathe.

Advantages of Compress Wheels

As compared with the disk form of wheel, it will be seen that no adhesive is necessary to hold the material together in the cushion of the wheel; also, there is no possibility of variation in the density of the face of the wheel throughout its working area, due to hard and soft spots in the leather, which will always be present in disk wheels; and inasmuch as the center of the wheel is metal, it is practically impossible for the wheel to change its shape because of atmospheric or other conditions. Furthermore, this form of assembly insures a wheel which will remain round, if properly used by the operator; and it is not reduced in diameter, as are all the disk wheels, because it does not have to be faced off constantly to keep it round and true.

Another advantage of placing the material crosswise of the wheel as described, is that a wheel of this kind can be turned to shape. Much polishing work is done nowadays on formed wheels following the principle of the formed milling cutter. The polishing wheel is turned to the exact shape of the article to be polished. It is not mechanically possible to turn wheels to shape when made of disks; furthermore, they do not retain their shape, as the spread of the disks throws the face out of shape sooner or later. The advantages of the formed wheel are obvious. A formed wheel covers the entire contour, or a portion of the contour, at one time, whereas a flat-faced wheel must work all over the surface to be polished, consuming more time with less accuracy in the finished piece. Often, instead of having several wheels for each particular form, a number of contours are cut into the face of one wheel, so that the operator can finish the job without having to set up another wheel.

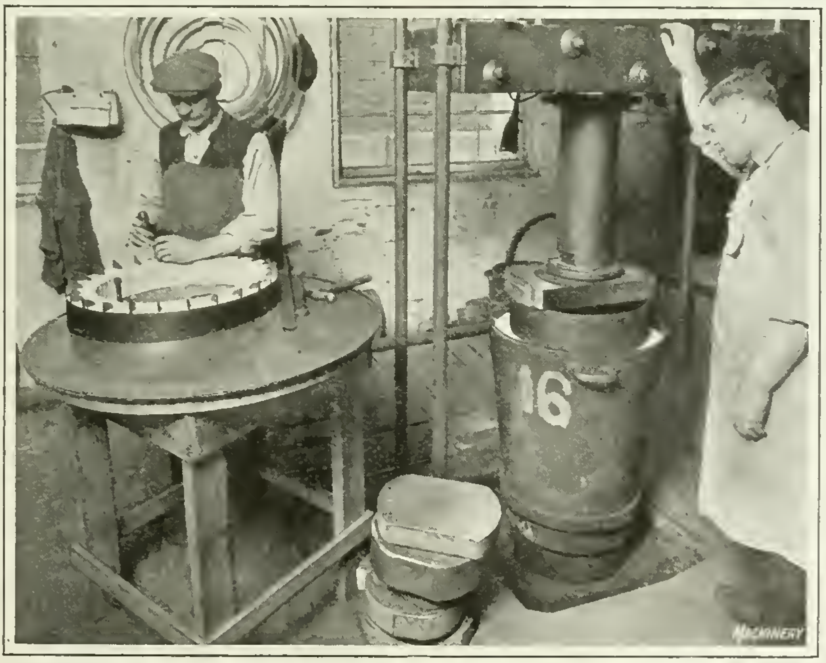


Fig. 4. Assembling the Blocks of Canvas into a Ring preparatory to compressing them with the Equipment shown at the Right

In converting the canvas for polishing wheels from sheet form into strip form, special sewing machines are used, as shown in Fig. 1, the machines having two needles; centrally located between the needles, but behind them there is a slitting saw. The "book" of canvas is placed on an angular traveling top with the edge of the canvas brought to a stop and clamped in place. The stop has a straight edge and is adjustable to give any desired width of strip. The moving top travels backward and forward past the needles, the edges of the canvas being sewed and the canvas cut into strips at the same time. This insures the strips of canvas having an absolutely straight and square edge like a block of metal, which is necessary for the proper assembly in the wheel of the blocks cut from the strips.

After the strips have been cut into blocks, these blocks are assembled to form a ring by placing them inside a steel band. In the operation of assembling the canvas in the steel bands, shown in Fig. 4, it will be seen that the operator is placing metal spacers between the blocks of canvas in order to give sufficient stability to permit the material to be compressed without collapsing. After compression, the spacers are removed to leave the wheel with the proper density on the face. Many of the wheels are required to be so soft on the face, when finished, that the finger can be inserted between the layers of canvas, while on the other hand other wheels are practically as hard as metal. The number of spacers depends, of course, upon the degree of density required.

The Compressing Process

In the compressing process, the assembling ring containing the canvas, leather, or other material is placed in the top of a large metal cylinder which is tapered. The annular ring of material is forced down through the cylinder by a hydraulic press or a power press. The pressure required varies according to the diameter of the wheel and the width of the face, but ranges from ten tons for the smaller wheels up to about sixty tons for the larger wheels. In the illustration, a ring of material is shown after it has been forced from the band and has started to be compressed in the tapered cylinder. After it has passed through the tapered cylinder, it is held in position in a cast-iron ring which is tooled to fit the lathe in which the ring of canvas or other material is finished on the inside and on both the side faces; at the same time a channel or groove is turned in each side, as shown in Fig. 2, to receive the edge of the side plates.

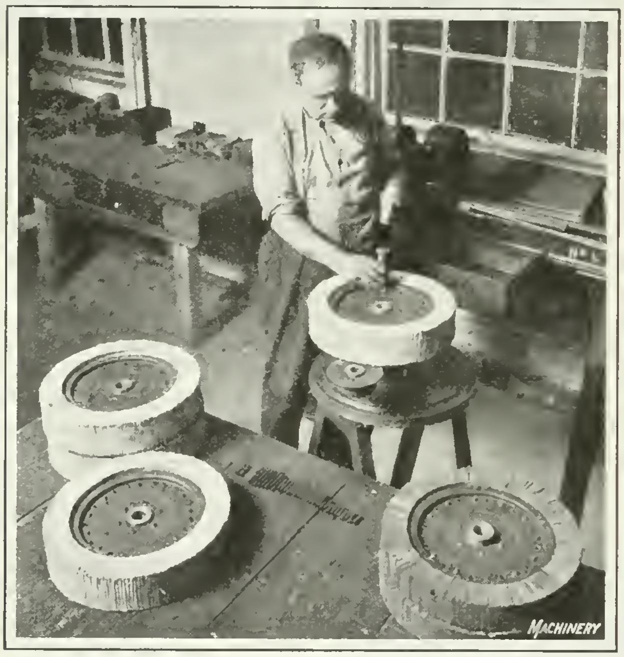


Fig. 5. Assembling the Balancing Tubes in the Compress Wheels

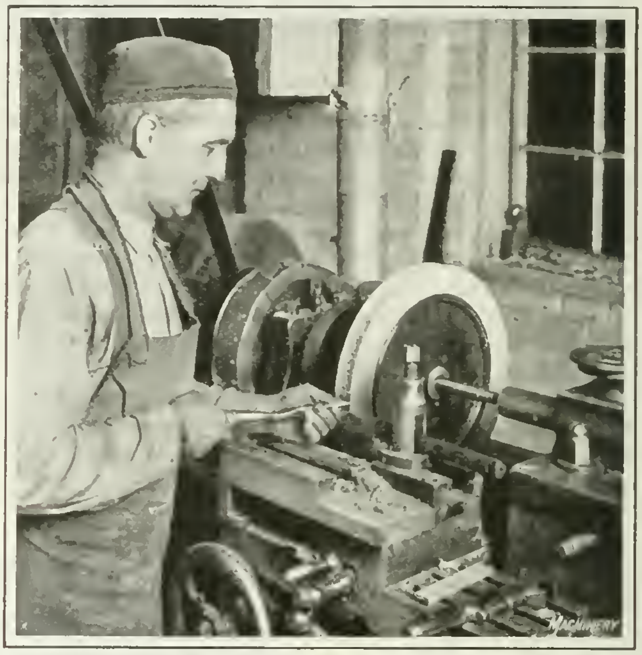


Fig. 6. Forming a Concave Face on a Leather Compress Wheel

The operation of assembling the plates and the cast-iron hub riveted between the two plates is shown in Fig. 3, where the operator has already located one flange, placed the hub through the hole of the flange, and is about to put on the other side plate of the wheel. The whole assembly is held together by rivets which are headed with a power riveting machine. Extreme care must be taken not to bend the rivets between the plates, for the strain due to the speed of the polishing wheel would have a tendency to straighten the bent rivets, so that they would become loose, and thus loosen up the whole construction of the wheel. The wheel remains in the cast-iron holding ring or container until it is completely assembled, and there is nothing left to do but machine the face which, of course, is done after the wheel is removed from the holding ring.

Balancing the Wheels

For balancing the wheels, tubes are inserted through the plates, just underneath the inside edge of the polishing material, and a sufficient quantity of one-quarter inch lead wire is placed in them to accurately balance the wheels. If the piece of lead wire needed is shorter than the balancing tube it is upset in the tube, but if it is longer than the tube the ends are turned over and hammered down. In either case, the lead may readily be removed, without damaging the tubes, for use in any subsequent balancing operation. This process is illustrated in Fig. 5. The final work is the truing up of the wheels; this is done by mounting them on their own centers in a lathe, so that they will be mechanically round when finished.

Leather wheels are made in practically the same way as canvas wheels. Leather of uniform density is selected from the same location in a number of hides. Usually a large number of hides are required to produce a sufficient amount of similar material to manufacture an order of wheels. The leather is cut into strips like the canvas, and the strips are cut into rectangles. The leather pieces are often passed through rolls to taper them, and sometimes they are skived to give them a wedge shape and to assist in the radial assembly in the wheel.

Recommended Service for Various Compress Wheels

For work ordinarily done on disk bullneck wheels, a compress leather wheel made of medium density is well suited. Such a wheel with a two-inch depth of leather cushion has more spring than one in which the leather is one inch deep. Medium or soft density leather wheels are commonly used for flexible grinding, such as roughing operations on castings, forgings, stamped and drawn metals, etc. Such wheels with narrow faces have greater stiffness than disk wheels and reach better into the necks of valves, grooves of twist drills, and similar places, where the wheels must stand up to the work and be solid enough to hold their shape. For use on disk grinders, compress wheels of leather and canvas are often made in cup form, where the cushion overhangs the face on one side. A band of steel is placed around the circumference of the wheel to hold the material against the strain of centrifugal force, and the abrasive material is applied on the side face of the wheel. This class of wheel is used to replace cloth and paper disks, for it is much cheaper to reset the wheels with the abrasive and glue than to purchase large disks when only a small area of the disk can be efficiently used.

The compress wheel with leather one inch deep in the polishing cushion is, of course, harder in density than that with the two-inch depth of cushion, and is used for classes of work where a more flexible wheel would not be satisfactory. Such a wheel, hard in density, will maintain the straight edge and surface on fine work, especially such work as sewing machine parts, or other parts having countersunk screw holes which must not be elongated. Typical examples of this class of work are firearm parts, such as pistol handles or rifle frames. This type of wheel is also used largely in the cutlery trade on automatic machines for finishing pocket knife blades where the fineness of the blade requires the most extreme accuracy in the wheel. It is also used for grinding the edges of the blades.

A certain class of polishers insist upon working on the flat side of the leather, as on leather-covered wood wheels; the compress leather wheel lends itself to securing a leather strap to the face of the wheel, which gives the advantages of the strap as well as the accuracy of the compress construction. This is a form of wheel largely used in England.

The compress construction covers a great variety of forms, of cushion densities and depths of cushion, and in the various constructions covers practically every possible range of polishing work, with rare exceptions. It is suitable both for dry polishing and for oil or grease wheels, and has advantages over any other form of wheel for holding sharp corners.

Special Compress Wheels

One rather special form of this wheel is the rubber and duck composition construction, which is manufactured only with the cushion one inch deep and is peculiarly suited for holding very coarse abrasives, such as No. 16 to 24. The abrasive and glue adheres to this composition material with great strength, beyond that of any other polishing wheel. It is peculiarly adapted for grinding castings and forgings, but is not in any sense a finishing wheel. Another very hard wheel is manufactured in the compress construction by using paper or strawboard. Such wheels are often covered with a leather strap, wherever an extremely hard wheel is desired. A good many polishers still insist upon having compress wheels made of felt and walrus hide for some of the finest finishing work.

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THE MACHINE TOOL MARKET IN NEW ZEALAND

By DAVID K. BLAIR, Director, Blair, Reed & Co., Ltd., Wellington, New Zealand

New Zealand is not an industrial country, and as there are very few metal-working shops, the market for machine tools is limited. This must necessarily be so when the population is only about 1,250,000. The Government controls the railroads, and has four large and several small shops in different parts of the country for maintaining the rolling stock. The large shops employ about 1000 men and are fairly well equipped, although a considerable portion of the machinery is quite out of date and should be replaced. Prior to the war, the reorganization of the railroads generally was contemplated. Nothing has yet been done in connection with the shops; but large orders have been placed in England for locomotives and other rolling stock.

There are several well equipped private shops employing from 50 to 200 men. One of these specializes in the manufacture of locomotives, while others make oil engines, pumps, dairy equipment, flax strippers, and agricultural machinery. Some of the small shops confine themselves to the cutting of automobile replacement gears and the manufacture of oil-engine pistons. None of these shops, so far as the writer knows, are equipped with automatic gear-cutting machines, the gear teeth being generally cut by milling, as there is not a sufficient demand for any one size of gear to justify the installation of automatic machines. One of the shops manufactures a post-office machine which is supplied to all parts of the world. This shop also specializes in the maintenance and repair of motion-picture machines and turns out parts equal to any imported.

Machine Tools Mainly of American Manufacture

The total annual demand for machine tools would be somewhat difficult to ascertain, but it is not very great. The chief demand is for lathes up to 12 inches swing, with 6-foot beds, for use in automobile and motorcycle repair shops. Drilling machines are next in importance, and then come tool-grinders and milling machines. Most of the machine tools are of American manufacture, and, if not, follow closely American design, especially in the case of upright drilling machines, tool-grinders, shapers, and milling machines. Shapers, however, are not numerous, and are chiefly found in the repair shops. Quite a number of lathes are provided with electric grinding equipment for finishing cylinders, shafts, etc. There is only a limited number of universal grinding machines—probably not more than thirty in the whole country. There are about a dozen technical schools in New Zealand, and all of these have fairly good shops for the training of students. The bulk of the equipment in these shops is also of American make.

Cutters and Mechanics' Tools

Twist drills, reamers, lathe tools, taps, dies, etc., as a rule, are of American manufacture. Occasionally, British tapping and threading equipment is seen, but in the writer's opinion, it is not as good as that coming from the United States. The bulk of mechanics' tools are also American made, with the exception of wood chisels, which are generally of Sheffield manufacture. Formerly, there were quite a number of German tools, such as bits, pliers, taps, die-stocks and blow-torches, but since the war a tool of German manufacture is rarely seen. Blow-torches now generally come from Sweden.

Wood-saws, carpenters' hammers, and axes are almost universally American-made, and practically all fine measuring instruments, such as micrometers, come from the United States. New Zealand has quite a number of fine large fruit-canning establishments, and in these, the equipment is also almost entirely American. Only rarely is a British or Australian machine seen.

Duty on Imported Machinery

For the last few years about 60 per cent of all machines and tools imported into New Zealand have come from the United States, the remaining 40 per cent being divided among British and foreign manufacturers. New tariff laws which went into effect last June considerably changed the duty on imports. Under the old tariff, machinery and mechanics' tools were admitted free, irrespective of the country from which they were imported, but now only British products are admitted free. Foreign products are taxed to the extent of approximately 10 per cent of their value. An additional 1 per cent primage tax is applied both on free and dutiable goods.

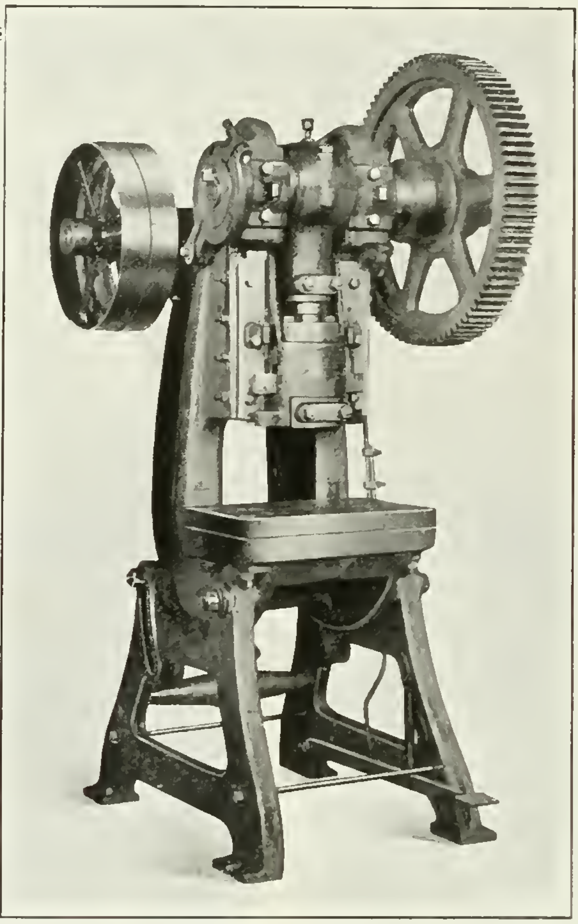
The conclusions here given are the result of observations extending over the twenty-three year period during which the concern with which the writer is connected—a distinctly New Zealand organization—has been selling machine tools in New Zealand.

* * *

The Dutch East Indies in 1921 absorbed more than four times as much machinery as in 1911. During that period the share of this business secured by America has expanded from 264,000 to 5,701,000 guilders (1 guilder = $0.402).

Design of Inclinable Power Presses

By P. A. FRIEDELL



AMONG the industries using power presses to the greatest extent are those producing automobiles and household utensils. Automobile parts produced in power presses include the frame, axle housings, radiator, hood, fenders, brake-drums, wheel hubs, disk wheels, and body. Power presses can also be used to advantage in many other lines of manufacture. Numerous articles which were formerly iron, steel, malleable-iron, or brass castings, are now made in power presses from sheet metal. The sheet-metal parts are almost invariably stronger, lighter, and more uniform, as well as cheaper to make. Different metals can be drawn, formed, and otherwise operated upon in power presses of various styles, each of which has been developed to meet some peculiar demand. This article will call attention to the most common types of power presses, and the work for which each type is especially adapted. It will also give methods of calculating the dimensions of important members entering into the construction of inclinable power presses. Subsequent articles will supplement this information.

This is the first of a number of articles on the design of power presses, showing the application of formulas to a specific design of inclinable power press. The present article deals with the crankshaft, main bearings, slide or ram, and connection between the crankshaft and slide. The next article will take up the design of the gibs, frame, and flywheel of an inclinable power press.

Common Types of Power Presses

Power presses are generally classified according to some characteristic, although it cannot be said that the names applied are always appropriate or self-explanatory.

Inclinable Power Presses—Presses of this class are so designated from the fact that the upper part of the frame may be inclined at will to allow finished parts to slide from the die through the action of gravity. This type of press may also be used with the inclinable member in the vertical position. Inclinable power presses are generally of the gap type. The class of work for which they are suited will be considered later in detail.

Inclined Presses—These presses have the frame built in a fixed, inclined position, and are thus non-adjustable. Most all types of presses can be built with an inclined frame.

Horning and Wiring Presses—This type of press is constructed in such a manner that a horn can be fitted in place of the customary bed to permit operations to be performed on tubular parts, such as pipe, cans, etc. An adjustable table may be substituted for the horn to facilitate wiring and other operations requiring high dies.

Arch Power Presses—This class includes presses built with a wide bed and arched frame, and a comparatively small slide. Presses of this kind are recommended mainly for large blanking work or shallow forming operations on the lighter gages of metal.

Straight-sided Presses—Presses of this type have neither a gap nor arch in the frame. This style is suitable for heavy blanking, piercing, forming, redrawing, reducing, and bending. It is sometimes built with a special slide on the outside of one housing, the slide being operated from the corresponding end of the crankshaft. This slide is used for punching holes, cutting off, or trimming. When a press is so equipped, it is called a straight-sided trimming press. The term "straight-sided" also implies that the press has a single crank.

Double-crank Presses—These presses have the slide operated by two cranks. In other respects, they are similar to straight-sided presses, but they are not recommended for redrawing or bending operations unless especially constructed for the purpose. They are well adapted for shallow drawing operations when equipped with a spring or air-operated blank-holder.

Gap Presses—This type of press is built with a gap or throat through the frame so that the stock can be fed from side to side or from front to back. With the exception of the gap, they are similar to straight-sided or double-crank presses.

Embossing or Knuckle-joint Presses—This class comprises presses intended for heavy operations, such as embossing coins and silverware. Presses of this kind are also adapted for extrusion processes.

Drawing Presses—Presses of this type are usually constructed with two slides called the "plunger" and the "blank-holder," although they are also occasionally built with a bottom drawing slide. The plunger is operated directly by the crankshaft, and the blank-holder and bottom drawing slides through cranks and links (toggle type) or cams. This type of press is extensively used for drawing cylindrical parts from sheet metal. Toggle drawing presses are made with both single and double crankshafts.

Numerous other names are given to power presses, but they all represent some modification of the types referred to. All power presses should be selected to meet the maximum tonnage likely to be imposed, and should have a sufficient stroke for the work to be done. The die space, which is another important consideration, should be ample. Filler pieces can always be placed under the die, or a heavy bolster can be used.

The Inclinable Power Press

The inclinable power press is one of the most widely used types. It is particularly adapted for blanking, piercing, forming, and shallow drawing operations on household utensils, small automobile parts, and many other articles, as well as light embossing operations on jewelry, etc. An inclinable power press of typical design is shown in the heading illustration. Presses of this type are generally built in sizes having capacities ranging from two to seventy-five tons. A press of greater capacity than the maximum mentioned would be so heavy as to be difficult to incline by means of the hand-operated mechanism with which these presses are usually furnished.

The inclinable power press is particularly suitable for the automatic production of small parts when it is equipped with a feeding arrangement adapted to the part being produced. For the first operation on a given part the stock is usually fed to the dies in the form of a ribbon or strip by either a single or a double roll feed. Very high production rates can be obtained in this manner, it being frequently possible to produce completed or partly completed parts at the rate of 150 per minute. Other styles of feeds used for succeeding operations include dial, hopper, and finger mechanisms.

Designing an Inclinable Power Press

The first consideration in the design of a power press, after the tonnage capacity, stroke, and die space have been decided upon, is the crankshaft. The dimensions of this important member should be calculated according to the method explained in the article entitled "Designing Power Press Crankshafts," which was published in December Machinery. The formulas given in that article will be here employed in determining the dimensions of a crankshaft for a single-crank power press of 50-ton capacity, having a two-inch stroke. This crankshaft is to be of the design illustrated in Fig. 1. The trial diameter $d = \sqrt{\frac{50}{3}} = 4.08$ or $4\frac{1}{8}$ inches. The trial diameter D should be such that the area of a circle of this diameter would be about 50 per cent greater than the area of a circle of diameter d. By using the tables of circumferences and areas of circles given in Machinery's Handbook, the trial value for diameter D will be found to be $5\frac{1}{8}$ inches.

$$R = 0.1D = 0.1 \times 5.125 = 0.51 \text{ or } \tfrac{1}{2} \text{ inch}$$

According to the first method in the previous article,

$$E = (50 \div 2D) + 0.2D = 4.878 + 1.025 = \text{about } 6 \text{ inches}$$

$$E \text{ (second method)} = \sqrt{2\left(\sqrt{\frac{P}{5}} + \tfrac{1}{4}\right)^2 + \tfrac{3}{4} + 2R} =$$

$$\sqrt{2\left(\sqrt{\frac{50}{5}} + \tfrac{1}{4}\right)^2} + \tfrac{3}{4} + 1 = \text{about } 6\tfrac{5}{8} \text{ inches}$$

As the dimension obtained by the second method exceeds that of the first, the second figure should be taken.

$$C = 0.6d = 0.6 \times 4.125 = 2.47 \text{ or } 2\tfrac{1}{2} \text{ inches}$$

$$F = 0.1d = 0.1 \times 4.125 = 0.4 \text{ or } 7/16 \text{ inch}$$

Therefore, $B = 6\frac{5}{8} + 5 = 11\frac{5}{8}$ inches, and $L = 11\frac{5}{8} + \frac{7}{8} = 12\frac{1}{2}$ inches.

As the crankshaft is to be designed to receive the maximum load with the axis of the crank at a position 1 inch distant from the vertical center line of the crankshaft bearings, the twisting moment equals 100,000 × 1 or 100,000 inch-pounds. Then, the correct diameter of the crankshaft bearings may be determined as follows:

$$d = \sqrt{\left(1.72\sqrt[3]{\frac{T}{10{,}000}}\right)^2 + \frac{Q}{10{,}000}} =$$

$$\sqrt{\left(1.72\sqrt[3]{\frac{100{,}000}{10{,}000}}\right)^2 + \frac{50{,}000}{10{,}000}} = 4.328 \text{ or } 4\tfrac{3}{8} \text{ inches}$$

The bending moment on the crankpin is as follows:

$$M = \frac{W}{4}\left(L - \frac{B}{2}\right) = \frac{100{,}000 \times 6.68}{4} = 167{,}000 \text{ inch-pounds}$$

Then the correct diameter D of crankpin may be determined from the following:

$$D = \sqrt[3]{\frac{32M}{\pi S}} = \sqrt[3]{\frac{32 \times 167{,}000}{3.1416 \times 10{,}000}} = 5.54 \text{ or } 5\ 9/16 \text{ inches}$$

Next,

$$O = D + 2R = 5.56 + (2 \times 0.5) = 6\ \ 9/16 \text{ inches}$$

$$H = \frac{D + d + 2t}{2} + 2R = \frac{5.56 + 4.375 + 2}{2} + 1 = 7 \text{ in.}$$

$$G = 1.75d = 1.75 \times 4.375 = 7.65 \text{ or } 7\ \ 11/16 \text{ inches}$$

The distance across the main bearings of the press would then equal

$$B + 2G = 11\tfrac{5}{8} + 15\tfrac{3}{8} = 27 \text{ inches}$$

$$d_2 = d - 1/64 = 4\ 23/64 \text{ inches}$$

$$d_3 = d - 1/32 = 4\ 11/32 \text{ inches}$$

Length J should be made to suit the type of clutch used.

Length K, which is the allowance for the hub of a clutch gear or flywheel should not be less than $2d$. Thus K (minimum) $= 2 \times 4.375 = 8\frac{3}{4}$ inches.

Length I depends upon the dimension of the brake or outside crank for automatically feeding the stock, which may be mounted on this end of the crankshaft.

Determining the Dimensions of the Main Bearing Caps

The design of the main bearing caps for the crankshaft will be assumed to be as illustrated at X, Fig. 2. It is preferable to set the bearing caps with the machined surfaces that contact with the bearing boxes of the frame, at an angle of 30 degrees from the vertical in such a way that the thrust of the crankshaft will be directed on the solid boxes of the frame instead of toward the dividing line of the caps and the boxes. The caps should each be securely attached to the frame by means of four stud bolts. The bolt center distance C should be as small as possible, in order to reduce the bending stresses which tend to break the cap.

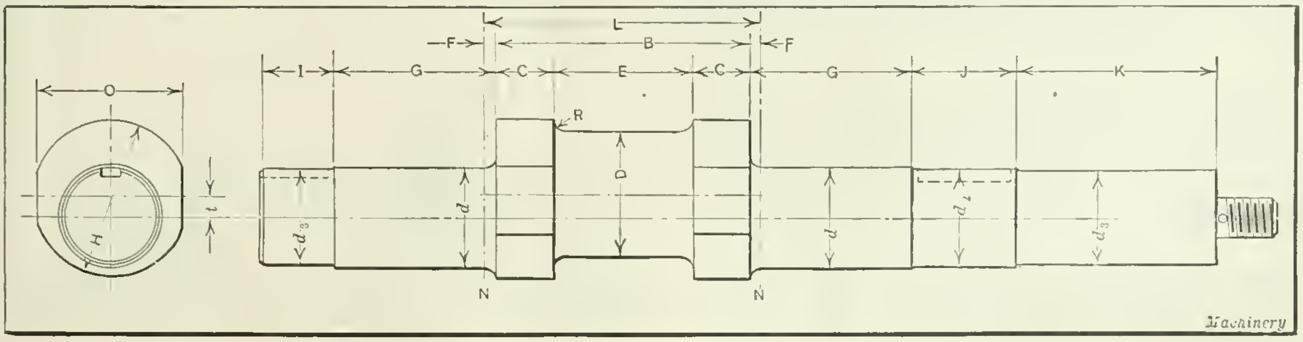


Fig. 1. Dimensions to be calculated in designing a Single Crankshaft for an Inclinable Power Press

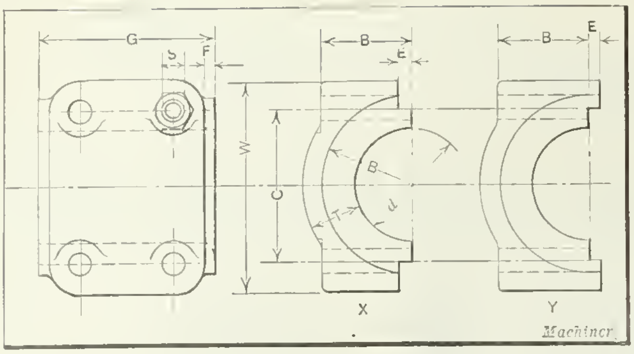


Fig. 2. Types of Caps Suitable for the Main Bearings of the Crankshaft and the Connection

The bearings should be carefully scraped and properly grooved to insure adequate lubrication. Iron castings make very satisfactory bearing caps.

By means of the following formulas, bearings of minimum weight for withstanding the load to be imposed upon them, may be readily designed. The letters of these formulas correspond to similar letters in Fig. 2, and dimension d in this illustration corresponds to dimension d in Fig. 1. S represents the bolt diameter.

$S = 0.15d + 0.25 = (9.15 \times 4.375) + 0.25 = 0.91$ or 7/8 inch

$C = 1.25d + 0.5 = (1.25 \times 4.375) + 0.5 = 5.97$ or 6 inches

$W = 1.7d + 0.75 = (1.7 \times 4.375) + 0.75 = 8.18$ or 8 3/16 in.

$T = 0.45d = 0.45 \times 4.375 = 1.97$ or 2 inches

$B = 0.8d = 0.8 \times 4.375 = 3.5$ inches

E and $F = 0.125d = 0.125 \times 4.375 = 0.547$ or 9/16 inch

Length G would be made to suit the crankshaft, and in this case corresponds to dimension G, Fig. 1, or 7 11/16 in.

Proportioning the Connection

The connection casting employed for transmitting the power of the crankshaft to the slide or ram will next be proportioned. It is desirable to make this part as light as possible; yet strength must not be sacrificed for weight. A well proportioned connection is essential to continuous operation of a press; otherwise considerable trouble is likely to be encountered through breakage of the connection or stripping of the threads in its tapped hole or on the screw by means of which it is fastened to the slide. The connection cap should be designed by applying the same formulas used in proportioning the main bearing caps, value D in Fig. 1 being used for value d in Fig. 2. The type of cap shown at Y in Fig. 2 is the more satisfactory for the connection, because it and the connection tend to support each other when the load is imposed on them.

A suitable clamping arrangement must be provided on the connection for securely clamping the screw employed in attaching it to the slide. Without a satisfactory clamp, accidental adjustment of the slide may take place, or stripping of the threads due to play between the connection and the connection screw. With the design shown in Fig. 3, the screw is clamped by simply tightening up two bolts. This design is most satisfactory for presses up to about 50 tons capacity. The cap design illustrated in Fig. 4 is more satisfactory for larger presses, on which it is rather difficult to spring a split connection sufficiently to insure proper clamping of the screw.

It will be assumed that the press being designed is to have a split connection. The procedure followed in determining the different dimensions of this member may then be presented. Dimension E, Fig. 3, should be made equal to dimension E, Fig. 1, or 6⅝ inches.

$$F = \sqrt{\frac{P}{5}} + \tfrac{1}{4}$$

in which F = diameter of tapped hole for connection screw; and P = capacity of press in tons.

Thus

$$F = \sqrt{\frac{50}{5}} + \tfrac{1}{4} = 3.41 \text{ or } 3\tfrac{1}{2} \text{ inches}$$

The number of threads per inch on any connection screw should not be less than 3, because with a thread of too large a pitch, too great an amount of effort is required for adjusting the slide. All connection screws from 2½ to 6 inches in diameter should be made with 4 threads per inch. Therefore, as the connection screw for the press being designed is 3½ inches in diameter it should have 4 threads per inch.

When the connection is an iron casting,

$U = \sqrt{2F^2} + \tfrac{3}{4} = \sqrt{2 \times 3.5 \times 3.5} + 0.75 = 5.7$ or 5¾ inches

$S = 0.15D + 0.25 = (0.15 \times 5.56) + 0.25 = 1.08$, say 1 inch

$H = 0.25D = 0.25 \times 5.56 = 1.39$ or 1⅜ inches

$J = 0.85D + 0.375 = (0.85 \times 5.56) + 0.375 = 5.10$ or 5⅛ in.

M = not less than $0.25D = 0.25 \times 5.56 = 1.39$ or 1⅜ inches

N (amount of adjustment) $= 0.5d$ (Fig. 1) = say 2 inches

$O = 1.1F + S = (1.1 \times 3.5) + 1 = 4.85$ or 4⅞ inches

K = at least $2F = 2 \times 3.5 = 7$ inches

The dimensions of the connection shown in Fig. 4 should be calculated in the same manner as those for the split connection, Fig. 3, except that K for the connection in Fig. 4 should not be less than $2.5F$. Also $V = 3S$ and $X = 1/16$ inch. It is advisable to shim up the clamping cap on this connection while the connection is being bored and tapped. Length G of both connections varies according to the stroke, die space, etc. The minimum dimension for length G in Fig. 3 may be found as follows:

$$G \text{ (minimum)} = 2F + 0.75D + N = (2 \times 3.5) + (0.75 \times 5.56) + 2 = 13\ 3/16 \text{ inches}$$

The minimum length G of the connection in Fig. 4 would be as much greater than the length of the connection in Fig. 3 as the difference between dimensions K of the two connections. Therefore, in all instances where a short connection is desirable and the capacity of the press is 50 tons or less, the design illustrated in Fig. 3 can be safely made shorter than that illustrated in Fig. 4.

Connection Screw and Ball Cap

The simplest form of screw for attaching the connection to the slide, and the one that proves most satisfactory for presses on which the load per crank is not in excess of 200 tons, is the ball type. Such a screw is shown in Fig. 5, attached to the slide by means of a ball cap. For presses of greater capacity than the maximum mentioned, a double connection should be used, in which case the design of the screw would be different.

The following formulas apply to the connection screw shown in Fig. 5. In calculating the dimensions of the connection for the press under consideration, it was found that the screw should be 3½ inches in diameter and have 4 threads per inch.

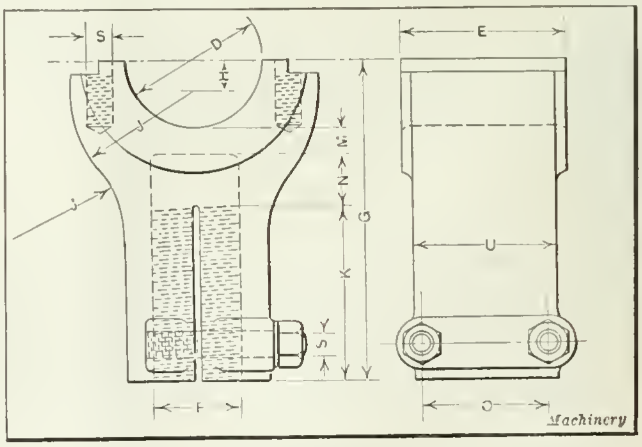


Fig. 3. Connection Design in which the Connection Screw is clamped by springing the Split End of the Casting

Then,

$$N = K + N \text{ (Fig. 3)} = 7 + 2 = 9 \text{ inches}$$

$$O = \sqrt{\frac{F^2}{2}} = \sqrt{\frac{3.5 \times 3.5}{2}} = 2.47 \text{ or } 2\tfrac{1}{2} \text{ inches}$$

$$d = \sqrt{\frac{P}{2}} = \sqrt{25} = 5 \text{ inches}$$

$$S = \text{same as } S, \text{ Fig. 3}$$

$$L \text{ (minimum)} = 1.5F + S = (1.5 \times 3.5) + 1 = 6\tfrac{1}{4} \text{ inches}$$

X (distance across corner of hexagonal section of screw) $= F$ approximately but should not be greater than this dimension. The distance across the flats of this hexagonal section should approximate $0.866F$. Thus, $0.866 \times 3.5 = 3.03$ or $3\tfrac{1}{8}$ inches. A hexagonal section of this dimension across flats will receive a standard 2-inch wrench. The ball end should be scraped to fit the socket and the cap, and should be provided with oil-grooves. The connection screw should preferably be made from 0.40 to 0.50 per cent carbon open-hearth steel. It must be properly fitted to the tapped hole of the connection to prevent binding and facilitate adjustment of the slide.

The ball cap should be a fine-grained iron casting, bored and scraped true to the ball end of the screw. Dimension I should equal diameter F, and the dimension Q should be the same as diameter d. The central hole in the cap leading to the ball seat must be tapered to allow the screw to follow the sidewise motions of the connection. Bolt diameter S should be the same as the bolt diameter on the connection cap, because the ball cap supports practically the same load as the connection cap.

Other dimensions are determined as follows:

$$C = d + 2S = 5 + (2 \times 1) = 7 \text{ inches}$$

$$D = d + 4.25S = 5 + (4.25 \times 1) = 9\tfrac{1}{4} \text{ inches}$$

$$H = F = 3\tfrac{1}{2} \text{ inches}$$

Slide or Ram Design

The width and length of the slide or ram of a power press vary to some extent on machines of different makes; however, it will be found that a slide of the dimensions obtained in the manner here given will prove satisfactory in practically all designs of inclinable presses. It is always desirable to keep the weight of the slide as low as possible, because the lighter the reciprocating parts, the less the amount of braking that will be required, and consequently the lower the power consumption. However, as in designing all other machine parts, strength should not be sacrificed for weight. It is advisable to core out metal which can be spared without weakening the slide.

On inclinable presses the slide is usually provided with either a round or a square hole to receive the shank of the punching member. The square hole is more satisfactory, as a rule, for both round or square shanks. A square-hole clamp will grip a round shank at four points, while a round-hole clamp will grip the shank at only two points. A square-hole clamp can also be used for punch shanks that are not of standard size, whereas the round-hole clamp will not prove satisfactory for any shank of a different size from that for which it was made. One method of designing a square-hole clamp is shown at Y, Fig. 5, which is the design incorporated in the slide illustrated. The clamp alone is relied upon to hold the punch in position. Another good design, where round punch shanks are employed, is to make either the front or rear clamping block flat, and to provide a 90-degree vee in the second block. This design gives a three-point contact and is more nearly universal than any other type.

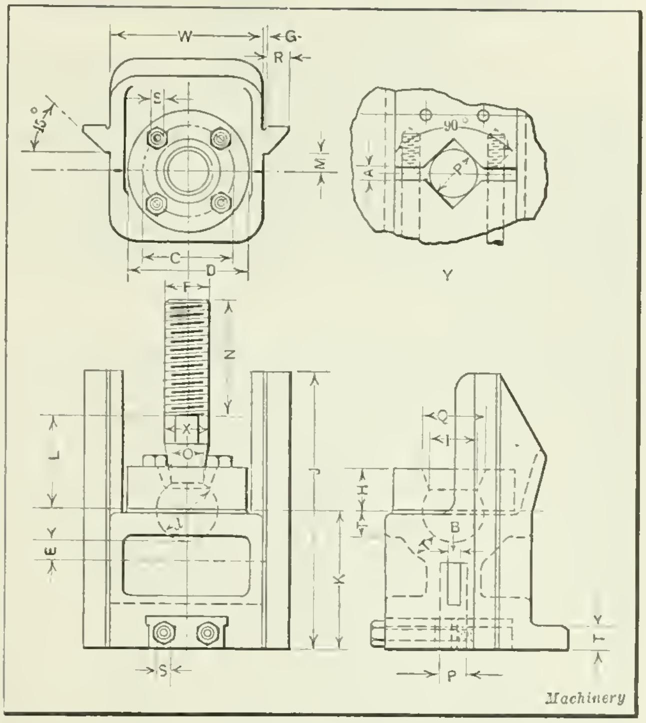


Fig. 5. Typical Design of Ball-type Connection Screw and Slide or Ram

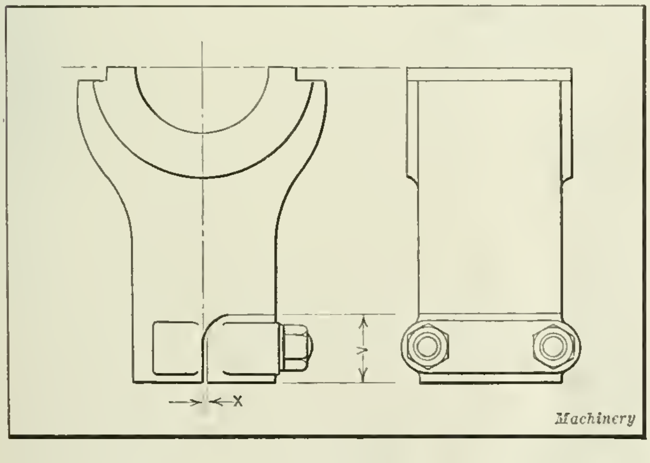


Fig. 4. Construction of Connection employed on Large Presses, the Screw being clamped by Means of a Cap

Dimension P (diameter of the punch shank) should equal approximately one-third the crankpin diameter; thus $P = 0.333 \times 5.56 = 1.85$, or 2 inches. A cored slot of width B is provided to permit the use of a knock-out bar for forcing slugs or completed parts from the punch.

$$B = 0.5P = 0.5 \times 2 = 1 \text{ inch}$$

$$T = 0.4d = 0.4 \times 5 = 2 \text{ inches}$$

$$E \text{ (minimum)} = \text{not less than } M, \text{ Fig. 3} = 1\tfrac{3}{8} \text{ inches}$$

$$S = \text{same as } S \text{ in Fig. 3} = 1 \text{ inch}$$

$$W \text{ (minimum)} = d + 7S = 5 + (7 \times 1) = 12 \text{ inches}$$

$$G = 0.25S = 0.25 \times 1 = \tfrac{1}{4} \text{ inch}$$

$$J = \text{twice the crankpin diameter } D, \text{ Fig. 1} + 12 \text{ inches} = (2 \times 5.56) + 12 = 23\tfrac{1}{8} \text{ inches}$$

$$R = 0.08J = 0.08 \times 23.125 = 1.85 \text{ or } 1\tfrac{7}{8} \text{ inches}$$

$$K = 0.5J = 0.5 \times 23.125 = 11\ 9/16 \text{ inches}$$

$$M = 0.6B + S = (0.6 \times 1) + 1 = 1.6 \text{ or } 1\tfrac{5}{8} \text{ inches}$$

On a slide having the shank clamping arrangement of the design shown at Y, dimension A should equal $\tfrac{1}{4}P$. The bearing surfaces of the slide gibs should be scraped and provided with oil-grooves.

* * *

HOW SHIPPERS CAN HELP MOVE FREIGHT

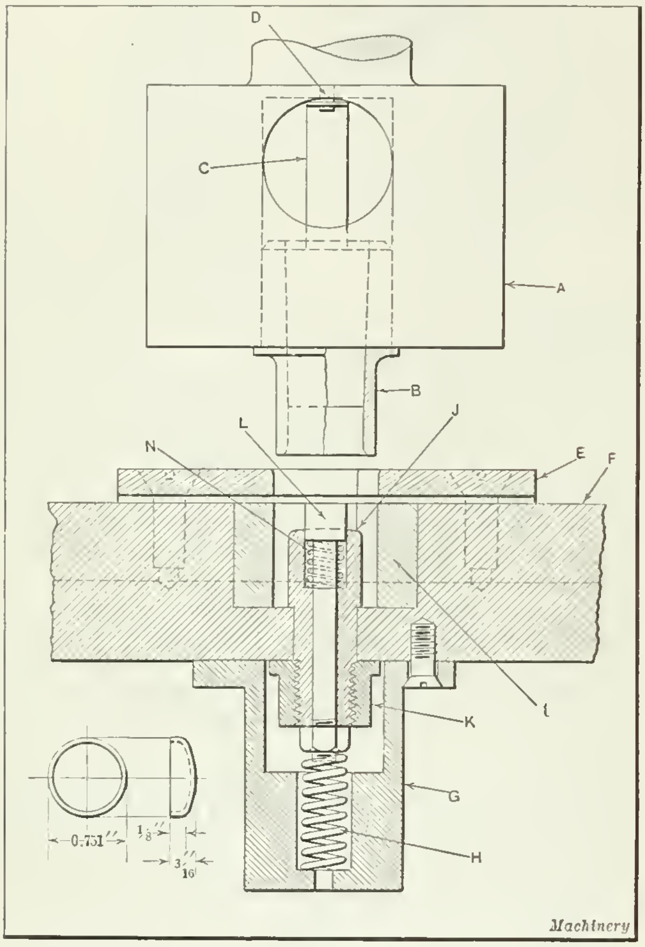
1. Do not order more cars than can be loaded promptly.
2. Load in one day.
3. Load light-weight or bulky freight to the full cubical capacity of the car.
4. Work a little over-time in the evening to finish loading.
5. Do not reject cars for small defects which the station agent or his helper can repair in a few minutes.

BLANKING AND FORMING DIE

By CHARLES E. FITZGERALD

Small cup-shaped parts can be produced by using one die for blanking and another for forming. When such parts are required in large quantities, however, it is generally more economical to use a combination die that blanks and forms one piece at each stroke of the press. A die of this type designed by the writer for use on a No. 3 Niagara press is shown in the accompanying illustration. The shape and dimensions of the work are shown by the view in the lower left-hand corner.

It was necessary that the outside diameter of the work be held accurately to size, as the finished cups were required to be a good press fit in a counterbored hole 0.749 inch in diameter by 3/16 inch deep. When pressed into place, the face of the cup was required to be flush with the surface of the counterbored part.



Blanking and Forming Die for Cup-shaped Parts

The press on which the die was mounted operated at a speed of 125 strokes a minute, but as short lengths of stock were being used, production was cut down somewhat by the time lost in changing strips. Disregarding the time lost in this manner, the production rate was calculated to be about 100 pieces a minute, or 6000 pieces an hour. About 100,000 pieces were produced on the first run, after which the dies were ground.

Construction of Die

The hole in the lower end of holder *A* is a press fit on the shank of the forming and blanking punch *B*. The upper end of part *A* has a shank which fits into the ram of the press. Punch *B* is hardened and ground on the inside to a diameter of 0.750 inch, and on the outside to a diameter of 0.9375 inch. As the diameter of the outside of the punch determines the size of the cup, it must be finished accurately to size. Spring *C* is held in position at one end by pin *D*, while the other end is sprung into place against the upper end of punch *B*. The spring is thus curved or bent to such a shape that it guides the finished parts out through the vent in part *A* at the back of the press. As the parts leave the vent they fall into a chute which carries them away from the press.

The stripper plate *E* is held in position on die-block *F* by screws and dowels. The hole in the stripper plate through which the punch passes is about 0.015 inch larger than the outside diameter of the punch. This gives ample clearance for the punch, and at the same time is small enough to prevent the stock from buckling on the upward or stripping stroke of the press. Die-block *F* is of cast iron, and is bored out to a press fit for the hardened and ground die *I*. The hole in the die is ground straight and held to a plug fit, being 0.939 inch in diameter, so that no draft is necessary. The depth of the die seat in the die-block is equal to the length of the die so that the upper surfaces of these two members are flush. This presents a smooth surface over which the stock slides freely. The hole in punch *B* has a draft of 2 degrees starting 7/16 inch back from its face.

Part *G* is a casing which contains the lower spring *H*. This spring and spring *N* prevent the formed parts from sticking on the forming post *J*. The forming post is ground on the outside to a diameter of 0.700 inch at the end, tapering back to 0.702 inch. This 0.002 inch draft does not affect the diameter of the cup appreciably and is provided simply to prevent the cup from sticking on the forming post. The shank of the forming post is ground to a press fit in die-block *F*, and is held in place by lock-nut *K*. The knock-out pin *L*, which is acted upon by springs *H* and *N*, forces the work into the hole in punch *B* and off forming post *J*. On the succeeding down stroke of the press the work is forced into the relieved or tapered section in the forming punch *B* and from there passes out through the vent in part *A*.

The fact that forming punch *B* has no draft at the end, while forming post *J* has a slight draft, and that there is less friction on the inside of the formed cup than there is on the outside, makes it possible for punch *B* to pick up the work. To make this action certain however, springs *N* and *H* are provided. All working parts of the die are ground concentric, the sizes being determined by the thickness of the stock to be used. The dimensions mentioned in connection with the grinding of parts *B* and *J* are used for stock 0.025 inch in thickness. In forming stock of this thickness on the forming post *J*, which is 0.700 inch in diameter, a cup is produced which is 0.751 inch in diameter. Cups of this diameter proved very satisfactory with respect to the drive fit in the counterbored holes having a diameter of 0.749 inch. A punch and die of the design described worked satisfactorily on many classes of work with little or no expense for upkeep. An automatic feed for the stock can be applied if desired.

* * *

INFLUENCE OF HUMIDITY ON LEATHER

The strength and elasticity of leather are greater in moist air than in dry, and for that reason it is important in making comparative tests of leather to be sure that they are made under the same humidity conditions. A given piece of leather tested in a dry atmosphere might appear to be weaker than a much poorer piece of leather tested in moist air. Experiments have shown that an increase of from 35 to 55 per cent in relative humidity increases the strength of leather 13 per cent and the stretch 16 per cent. When the humidity was raised from 35 to 75 per cent, the average increase in strength was 42 per cent and in stretch 53 per cent. The Bureau of Chemistry of the United States Department of Agriculture has devised a room in which the humidity is under almost perfect control, so that tests of leather can be made that will be trustworthy. This testing room is claimed to be the only one in the world in which the humidity is so well controlled.

Hydraulic Bulging and Bending

Improved Method of Forming Shells by Hydraulic Pressure

In the manufacture of many sheet-metal parts, operations such as bending, forming, and expanding can be performed economically by "hydraulic bulging." With the method to be described, the work is placed in a die, which is usually split, and water under a pressure varying from 600 to 1200 pounds per square inch is admitted from either a hydraulic accumulator or a force pump. A force pump is generally sufficient for the purpose, and gives a ready means of varying the fluid pressure; the initial cost is also low. In the case of hollow work, the water under pressure is admitted directly into the work itself, so that in this respect it differs from the older method of hydraulic bulging, in which the quantity of water is measured, put into the receptacle to be bulged, and the operation performed under a power press.

With the improved method, a power press is not required, and the construction of the dies is so simple that their first cost is much less than when the combined mechanical and hydraulic operation, commonly used in the past, is employed. Furthermore, the method of operation does not depend for its success upon the watchfulness of the operator in measuring the fluid. It is merely necessary to insert the work in the lower half of the dies, clamp the top half in position, admit the water under pressure from a suitable water cock and drain the water off after the piece has been formed. Another advantage of the process is the rapidity with which the water pressure forms the article to the desired shape, the time required being not more than one-sixth that taken by the other method.

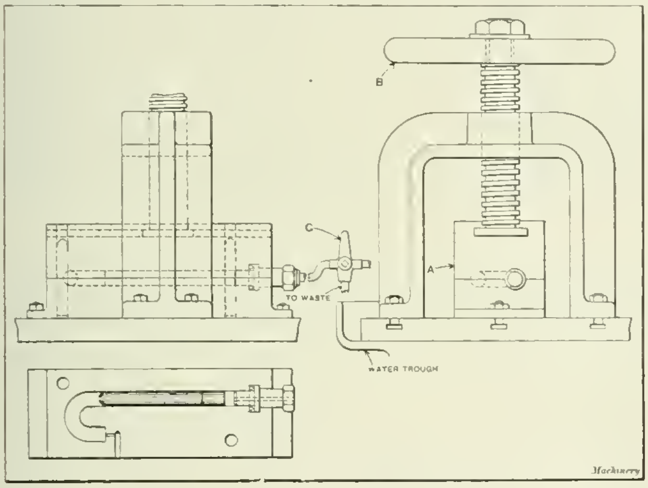


Fig. 1. Dies for making a U-shaped Bend, and Fixture in which the Dies are clamped while under Pressure

The finish produced by this bulging method is quite free from tool marks, and all bends are of full section throughout. An important point to be considered is the water pressure, which must be governed by the thickness of the metal and its physical characteristics. A safe pressure to use at first is about 700 pounds per square inch for annealed brass 0.020 inch thick, increasing this to approximately 1200 pounds per square inch for a thickness of 0.060 inch. If the pressure is excessive, it may burst the end of the shell, and so it is advisable to increase the pressure gradually until the desired results are obtained. An operation such as bending a tube requires more pressure than a simple expanding operation, since, in bending, the tube must be forced around a curved recess in the die. In an operation of this kind plenty of thin oil should be used to facilitate the movement of the work in this recess.

General Arrangement of the Dies

A typical arrangement of the dies used for bending is shown in Fig. 1. The lower die is fixed to a T-slotted table, and the upper half is clamped to it by means of a handwheel-operated screw passing through a bridge iron which is attached to the table. Instead of a handwheel for manual operation, it is entirely practicable to arrange a hydraulically operated plunger in the bridge as a clamp for the dies. In such an installation, a three-way cock may be employed first to admit pressure to the clamping plunger and then to admit the water to the dies and drain it from the dies.

Application to Thin Tube Bending

The shell shown at A, Fig. 2, is made into a gramophone swan-neck, and is drawn from a blank of sheet brass, 4.125 inches in diameter and 0.044 inch thick. This shell is bent as shown at *B*, by hydraulic pressure, in the die illustrated in Fig. 1. It will be noticed that the end of shell *A* is rounded; it is made this shape in the drawing operation, to facilitate the bending in the hydraulic dies and to give sufficient metal to permit a flat end to be formed subsequently.

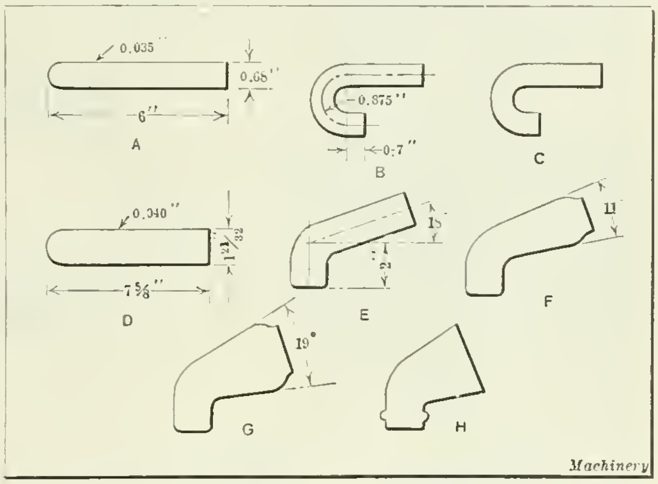


Fig. 2. Diagram showing Various Steps in the Production of Two Parts by Hydraulic Bending and Bulging

From what has previously been said it will be understood that the dies are made in halves, the upper half *A* being clamped by means of the handwheel *B*, and a rigid support for the clamping screw is provided by the substantial bridge construction. The upper and lower members of the die are aligned by means of dowel-pins and during the operation they are opened just enough to permit the work to be placed in position. The plan view shows the position of the shell in the lower die prior to the bending operation. The water is admitted to the dies by means of a flexible connection to the pump or accumulator, and is controlled by the two-way cock *C*. A pressure of 1200 pounds per square inch is employed, and the water, when admitted, enters the shell and forces it around the bend, producing a shell with a square end and with a surface that is entirely free from wrinkles. In the end of the recess in the die is a channel leading to an air vent, which is an essential detail in the construction of dies of this type.

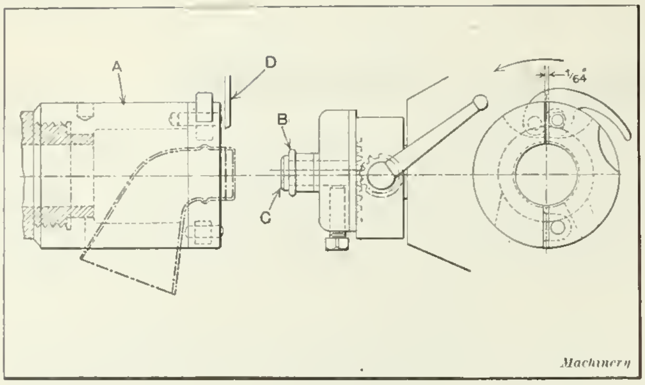


Fig. 3. Tool Equipment for forming a Bead by Spinning

After the operation has been completed the two-way cock is turned around to its second position, which shuts off the source of supply and permits the water in the shell to pass into the waste pipe. It should be mentioned that the contacting surfaces of the two die members are carefully lapped, and as a result, only a very slight line is produced at the parting. Lubrication of the shell and interior of the die is very important. This completes the bending of the shell, but there are a number of other operations required to make the swan-neck, which include cutting off the closed end, as shown at *C*, Fig. 2, squaring and tapping the long end, milling a slot in the long end, and punching a bayonet slot in the small end. As these operations do not pertain to hydraulic bending or bulging, they will not be described in the present article.

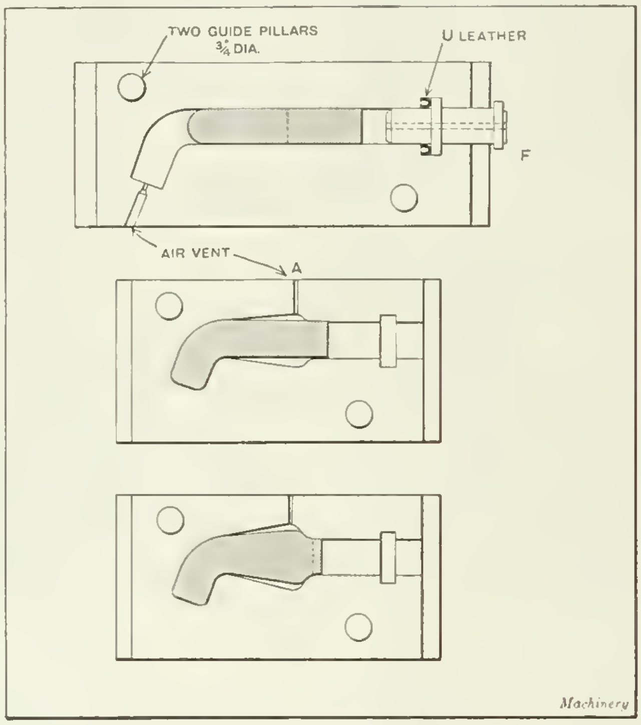


Fig 4. Dies used for bending and bulging a Gramophone Horn Elbow. Only the Lower Halves of the Dies are shown

Bending and Bulging Operations

The manufacture of the swan-neck requires only a bending operation, but the making of a gramophone horn elbow (*H*, Fig. 2), is a good example of the possibilities of this method of metal-forming, since both hydraulic bending and bulging operations are employed. In this case, the diameter of the drawn shell *D* is somewhat larger than that of the swan-neck shell and the wall thickness is also greater. With this diameter and wall thickness it is doubtful whether uniformity of shape could be obtained by any other method of bending and expanding. The shell is drawn from a blank of brass, 6 5/16 inches in diameter and 0.050 inch thick, and five drawing and annealing operations are performed before the shell *D* is produced.

The drawing operations are performed in dies of familiar construction. The first bend *E* is performed hydraulically, the lower half of the bending die being shown in the upper part of Fig. 4. These dies are of similar construction to those used in the previous bending operation (Fig. 1), and the method of clamping and operation are essentially the same. A pressure of 1200 pounds per square inch is used to produce the bend. The shell is then annealed preparatory to expanding to the shape shown at *F*, Fig. 2. This operation is performed with the same type of bench fixture that is shown in Fig. 1, but the bulging dies are not of the same construction. Two bulging operations are performed, the second bulged shell being shown at *G*, Fig. 2.

The lower members of both sets of dies are shown in the lower part of Fig. 4. The second expanding operation, which is preceded by annealing, is necessary to finish the shell to the required shape. Both expanding dies are of the same type and it is necessary to provide a small air vent *A* at the bulged section. The bulged end of the tube is then trimmed to length, after which the small end is cut off and a bead spun on the stem. The appearance of the shell after the bead has been spun is shown at *H*, Fig. 2.

Although this beading operation is not performed hydraulically, the fixture used is of interest. The work is performed on a turret lathe. The body *A* of the fixture, Fig. 3, is fitted to the nose of the spindle and has a hinged clamp at the front end. The body has a large opening in the side through which the tube is put into position and clamped. In making this clamp, it is important to have the two halves nearly touch, leaving only a very small clearance to secure a firm grip on the work. Any distinct gap between the clamping members would result in a ridge being raised on the bead during the spinning operation. The spinning of the bead is effected by means of a roller *B* which revolves freely on stud *C* mounted in a rack-operated recessing tool-holder which is carried in the turret. The parting cutter *D*, which is mounted in the back toolpost, trims the work to length after the bead has been spun. The final operation in the manufacture of the shell is punching a bayonet slot in the small end.

Manufacture of Telephone Receivers

In manufacturing telephone receivers, the first step is drawing from a brass blank. After the necessary drawing operations, the shell has the general appearance shown at *A*, Fig. 5. This particular receiver is made from a blank 4½ inches in diameter and 0.072 inch thick. After the shell has been drawn and properly annealed, the open end is sized and the metal swaged to the proper thickness for

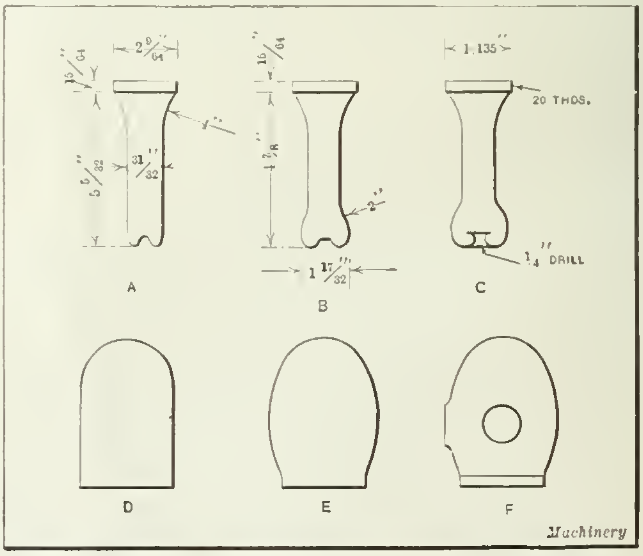


Fig. 5. Examples of Bulging as applied to a Telephone Receiver and an Automobile Side-lamp

subsequent threading. This operation is performed with the tools shown at the left in Fig. 7. The length, diameter, and shape of the shell are not materially changed by these dies.

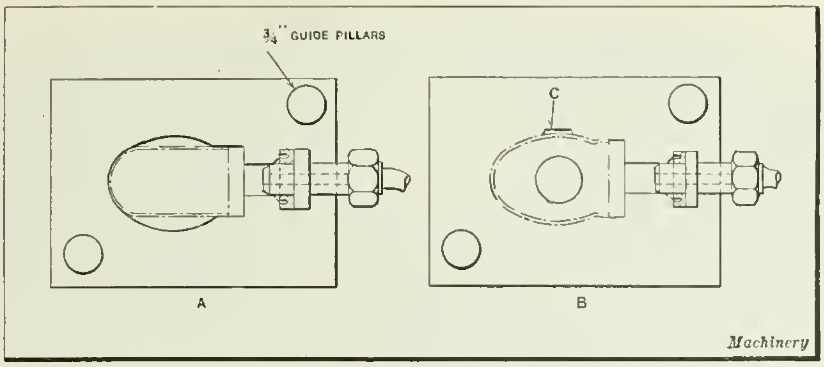


Fig. 6. Plan View of Dies used for bulging Automobile Side-lamp Shell and producing the Formed Bosses

Die *A* is formed with a flared mouth to suit the shape of the shell, and the large opening is finished to the diameter to which the work is to be sized. The die is held in position in the cast-iron bolster *C* by the ring *B*. The lower knock-out *D* ejects the shell at the completion of the operation. The pressure plunger *E* is controlled by spring *F* and holds the work in the die *A* while the punch *G* descends and fills the recess within the die opening.

It is necessary to design the dies so that pressure will be exerted on the flared part of the shell, since the action of the tools tends to force the shell downward through the die, which would distort it. The shallow grooves cut around the outside of plunger *E* insure a grip being maintained on this part of the shell. The swaging punch *G* is held in a recess in punch-holder *H*, and a knock-out on the press operates the ejector *J*. This member is a loose fit through the punch and has a stop-pin *K* to prevent it from falling through the punch. This ejector strips the work from the straight part *L* of the plunger, and it is shaped with a slot, so as to conform to the shape of the shell at the closed end and not deform it.

Bulging Operations on Receivers

Two methods may be employed for bulging the end of the shell, one of which utilizes a rubber pad as the expanding medium, and the other hydraulic pressure. Of the two, the hydraulic method is preferable, chiefly on account of the inexpensive tool construction, rapid operation, and low tool upkeep. By the hydraulic process a pressure of about 1200 pounds per square inch is required, using dies similar to those previously described.

The lower die member for bulging the telephone receiver is shown in Fig. 8. This illustration also shows the flexible connection, and the position of the work is indicated by a heavy broken outline. These dies are operated under the bench-type bridge iron fixture illustrated in Fig. 1, and with few exceptions the dies contain no special features. Pin *A* is required to support the indent in the end of the shell and prevent it from losing its shape under pressure. In the working position the flanged sector on this pin is located in a groove in the bottom half of the die, thereby resisting end thrust. When the dies are open, the pin is turned through 180 degrees to bring the flanged piece clear of the groove in the die. Then the pin can be withdrawn, permitting the bulged shell to be removed.

Using Rubber Instead of Water for Bulging

Another method of forming the bulged end is by the use of rubber as the expanding medium. A double-action power press is also used when the bulging operation is performed by using a rubber pad in place of fluid pressure, and the dies required are illustrated at the right in Fig. 7. The lower die member is composed of two parts *A*, which are confined within the body *D* of the die and which are

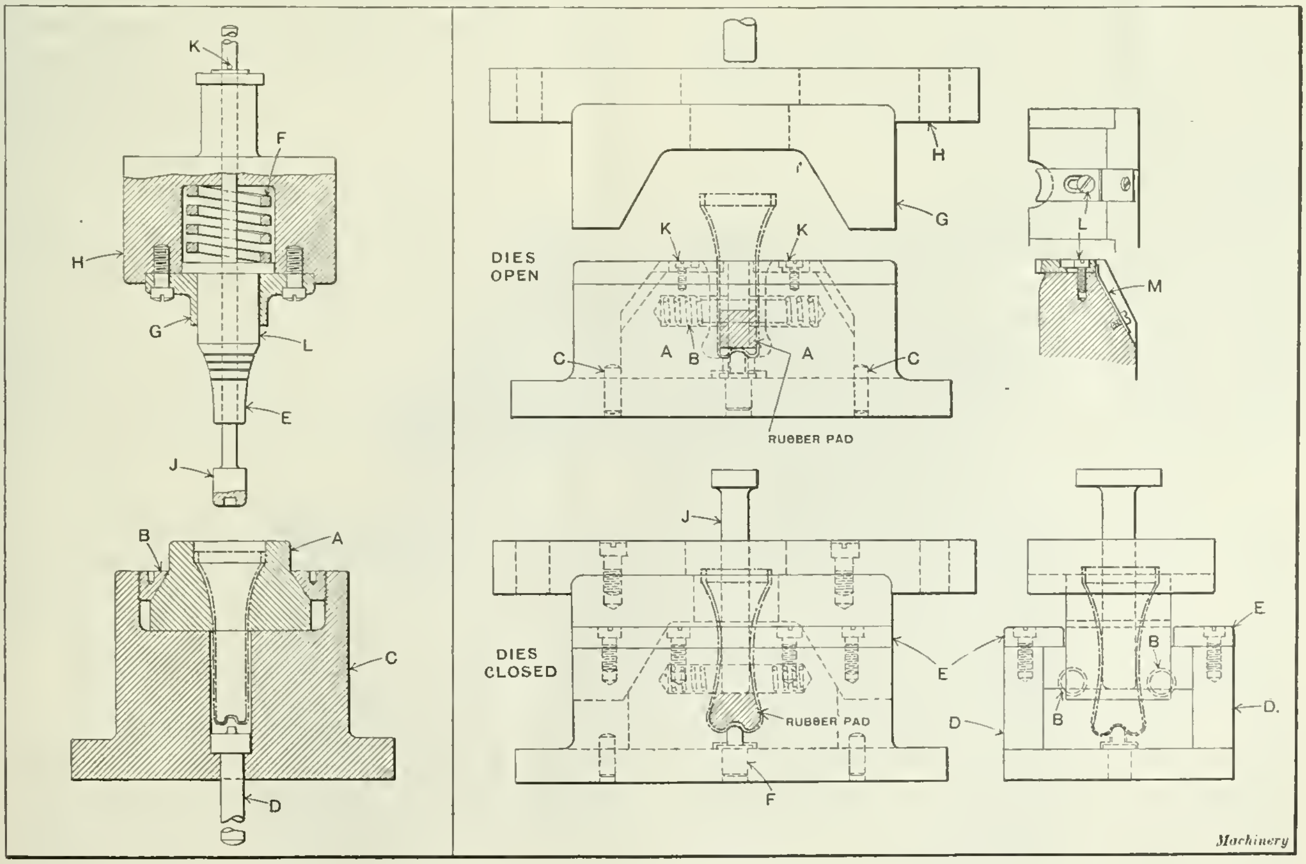


Fig. 7. (Left) Dies used for swaging the End of a Telephone Receiver prior to threading. (Right) Dies used for Bulging Operation performed by the Use of a Rubber Pad instead of hydraulically

normally held apart by the action of springs *B*. The outward movement of the die members *A* is limited by pins *C* which are so located that the die will just permit the work to be extracted after being bulged. Cover plates *E* prevent the lower dies from lifting from the body *D*. Peg *F* is provided for locating purposes, and is fixed in the body of the tool so that it engages the indentation in the end of the shell to locate it and keep it from losing its shape.

The sides of the dies *A* are tapered, so that the corresponding taper on the die-closing block *G* operates against the lower dies and closes them against the tension of springs *B*. The closing block is carried in the top tool-holder *H*, and the punch *J* operates through both these members, extending into the shell and expanding the pad of rubber previously placed in the end of the shell. In addition to peg *F*, two side spring plungers *K* are employed to locate the shell in the open dies. These plungers are shaped to fit the curvature of the work and prevent side tilting. They operate in a groove on the top of dies *A*, and are retained by screws *L*, and operated against the pressure of flat springs *M* attached to the sides of the dies (see partial sectional view).

It is not necessary to use an exact quantity of rubber for the bulging operation, since the ram adjustment of the press will enable the operator to accommodate different sized pieces of rubber after he has noted the amount of pressure required to complete the bulge. One piece of rubber may be used for as many as one or two thousand operations.

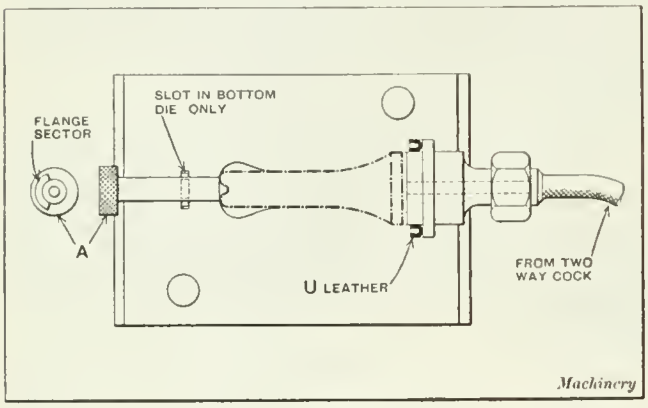


Fig. 8. Plan View showing One Section of Bulging Die used when Bulging of Receiver is performed hydraulically

The bulged shell, partially dimensioned, is shown at *B*, Fig. 5, and the completed shell is shown at *C*. After bulging, the operations consist of drilling a 1/4-inch hole in the formed end, spinning the flanges produced by this operation, tinning, vulcanizing, polishing, threading, and facing. The purpose of spinning the flanges produced by drilling the hole is to prevent fraying of the telephone cord which passes through this hole.

Bulging Automobile Side-lamp Shells

The drawn shell *D*, Fig. 5, is made from 0.025-inch thick sheet brass, and two bulging operations are required to produce the shapes *E* and *F*, the latter being the approximate shape of a completed automobile side-lamp. After the necessary annealing and trimming operations, the die shown at *A* in Fig. 6 is used to produce shell *E* by direct hydraulic pressure. These dies are made in halves and are operated on a bench fixture of the type illustrated in Fig. 1. A water pressure of 800 pounds per square inch is employed, which may be furnished either by a hydraulic accumulator or a force pump. It is important to note that an annealing operation was necessary before this bulging operation, since otherwise the hard shell produced in drawing would cause the work to be split under the strain of bulging.

It is not practicable to perform the next forming operation hydraulically. This operation consists of expanding the mouth of the shell, and if it were attempted to accomplish this by water pressure a space would have to be left around the shell for the water to force the metal into. The result would be that water would be admitted to both sides of the shell, and no expanding action would result. With this method of hydraulic forming the water must be confined to the interior and not be allowed to fill spaces that are intended for the forming operation. The operation of expanding the mouth of this shell is performed on a power press, with split dies arranged to hinge and clamp by means of a cam.

The final forming operation, in which the two bosses on the lamp case are produced, is a typical example of the sort of work that can be performed by hydraulic bulging without difficulty and without a great expenditure for tools. The tools for this operation, shown at *B* in Fig. 6, consist of a top and bottom die, properly formed to receive the shell and containing recesses to produce the bosses. One boss recess is let into the bottom half of the die and the other *C* is partly in each die member. The same construction of dowel-pins for aligning the die members, flexible connections, and two-way cock are used as employed in other bulging and forming operations previously described. The pressure employed in this operation is 800 pounds per square inch.

The steps required to complete the lamp shell are two piercing operations in the bosses, rough-polishing the outside of the shell, soldering a bushing and a spigot into the holes, enameling the inside of the shell, assembling glass in position and spinning over the open end, and finish-polishing the outside.

* * *

DETERMINING THE LENGTH OF ROLLED BELTS

By W. F. SCHAPHORST

A rule for determining the length of a rolled-up belt was given on page 144 of October MACHINERY. The method given in the following, which was recently developed by the writer, is somewhat simpler and quicker than the one mentioned. By means of a yardstick or rule, measure the distance $(t + d)$ which amounts to the total thickness of the ring of belting material plus the diameter of the hole. Taking the measurement $(t + d)$ in inches, multiply it by 0.2618, and multiply the product thus obtained by the number of complete turns in the roll. The result is the length L of the belt in feet. Expressed as a formula,

$$L = 0.2618\ (t + d)\ N$$

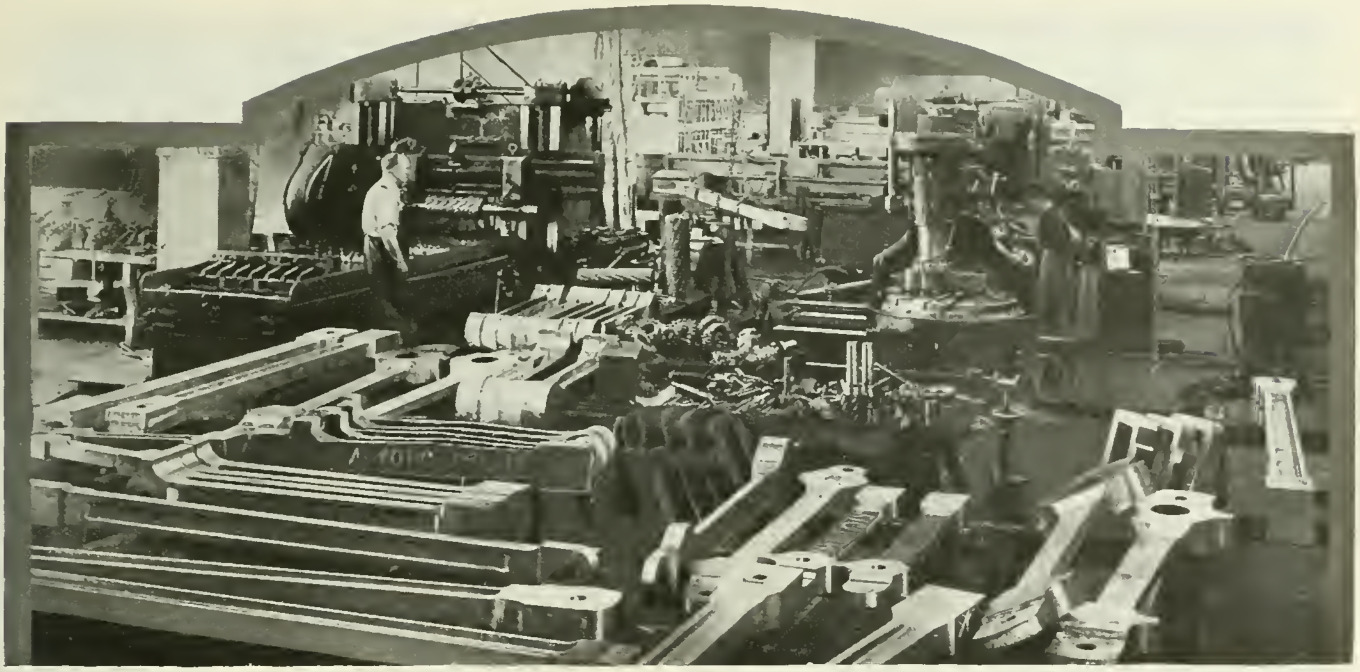
where t = total thickness, in inches, of ring of belting;
d = diameter, in inches, of opening or hole; and
N = number of complete turns.

The measurement $(t + d)$ can often be taken without removing the roll of belting from its place in the stock-room. It will be noted that the method here given requires only one measurement, whereas the rule given in October MACHINERY necessitates the making of two measurements.

* * *

CRACKING OF ENAMELED WARE

The Bureau of Standards has recently conducted tests to find the cause of the cracking of enamel on enameled ware, and has found that it occurs when the enamel is not suitable for the metal that it covers. Some enamels have the same rate of expansion as the metal that they cover, and when utensils are covered with these enamels, there will be no cracking; but when the enamel has one rate of expansion and the metal another, cracks will appear in heating or cooling. The rate of expansion of the enamel, depends upon its composition, and can be adjusted quite accurately to fit that of the metal. The Bureau of Standards has collected a great deal of information on this subject, and expects shortly to publish a bulletin giving compositions of enamels that can be used to the best advantage.



Milling Locomotive Side-rods

Results of Tests made to Determine the Possibilities of Reducing Costs in Railroad Shops by Milling

IN October MACHINERY, a description was published dealing with tests conducted at the plant of the Ingersoll Milling Machine Co., Rockford, Ill., to determine the possibilities of heavy-duty milling machines of special design for handling locomotive machine shop work. Machining data for main rods and main rod straps were given, showing the actual results obtained when working under favorable conditions. The present article describes the milling of side-rods with the same types of machines and equipment employed for milling the main rods and straps. The speeds, feeds, cutter sizes, dimensions of cut, horsepower and time are given in each case, and this information is also presented in tabular form for convenient reference.

The main side-rods are made of chrome-vanadium steel, and are heat-treated, the same as the main rods and main rod straps mentioned in the previous article. The first milling operation, which is slabbing, is illustrated in Fig. 1. In this operation, standard Ingersoll adjustable fixtures and inserted-tooth helical type high-speed milling cutters were used. Two forgings were slabbed at a time. The cutters were 9 inches in diameter, 24 inches long, and operated at a cutting speed of 33 feet per minute and a feed of 3 inches per minute. The low cutting speed and feed used in this slabbing operation were necessary because of the hard scale on the surfaces of the forgings, and were not the result of cutter inefficiency, as will be noted in later operations in which the speeds were materially increased. The depth of cut was 23/64 inch, the total width of cut 30⅝ inches, and the machining time, 4 hours and 33 minutes for both sides of two rods.

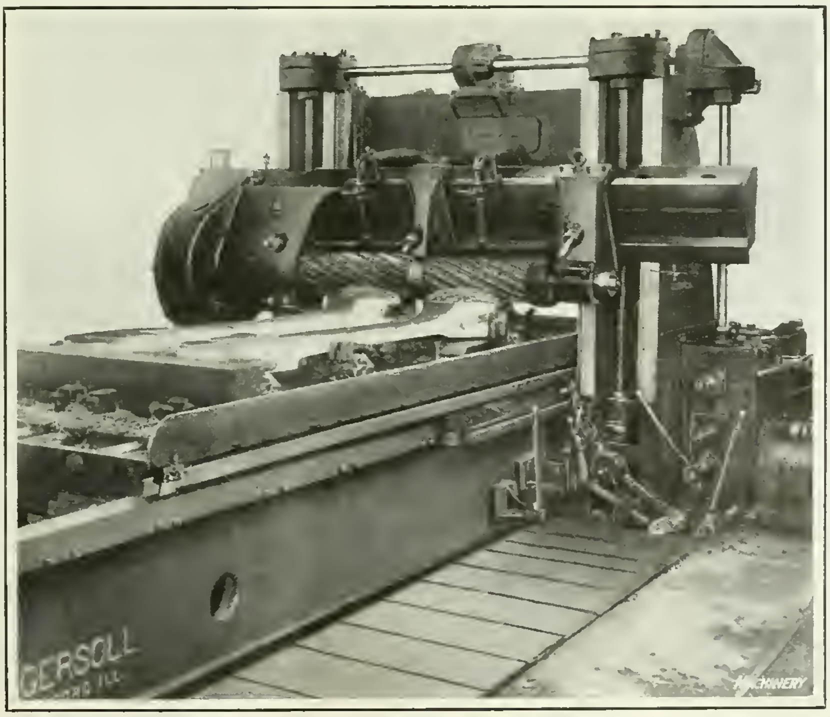


Fig. 1. Slabbing the Sides of a Locomotive Main Side-rod

The second operation was that of milling the edges of the rods. For performing this work, a horizontal type machine was used. Four forgings were edged at one time, although the machine table had accommodation for six forgings. The working conditions under which the edging cuts were taken were the same as in the slabbing operation, that is, the hard scale limited the cutter speed and feed to those used for slabbing. The same size and type of cutter was also used for edging, but the depth of cut was ⅞ inch, and the width on the straight part of the rods 8 inches. The two cutters removed a total of 21.1 cubic inches of metal per minute at an expenditure of 1.2 horsepower per cubic inch. The time required to mill both edges of four rods was 3 hours and 32 minutes, including the time for setting up.

The third milling operation was that of contour-milling both ends of the rods; the

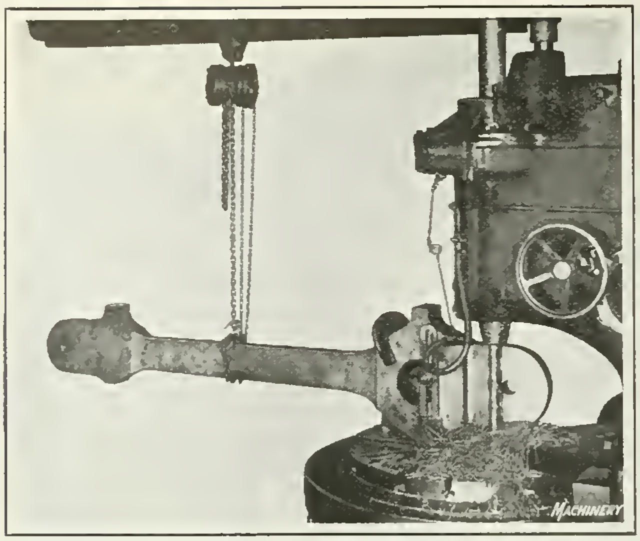


Fig. 2. Milling the Tongue of a Main Side-rod

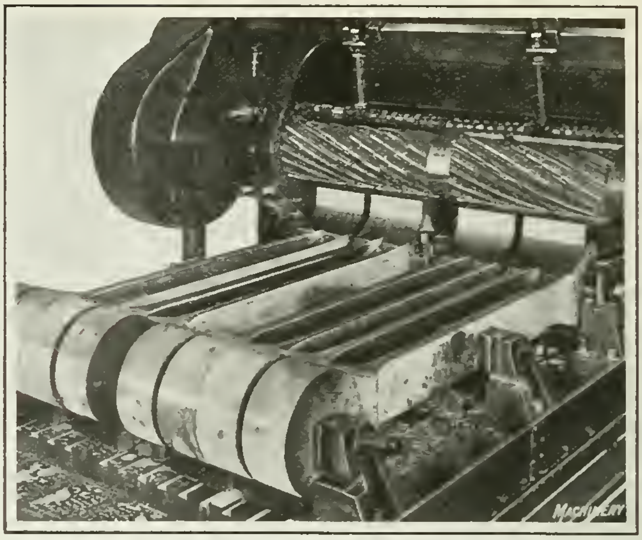


Fig. 3. Edging Eight Intermediate Side-rods

set-up for this operation was similar to that illustrated in Fig. 4. In milling the contours, a helical inserted-tooth cutter was used, 5 inches in diameter and 12 inches long, and a combination of hand and power table feed was employed. The cutter speed was 35 feet per minute, the width of cut 11½ inches, and the depth of cut varied from ½ to 1 inch with the contour of the work. The floor-to-floor time required to mill both ends of two rods was 5 hours.

The last operation on the main side-rods is illustrated in Fig. 2, which shows a vertical rotary machine equipped with a 2⅜-inch solid helical milling cutter. The work consisted of milling both sides of the tongue on each end of the rods, with the extending end of the forging supported by a hoist. The tongue was clamped to an angle-plate in a vertical position. The table feed was 2½ inches per minute, the cutter speed 65 feet per minute, the depth of cut varied from ⅛ inch on face of tongue to 1⅜ inches at radius, and the width of cut was 11½ inches. The milling time was 1 hour and 10 minutes for four surfaces.

Four milling operations were performed in machining the intermediate side-rods, the first of which consisted of slabbing both sides of the rod. As this operation was similar to the slabbing operation illustrated in Fig. 1, a set-up of this job is not shown. Two rods were slabbed at a time on a horizontal machine, with two helical inserted-tooth Ingersoll cutters, 9 inches in diameter and 24 inches long. The table feed was 2 5/16 inches per minute, the speed of cutter 33 feet per minute, the depth of cut 11/32 inch, and the total width of cut 30½ inches. The floor-to-floor time required to slab both sides of two rods was 4 hours and 8 minutes.

The edging operation is illustrated in Fig. 3 from which it will be seen that eight rods were milled at a time. The cutters and cutter speeds for this operation were the same as for slabbing. It will be noted that in this case also the speed was limited by the hard scale on the forging. For edging, a table feed of 3 inches per minute was used, as compared with 2 5/16 inches for slabbing. The depth of cut was ½ inch, total width of cut 10½ inches, amount of metal removed per minute, 15.6 cubic inches, horsepower per cubic inch of metal removed, 1.81, and the time, 1 hour and 56 minutes for eight rods.

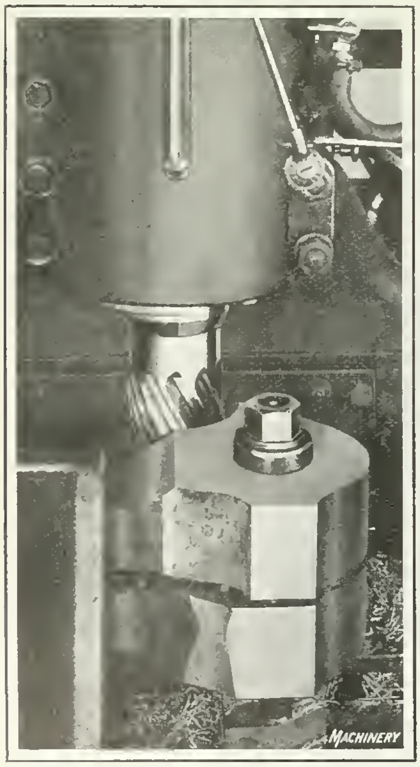


Fig. 4. Milling Contours at Ends of Rods

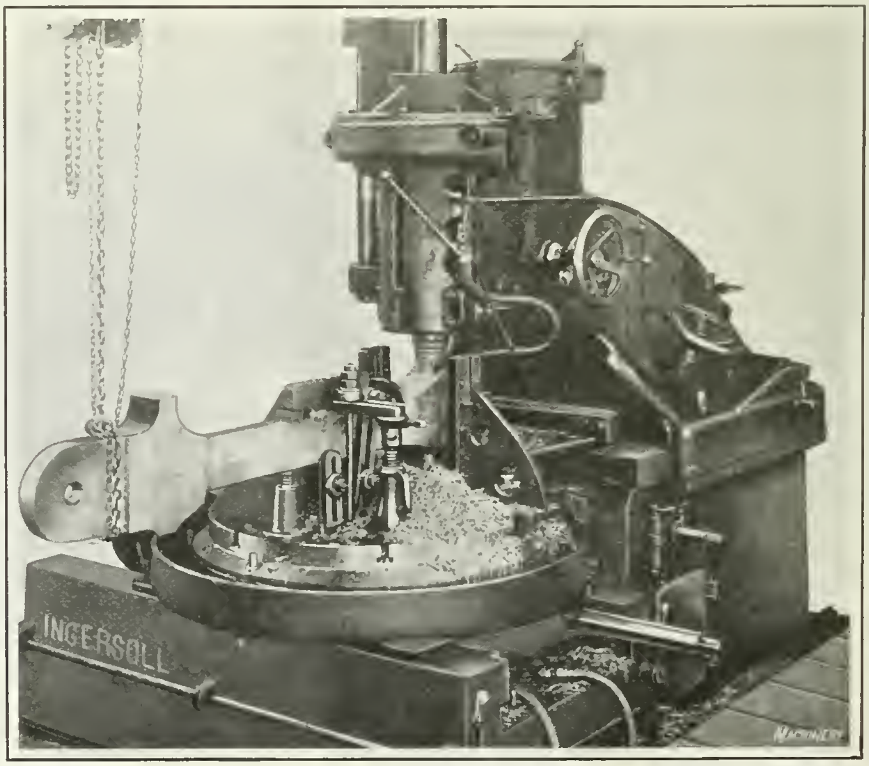


Fig. 5. Machining a Tongue Slot in an Intermediate Side-rod

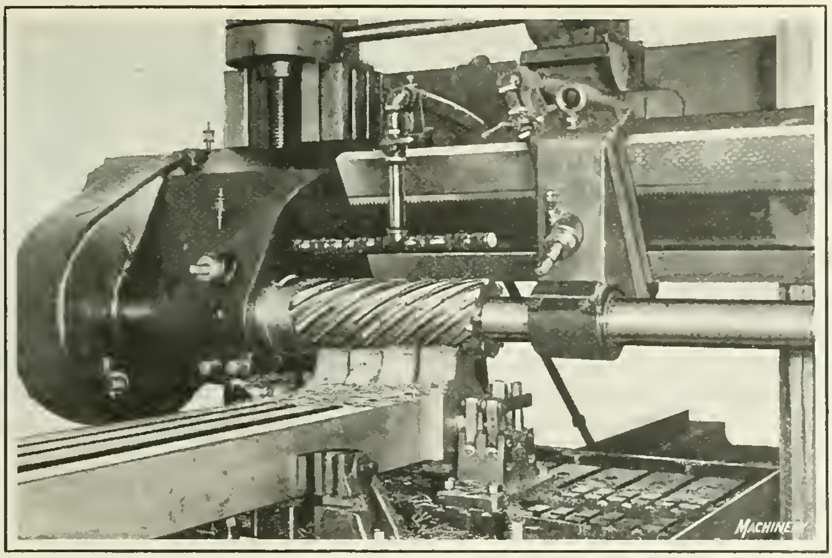


Fig. 6. Beginning of Edge-milling Operation on Locomotive Front Side-rods

The third operation performed on the intermediate rods was milling the contour at both ends of the forgings. This operation is illustrated in Fig. 4. The cutter used was of the helical inserted-blade type, 5 inches in diameter and 12 inches long. Both hand and power feeds were used, the cutter speeds being 35 feet per minute. The depth of cut was from ⅜ to ½ inch, the width of cut 8½ inches, and the floor-to-floor time for both ends of two rods 4 hours.

The final operation consisted of milling a slot for the main side-rod tongue, the set-up for which is shown in Fig. 5. A solid helical cutter, 2¼ inches in diameter was used, and after the full length of the slot had been milled the cutter was fed out, taking a finishing cut on one side of the slot. It was then fed in again, finishing the other side of the slot. For the roughing cut on the solid forging, a table feed of ⅜ inch per minute was used, and for the two finishing cuts the rate of feed was 1½ inches per minute. The cutter speed was 50 feet per minute, depth of slot 11⅝ inches, width of tongue 10¼ inches, width of slot 2¼ inches, and floor-to-floor time 1 hour and 20 minutes per rod.

Milling Front Side-rods

The set-up for the first milling operation on the front side-rods, that of slabbing, was similar to the slabbing operation illustrated in Fig. 1, the type of machine and the style and size of cutter being identical. These rods, instead of being made of heat-treated chrome-vanadium alloy steel, are carbon steel forgings. The rate of table feed employed was 5⅛ inches per minute, and the cutter speed 52 feet per minute. A cut ½ inch deep and 13 9/16 inches wide was taken by each of the two cutters on the sides of each rod, removing a total of 61.5 cubic inches of metal per minute. The power consumption was 1.35 horsepower per cubic inch of metal removed, and the floor-to-floor time was 4 hours and 25 minutes for slabbing the four surfaces.

The second operation, illustrated in Fig. 6, consisted of edging the rods. Although the machine illustrated is shown equipped for handling only four rods at a time, if its full capacity is taken advantage of, eight rods can be machined at a time. A 9- by 24-inch helical inserted-tooth milling cutter was used in this operation, with a table feed of 8⅞ inches, and a cutter speed of 52 feet per minute. With this rate of feed the finish was somewhat irregular, and tool marks 0.003 inch deep appeared at intervals of about ⅜ inch. However, men familiar with locomotive work who inspected these surfaces were of the opinion that this finish would be acceptable and that a high table feed would be preferable to a slower feed, even though the finish were not as smooth. The depth of cut was 13/32 inch, the width 16 inches, the amount of metal removed per minute 43.5 cubic inches, and the horsepower consumed per cubic inch of metal removed 1.005. The floor-to-floor time required to mill both edges of four rods was 4 hours and 5 minutes.

The third and last milling operation on the front side-rods consisted of channeling the forgings on both sides. This operation is not illustrated, but the set-up was similar to that shown in Fig. 3 of the article "Milling Locomotive Main Rods," in October MACHINERY. Two 3¼- by 10-inch diameter staggered inserted-tooth cutters were used, at a speed of 58 feet per minute. The rate of table feed was 5⅝ inches per minute, depth of cut 1 9/16 inches, width of cut 3 9/32 inches, amount of metal removed per minute, 57.7 cubic inches. The power consumption per cubic inch of metal removed was 1.13 horsepower, and the time required for channeling both sides of two rods, floor to floor, was 2 hours and 25 minutes.

The data presented in this article represents the actual results obtained. It was the first time that these operations had been performed with the equipment used, and if they were repeated in the regular process of manufacturing, it is probable that even better results could be obtained.

* * *

The Chamber of Commerce of the United States has collected figures that indicate that $70,000,000 is spent annually by American industries on research work. About one-half of this sum is spent in laboratory research, while the remainder is expended in experimental and development work.

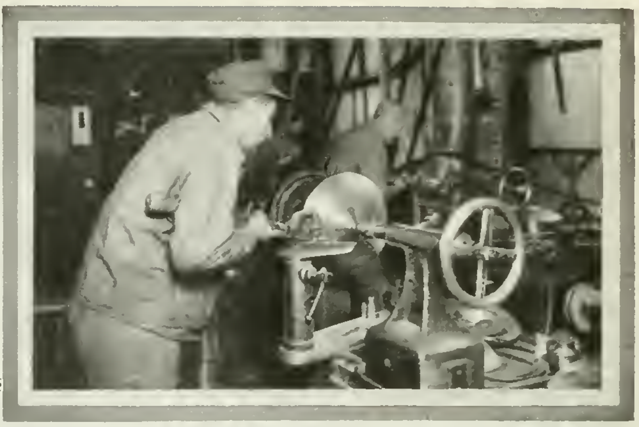
MILLING LOCOMOTIVE SIDE-RODS

	Operation No.	Operation	Table Feed, Inches per Min.	Cutter Speed, Feet per Min.	Depth of Cut, Inches	Total Width of Cut, Inches	Total Cu. In. Metal Removed per Min.	Horsepower per Cubic Inch	Production Time, Floor to Floor
Main Side-rods, Alloy Steel, Heat-treated	1	Slabbing (both sides)	3	33	23/64	30⅝	....	....	4 hr. 33 min. (2 forgings)
	2	Edging (both edges)	3	33	⅞	8 (in center)	21.1	1.2	3 hr. 32 min. (4 forgings)
	3	Mill contours (both ends)	Hand and power	35	½ to 1	11½	....	....	5 hours (2 forgings)
	4	Mill tongues (both sides)	2½	65	⅛ to 1⅜	11½	....	....	1 hr. 10 min. (4 surfaces)
Intermediate Side-rods, Alloy Steel, Heat-treated	1	Slabbing (both sides)	2 5/16	33	11/32	30½	....	....	4 hr. 8 min. (2 forgings)
	2	Edging (both edges)	3	33	½	10½	15.6	1.81	1 hr. 56 min. (8 forgings)
	3	Mill contours (both ends)	Hand and power	35	⅜ to ½	8½	....	....	4 hours (2 forgings)
	4	Mill slot	⅜ (rough) 1½ (finish)	50	11⅝ (slot in solid)	2¼	....	....	1 hr. 20 min.
Front Side-rods, Carbon Steel	1	Slabbing (both sides)	5⅛	52	½	27⅛	61.5	1.35	4 hr. 25 min. (2 forgings)
	2	Edging (both edges)	8⅞	52	13/32	16	43.5	1 005	4 hr. 5 min. (4 forgings)
	3	Channeling (both sides)	5⅝	58	1 9/16	3 9/32	57.7	1.13	2 hr. 25 min. (2 forgings)

Machinery

Spinning Chucks

By D. C. OVIATT
D. C. Oviatt & Co., Cleveland, Ohio



SPINNING chucks, which are used extensively in the manufacture of coffee pots, kettles, and numerous other utensils of similar shape, are frequently constructed in sections, held together by a ring or other suitable means so that the chuck may readily be disassembled and removed from the utensil after the spinning operation has been completed. Spinning chucks of a different type, embodying some interesting mechanical features, are illustrated in this article. These chucks are not of the sectional type, but are so designed that they should be applicable to a wide range of spinning work.

The spinning chucks shown in Fig. 1 are used in the first two spinning operations required in shaping a water pitcher. The design of both chucks is essentially the same. The reduction in the diameter of the work is indicated by the outline of the work before and after each operation, as shown at *A* and *B*, respectively. The work is first located in the driving chuck, in which it is held by end thrust, by the following arrangement: There is a driving plate *C* of a diameter to suit that of the inside of the shell, which contains a female center by means of which the spinning chuck is aligned before the operation is started. This driving plate is split through the center, and is hinged so that it can be removed from the shell without difficulty. The center shaft *D* is supported at its outer end in the tailstock, in which it is free to revolve, so that when the tailstock is slid along the ways of the lathe in the direction of the headstock, the opposite end of the device will be centered in the female center of plate *C* and secured in this position by clamping the tailstock to the lathe bed.

The opposite end of shaft *D* carries a ball thrust center *E*, which is free to slide on the shaft, so that after the spinning chuck has been centered, it may be offset sufficiently to bring the spool *F* against the inner wall of the shell, as shown in the illustration. The spool is keyed to the shaft so that it revolves with it, and thus drives the shell, and, through friction, the spinning roll, by means of which the pressure that shapes the work is applied.

The position of this roll is indicated in the illustration; it is carried in a holder, which during the spinning operation, is supported by a tool-rest. A spring collar *G* telescopes over the spool and bears against the end of the shell to support it during the application of the pressure required to form the metal. As the shell is spun out, the increasing length forces the collar *G* back, compressing the spring back of it, so that the longer the shell becomes and the greater the amount of overhang produced, the greater will be the tension exerted to support it.

After the shell has been spun down to the contour of the spool and the operation is completed, the spinning chuck and work can be readily removed by simply moving the tailstock transversely until the tool is in alignment with the lathe spindle, in which position the tool can be easily withdrawn from the shell. Driving plate *C* is then folded over on its hinges, and also withdrawn, which leaves the shell free to be removed. The second-operation chuck, shown in the lower part of the illustration, continues the reduction process by the use of a suitably designed spool.

Another spinning chuck which closely resembles those just described is shown in the upper part of Fig. 3. This chuck is not provided with a ball thrust center, but in other respects is the same as the other types. The design of spinning chuck shown in the lower left-hand corner of this illustration is used for forming the top of kettles, and the

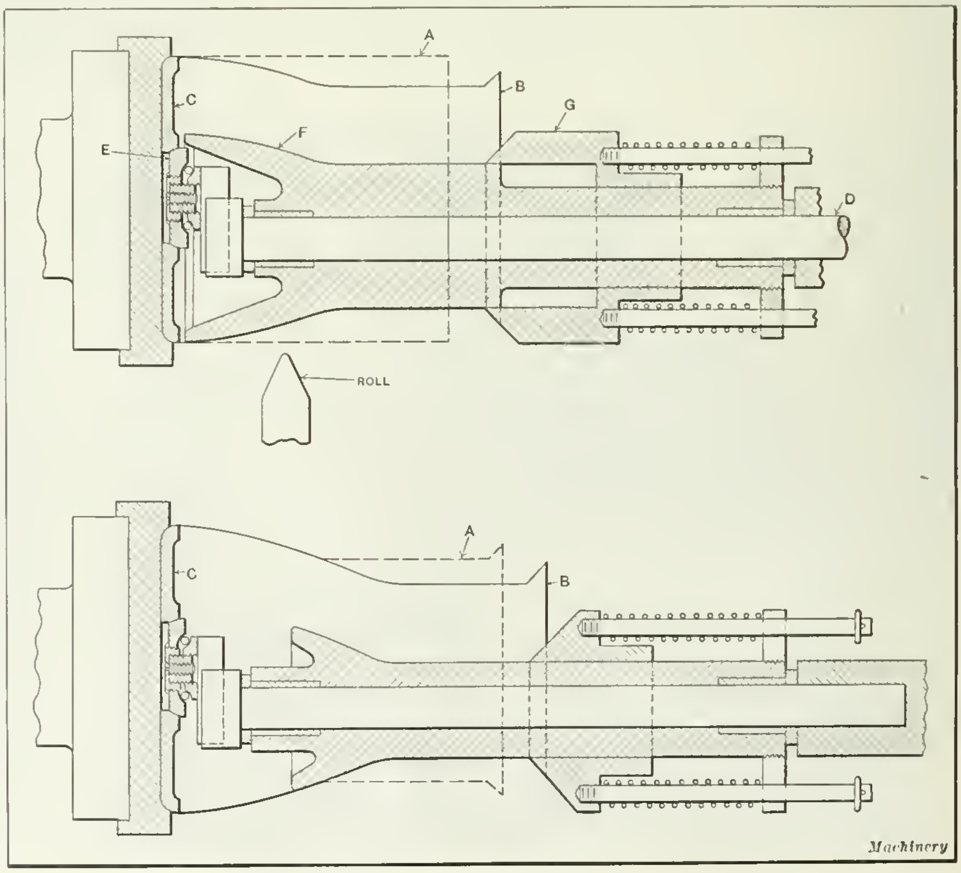


Fig. 1. Spinning Chucks used in the Manufacture of Water Pitchers

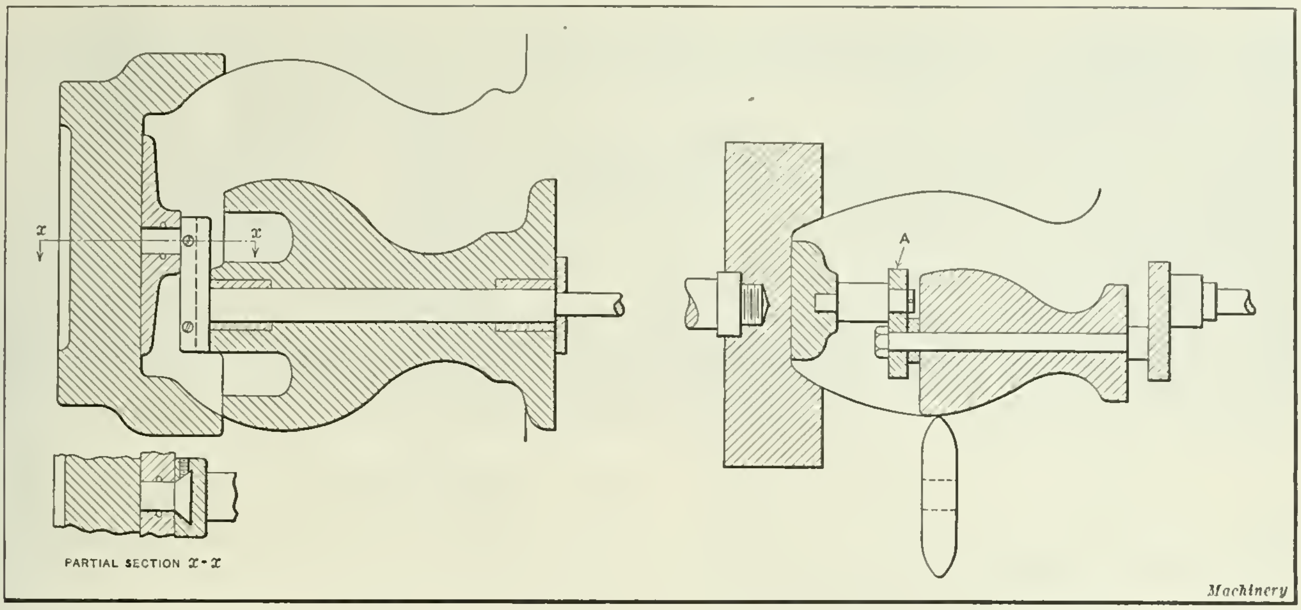


Fig. 2. Additional Examples of Chucks used in spinning Sheet-metal Utensils

spool employed is designed simply to form the curl at the top. The driving plate in this case is not required to be hinged, since the top of the kettle is large enough to permit the use of a driving plate that can be withdrawn directly from the shell without folding it. The shell is held by end thrust, and the center stud on which the tongue *A* is carried has sufficient axial play so that the shell and driving plate can revolve and the shaft that carries the spool be held stationary in the tailstock. Slide *B* and tongue *A* are dovetailed, and the slide provided with a taper gib to compensate for wear. The fact that the shell does not overhang excessively enables it to be held without much thrust, leaving the driving plate free to revolve against the friction produced by the contact of tongue *A*.

The spinning chuck shown in the lower right-hand corner of Fig. 3 is used for spinning such shells as bulged kettles. The work is located in the driving chuck, and held by a driving plate, carried on the end of a revolving tail-center *C*. The tail-center is secured in the tailstock by a set-screw. A forming roll *D* is held between adjustable centers in a suitable yoke, attached to the saddle of the lathe. The forming roll may be made of wood and provided with metal centers, and should of course, be adjusted to revolve freely with the work. The bulging roll *E* is carried on a holder *F*, and is mounted on ball bearings. The holder is attached to the compound slide of the lathe, so that the operating handle of the compound slide can be employed to swing the bulging roll outward as the kettle is being spun to the contour of the forming roll.

Other designs of spinning chucks are illustrated in Fig. 2. That shown at the left is similar in construction to the one shown in the lower left-hand corner of Fig. 3. In this design, however, a spool of rather special shape is required, because of the shape of the coffee pot that is spun by the use of this chuck. The dovetail slide construction employed in the chuck shown in the lower left-hand corner of Fig. 3, is also used in this chuck, as indicated by the partial sectional view below the chuck, Fig. 2. It will be noted that the bulbous end of this spinning spool has been lightened considerably by recessing it. The top of the coffee pot is large enough to permit the driving chuck and spool to be withdrawn without special provision being made for this in the design.

In the right-hand view of this illustration is shown a type of spinning chuck that does not employ either the ball thrust center or the dovetail slide construction for transverse adjustment. The supporting arm *A* is carried on a shouldered center stud, to which it is secured by a cotter-pin. This chuck is used for spinning pots which may be considered as special for this particular size of shell, there

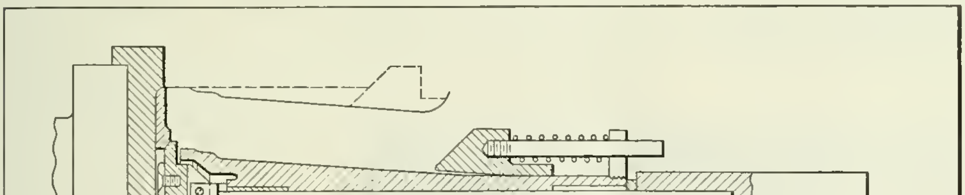


Fig. 3. Spinning Chucks for Kettles and Various Bulged Shells

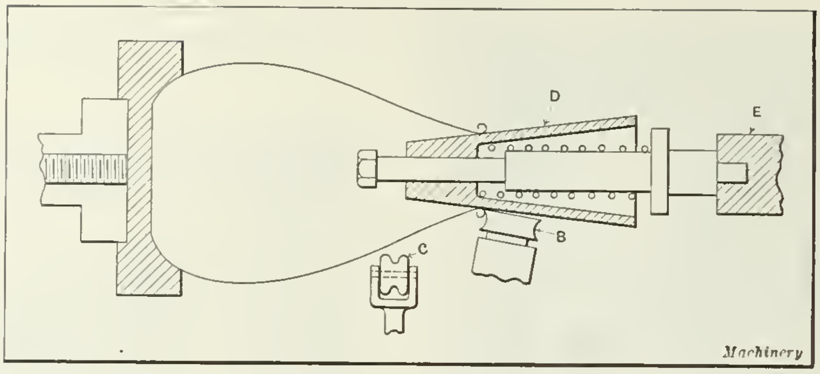


Fig. 4. Spinning Chuck for wiring or beading the Top of Shells

being no radial adjustment provided.

The spinning chuck illustrated in Fig. 4 is radically different from those previously referred to. This chuck is for wiring or beading the top of certain shells. The use of this tool is generally preceded by a spinning operation in which the top of the shell is spun outward to concave it, so that in the wiring operation the top edge of the metal may be readily picked up by the roll shown at *B* and then wired by means of the wiring roll *C*. Shells of this kind are seated in a suitable chuck, and supported at the open end by a tapered plug *D*, which is carried on a center stud. The center stud is free to revolve in the tail-spindle, and is provided with a collar for confining an extension spring that provides the axial thrust for supporting and driving the shell. The tapered plug revolves, of course, with the center stud, and is traversed axially by means of the coil spring, to compensate for the increase in opening produced by wiring up the end of the shell. To permit this tapered plug to be driven as well as moved axially, it is fitted to the center support by a sliding key (not shown).

Both the picking up roll *B* and the wiring roll *C* are carried by a specially designed bracket attached to the compound rest of the lathe, so that after the roll *B* has been swung into the position illustrated and the metal has started to curl, the cross-slide can be adjusted over and in, to bring the wiring roll into engagement with the work. These rolls may be mounted in any appropriate way; the design shown employs a yoke and trunnion for the wiring roll and a plain shouldered bearing for the picking up roll. The bracket that supports these two rolls may require the use of link levers or other suitable means for swinging one roll out of the way while the other is at work, if the design of the shell should make this necessary.

* * *

DIE FOR PUNCHING ODD-SHAPED HOLE

By M. E. DUGGAN

It is a simple matter for the toolmaker to produce a punch and die for piercing round holes in sheet metal, as no special tools are required. It is a more difficult problem, however, to produce a punch and die for holes other than round—as for instance, the hole in an electric bell such as shown at *A* in Fig. 1. The making of punches and dies for work of this nature usually requires the use of special tools.

The punch used to pierce the hole in bell *A* is shown at *B*, and the die is shown at *C*. One of the nine broaches made especially to produce the hole in die *C* is shown at *D*. Each of these broaches has nine teeth in the ¾ inch of its cutting length. Each broach takes a cut about 0.0010 inch deep, the width of cut taken by the finishing teeth of the last broach used being 0.0300 inch. The broaches are numbered from 1 to 9, each broach having its number stamped on the shank end. This provides a means of identifying the different sizes so that they may be used in the proper consecutive order.

The milling of the punch *B* is described in the following: The shank end of the punch, after being turned to the required dimensions, is placed in the hole *E* of the special holder shown in Fig. 2. The tailstock center on the milling machine is then inserted in the center in the blank punch. The supporting screw *F* in the arm *G* is brought up against the work to prevent chattering or bending of the punch during the milling operation. The relative positions of hole *E* in the special work-holding bushing and the milling cutter *H* are shown in Fig. 2. The supporting arm *G*, however, is shown under instead of at the side of the bushing. In operation, this arm is positioned so that set-screw *F* will support the work against the thrust of the milling cutter, as previously mentioned. A plug for testing the concentricity of the holder with respect to the milling machine spindle is shown at *K*.

A special tool for backing off the teeth of the milling cutter is shown at *L*. This is a regular "double center" tool designed to be operated by hand in the manner commonly referred to as "pumping." One side of the punch is milled off at the first cut, after which the index-head is given a half revolution and a cut taken on the opposite side of the punch. The finished broaches, punches, and dies were hardened in the usual way.

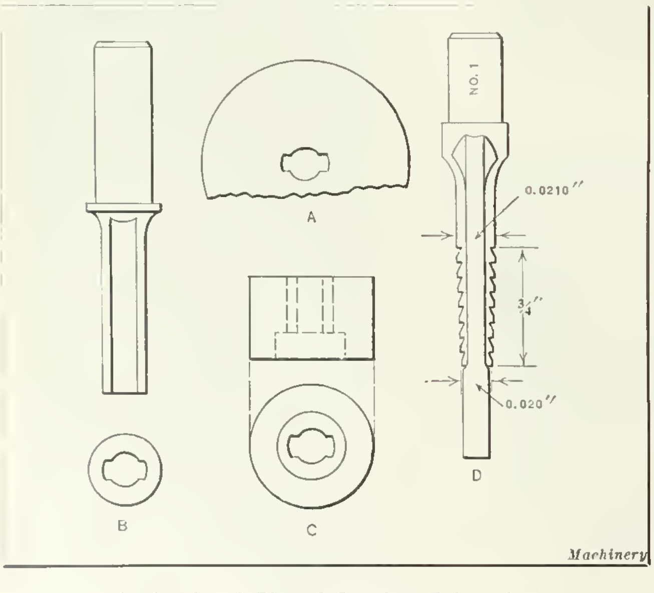


Fig. 1. Punch and Die and Broach used in making Die

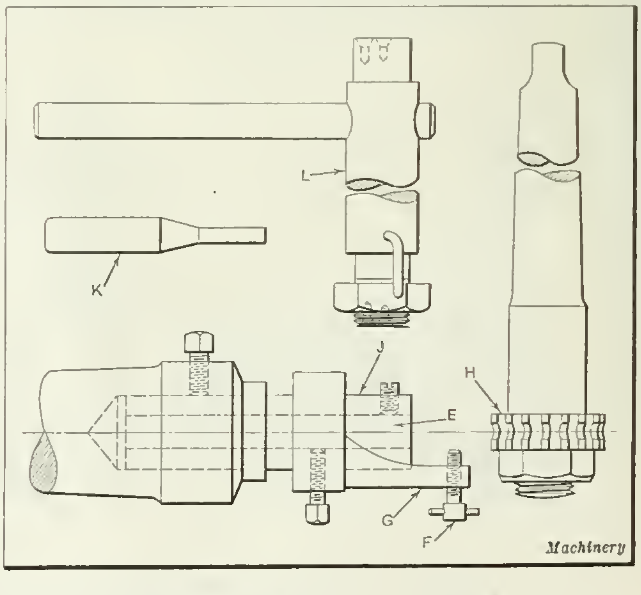
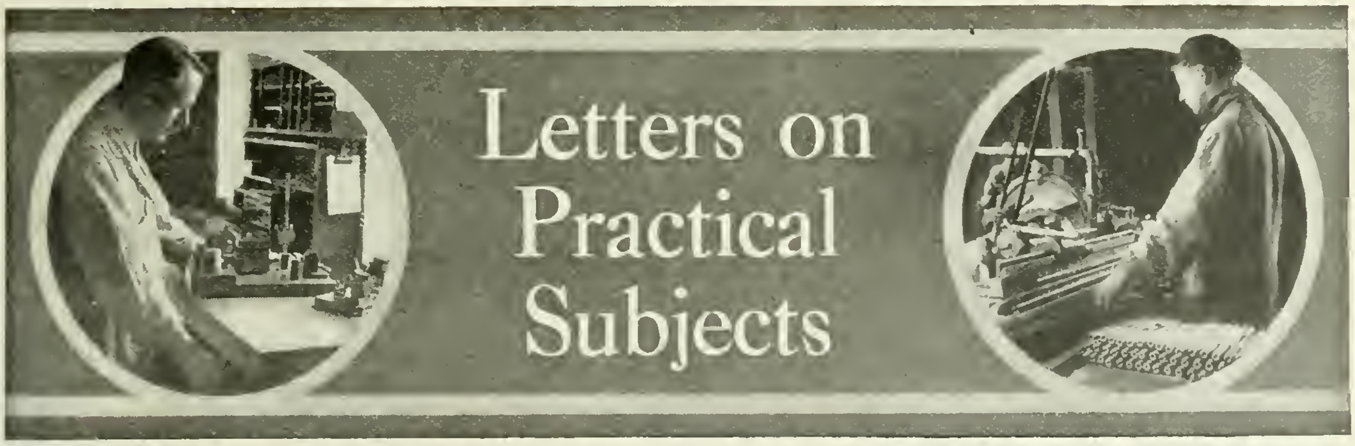


Fig. 2. Tool Equipment used in making Punch shown in Fig. 1



Letters on Practical Subjects

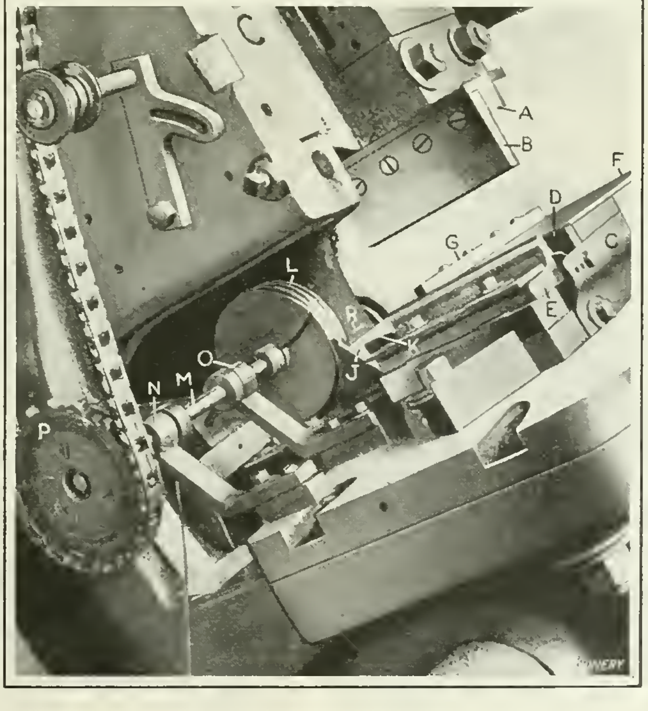
CUTTING OFF AND STACKING ATTACHMENTS FOR POWER PRESS

The press equipment shown in the accompanying illustration is designed to cut off and stack the blanks from which cylindrical tin boxes are made. The strip stock which is cut up to form blanks of the required dimension is lithographed on one side. The machine that forms, side-seams, and locks the seamed sides of a blank together to form the cylindrical part of the box has an automatic magazine feed. In order to insure the proper functioning of the feeding mechanism of this machine, it is essential that the tin blanks be uniform in width and that they be evenly stacked. The blanks, when stacked, must all face one way, so that the lithographed surface will be on the outside of the completed box.

As shown in the illustration, the press equipment for cutting off the blanks consists mainly of the machine-steel shear-holder *A*, the upper shear blade *B*, the casting *C*, which contains the lower tool-steel blade *D*, and the angle-iron stop *E*. The 1/8-inch plate *F* is secured to the top of casting *C* and serves as a table. The cold-rolled steel strip *G* guides the stock when it is fed to the shears. The casting *C* is machined or cut down on the back side to form a table on which the blanks are stacked. A cold-rolled steel strip *J*, attached to the edge of this shelf acts as a stop for the blanks as they slide down the chute, which is located below stop *E*. The strip *J* also forms a pocket for the stacked blanks.

The sheet-metal guide *K* is bent so as to bring the blank up on its edge when it slides down the chute, thus guiding it into the deep thread groove of the conveying worm *L*, which is pinned to shaft *M*. Shaft *M* is supported by the bearings *N* and *O* and is revolved by the sprocket *P*. Sprocket *P* is driven by a chain connected to a sprocket on the crankshaft of the press. The thread of the conveying worm is so thin and deep that it has more the appearance of a series of thin disks than an actual thread.

When the press is in operation, a strip of the lithographed tin is fed along the table *F* over the shear blade *D* until it comes in contact with stop *E*. The shear *B* then cuts off the blank, which drops into the chute below stop *E*. As the press is inclined backward, the blank slides down the chute on edge and, passing into the thread groove of the conveying worm, is stopped by the strip *J*. The conveying worm then carries the blank sidewise in the direction indicated by the arrow *R*. The blanks are thus stacked in the long pocket at the back of the guide *G*. A block of iron is placed in the pocket to prevent the blanks from falling over. As the blanks accumulate they push this block along the table or pocket. When a sufficient number of blanks has been stacked, the operator transfers them to the magazine of the machine previously mentioned, which performs the seaming and forming operations. The press, when in operation, is equipped with guards which enclose the shears. The guards are not shown in the illustration, as they were removed in order to give a better view of the shears and the conveying worm. When the press is in use the ram operates continuously at a speed of ninety strokes per minute.



Attachments used on Inclinable Power Press for cutting off and stacking Tin Blanks

Brooklyn, N. Y. S. A. McDonald

PERFORATING AND EMBOSSING DIE FOR FIBER PARTS

In Fig. 1 is shown a die for perforating, slitting, embossing and cutting off fiber stock to form the pole piece insulator shown in Fig. 2. The fiber stock from which this part is made is obtained in strips 72 inches long by 3 1/16 inches wide by 0.015 inch thick. The die is used on an inclined press, the stock being guided by the slot in stripper plate *A*. In operation, the stock is fed in from the right-hand side until it strikes the first finger-stop *B*. The punch *C* then perforates the slot in the center of the blank, as shown in Fig. 2, after which finger-stop *B* is released and the stock passed on to the second stop *D*. In this position punches *E* and *F* (see Fig. 3) emboss a rectangle on the blank, as indicated in Fig. 2, while punches *G* which are set 0.020 inch lower than the embossing punches cut four angular slits extending from the small slot to the corner of the embossed rectangle. The slits cut by punches *G* are indicated by dotted lines *H* in Fig. 2.

After the embossing and

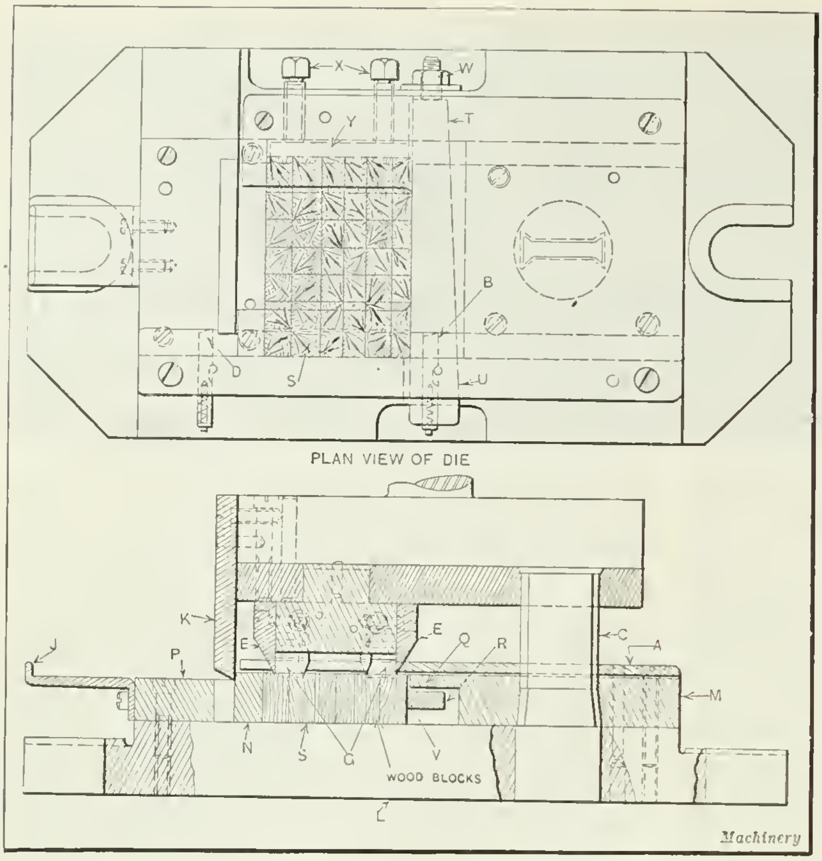


Fig. 1. Perforating and Embossing Die for producing Fiber Part shown in Fig. 2

slitting operation, the stock is fed on until it strikes stop *J*, when it is cut off by blade *K*. The edge of the cutting-off blade is ground at an angle with the face of the die *N*. As the press is inclined, the finished pieces slide out at the back, leaving the die clear so that the stock can be fed forward to permit the next blank to be cut off.

It will be noted that the die *S* is built up of wooden sections sunk into a slot in die-shoe *L*. Block *P* is simply a filler piece. The perforating die *M* has an overhanging ledge *Q* which just clears the wedge *R*. It will be noted that the embossing and slitting operations are performed on the wooden die or base *S* which is so constructed that the punches *G* enter the blocks on their ends or cross-sectional surfaces. Wedge *R* bears against the die-holder at points *T* and *U* and against the wooden blocks at *V*. When nut *W* is tightened, the wooden blocks of die *S* are clamped against block *N*. Clamp *Y*, being acted upon by set-screws *X*, also exerts a clamping action on the wooden blocks. The reason for making up this die of a number of small wooden pieces is that a more compact surface is obtained and at the same time there is sufficient "give" for the slitting punches to perforate the wood deep enough so that the embossing punches can perform their work.

Brooklyn, N. Y. JOHN A. HONEGGER

SIMPLE METHOD OF TESTING LUBRICATING OIL

The following method of testing lubricating oil should be of interest to purchasing agents and engineers of manufacturing plants where the services of a chemist are not available. It is important that lubricating oils be free from acids, that they have the proper body, and that they be free from gum. To test for acids, pour some of the oil in a glass, together with a small quantity of litmus solution, and heat the glass in warm water. If the solution turns red, it indicates that there is acid in the oil. If it remains blue, the oil contains practically no acid

In order to examine the oil for "body," take a long piece of glass and place it in a slanting position. Pour some drops of the oil to be tested on the highest point of the glass. It is obvious that the oil which runs the farthest is that which contains the least body. To test for gum, allow the oil in the second test to stand for a few hours. Then proceed to rub the oil off. Should the oil feel sticky, it indicates that it is mixed with plant or gum oil which is detrimental to the machinery.

Groveside, Hoosick Falls N. Y. LAWRENCE E. OLSEN

DIE FOR SLOTTING SIDES OF COIL SPRING

The die shown in the accompanying illustration is used to cut slots in the sides of a coil spring. The spring is shown in the upper left-hand corner of the illustration and also in the die at *X*, by heavy dot-and-dash lines. The slots are cut by two punches *A* and *B*, which are staggered so

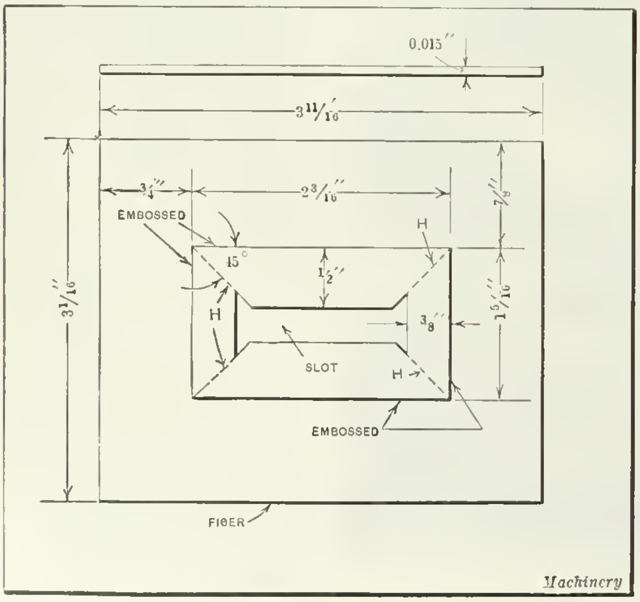


Fig. 2. Fiber Pole Piece produced in the Die shown in Fig. 1

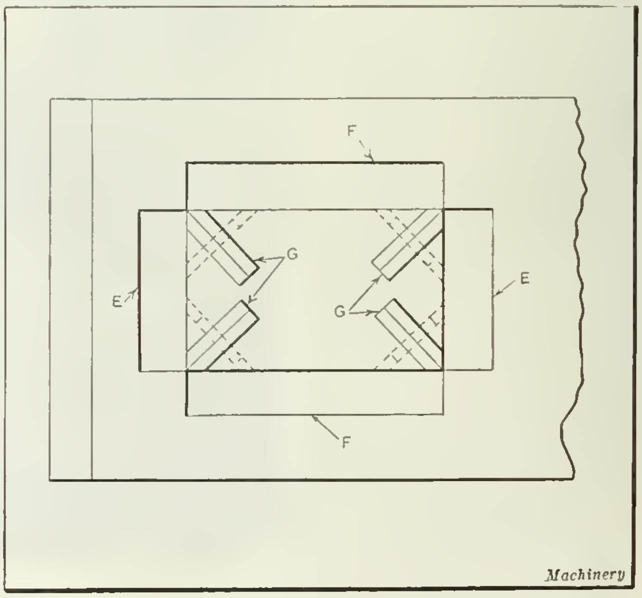
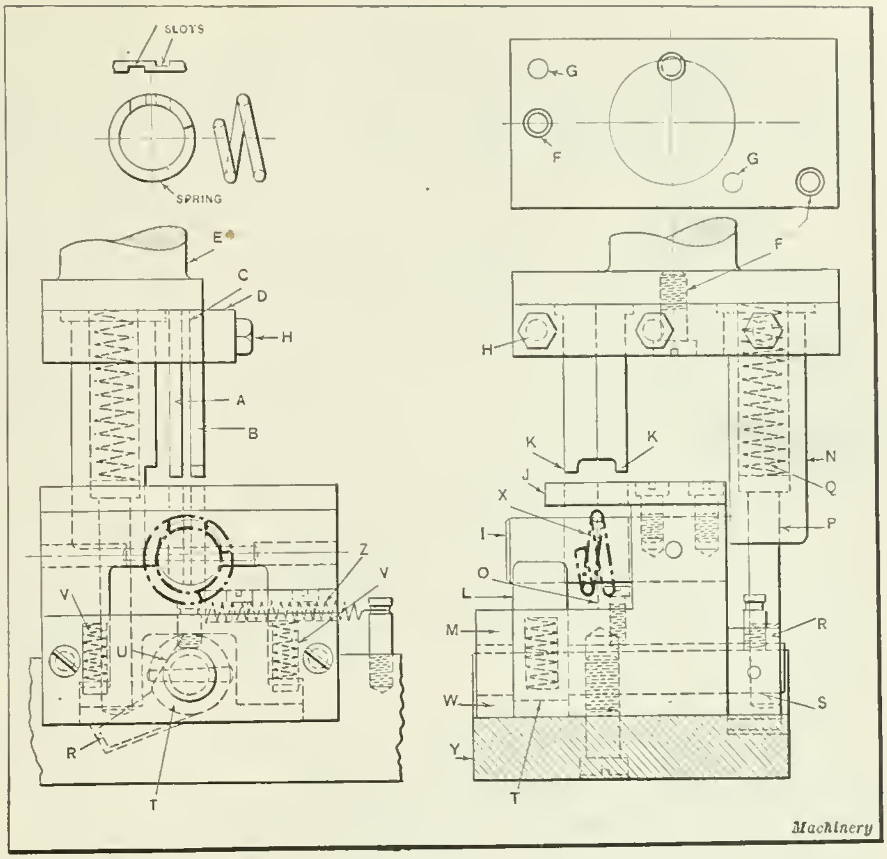


Fig. 3. Diagrammatic Plan View of Slitting and Embossing Punches

that one cut is made on each side of the spring stock. The punches are held in the block *C* by means of a clamp *D*. Block *C*, in turn, is held to the holder *E* by screws and dowels *F* and *G*, while screws *H* are employed to tighten the clamp. The spring is slipped over the arbor *I*, which has a groove on its upper side. This groove locates the work while the slots are being cut. The arbor is also slotted to serve as a die.

A plate *J* guides and backs up the punches. The punches are provided with steps *K*, so that they will be backed up by the arbor before coming into contact with the work. When the work is placed on the arbor, block *L* is in the lowered position, which it automatically assumes on the up stroke of the press. Various parts of the block lowering and raising mechanism are contained in the steel block *M*. The block-raising device is actuated by plunger *P*, which is backed up by spring *Q*. Plunger *P* is held in a sleeve *N*, which is attached to block *C*. As the punch-holder descends, plunger *P* comes in contact with a pawl *R*, which is attached to a short stud *S* by means of a pin. The head *T* of stud *S* has a flat *U* milled on one side which acts as a cam to raise block *L*. Block *L* is slotted so that it fits over the head *T* of the stud, with which it is held in contact. This contact between the two members is maintained by springs *V*. As pawl *R* is pushed down by plunger *P*, it causes block *L* to be raised into contact with the arbor *I* by means of the lift or cam surface *U*. Thus it will be apparent that block *L* braces the outer end of the arbor while the punches *A* and *B* are cutting the slots in the spring. The plate *W* serves to support the outer end of stud *S*. Block *M* is attached to the shoe *Y*, which is grooved out to receive it.



Die used for cutting Slots in the Sides of a Coil Spring

In operation, plunger *P*, on the down stroke of the press, pushes pawl *R* completely down so that block *L* will be raised into the arbor-supporting position, after which the continued downward movement of the ram causes spring *Q* to be compressed. A spring *Z* attached by a grooved pin to pawl *R* and to the base of the casting, exerts a pull on the pawl, thereby allowing block *L* to be pushed back clear of the arbor by the springs *V* on the upward stroke. Sleeve *N* is flattened on one side to provide clearance for block *M*. It is simply necessary to put the work on the arbor and remove it after the down stroke. A plate *O* is used to locate the work, the end of the spring being placed in contact with this block. As the punch ascends, all parts return to the inoperative position and the operator replaces the slotted spring by a new piece of work. As the two cuts balance each other, they have a tendency to prevent the spring from twisting.

H. M.

IMPROVISED ATTACHMENT FOR BEVEL GEAR CUTTING

Two bevel gears were required in the construction of a new machine developed at a certain plant. As the plant was not equipped for cutting the gears, it appeared that they must be purchased or that a machine cutting them

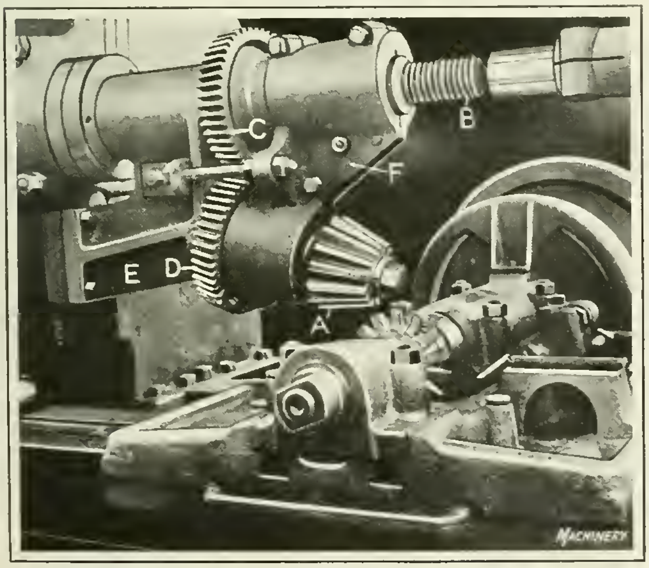


Fig. 1. Attachment for cutting Bevel Pinion on Spur Gear Machine

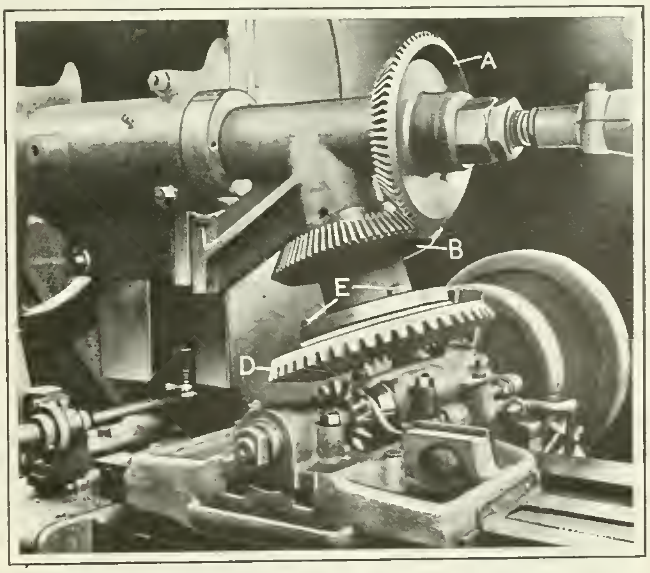


Fig. 2. Attachment for cutting Bevel Gear for Pinion shown in Fig. 1

must be added to the shop equipment. The first plan, that of purchasing the gears, did not appeal to the management, as it was the practice to manufacture all parts at the plant. The second plan did not seem feasible, because the newly developed machine on which the gears were to be used had not been on the market for a sufficient length of time to show that the demand for it would warrant the purchase of new equipment.

The problem was finally solved, however, by designing and making the bevel gear cutting attachments shown in the accompanying illustrations. These attachments were designed for use on a Gould & Eberhardt spur gear cutting machine. The bevel pinion *A* shown in Fig. 1 has fourteen teeth, and the mating gear shown at *D* in Fig. 2, has forty-eight teeth. The teeth are 2½ diametral pitch, making the pitch diameter of the large gear 19.2 inches, and that of the pinion 5.6 inches. The attachment for machining the pinion *A*, Fig. 1, consists of an arbor *B*, which is fastened to the head of the gear-cutting machine and driven by it in a manner similar to that employed in machining a spur gear. Fastened to the arbor is a gear *C* which meshes with another gear *D*. The second gear is fastened to the work-shaft which is supported by brackets *E* and *F*. The angle that the center line of the pinion arbor makes with the horizontal or the line of travel of the cutter is 15 degrees 15 minutes.

In Fig. 2 is shown the attachment used in cutting the teeth in the bevel gear. It will be noted that this device is similar in construction to the attachment used in cutting the pinion. The angle between the axes of gears *A* and *B* is such that the angle formed by the axis of gear *D* with the horizontal is 74 degrees 45 minutes. This angle, it will be noted, is complementary to the pinion angle. Gear *D* is held to the flanged end of gear *B* by bolts *E*. The gear-cutting attachments described gave excellent results and were used for several weeks until orders for the new machine on which the bevel gears were used warranted the purchasing of a standard bevel gear cutting machine.

Providence, R. I. ROBERT MAWSON

DEGREE OF CURVATURE

The term "degree of curvature" is not clearly understood by the majority of mechanical draftsmen as its use is confined chiefly to railroad practice. Consequently, many mechanical draftsmen are at a loss as to how to proceed to lay out a curve of a given degree of curvature unless there is available a table of corresponding radii, or a railroad curve with the required degree of curvature and the equivalent radius stamped on it. Briefly, the degree of curvature is the angle at the center of the curve subtended by a chord 100 feet in length. Thus it is evident that the greater the radius the smaller will be the degree of curvature, and vice versa.

The problem of determining the radius for a given degree of curvature is one of simply finding an equation that will give the hypotenuse of a right-angled triangle having an included angle equal to one-half the degree of curvature, and the short side equal to one-half the chord length, or 50 feet. Letting *D* equal the degree of curvature and *R* the required radius, we have the formula,

$$R = \frac{50}{\sin\ (D \div 2)}$$

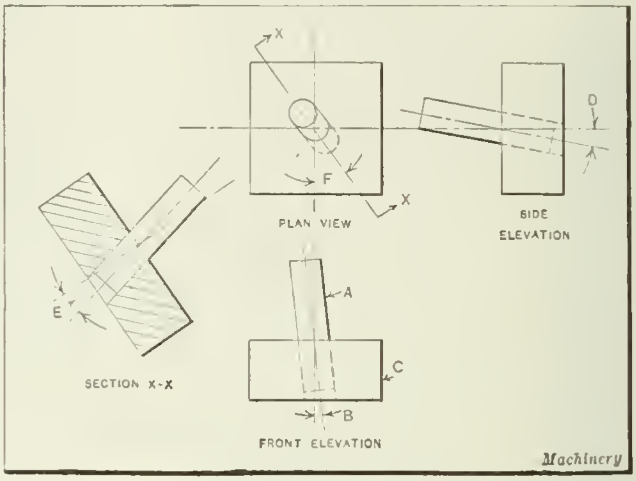
Thus, for example, if we desire to find the radius *R*, in feet, of a curve having a degree of curvature of 25 degrees, we have:

$$R = \frac{50}{\sin\ 12\ \text{degrees}\ 30\ \text{minutes}} = \frac{50}{0.21544} = 231.01$$

Baltimore, Md. HENRY R. BOWMAN

CALCULATING RESULTANT ANGLES

Draftsmen and machine designers sometimes find it necessary or desirable to calculate what is commonly termed "the resultant angle." This problem is frequently met with in making drawings for automobile and airplane parts. A clearer understanding of the problem, as it is encountered in practice, will be obtained by referring to the accompanying illustration. Suppose, for instance, that pin *A* is set at a given angle *B* with respect to the block *C*, as shown in the front elevation view. Now assume that pin *A* is also tilted to another given angle *D* in a different plane, as indicated in the side elevation. It is evident that the resultant angle *E* must be known by the workman in order to enable him to drill the hole for pin *A* at the correct angle in the plane of section *X-X*. First it is necessary to calculate angle *F* from the given angles *B* and *D*. When this angle has been determined, the draftsman can lay out the plan view quickly and with greater accuracy than would ordinarily be obtained by the projection method. It might be mentioned here that similar calculations are required in determining the position and the angle of inclination of the edge that is formed by two converging sides of a pyramid or wedge.



Resultant Angle Problem

Referring to the accompanying illustration, let it be assumed that the front and side elevations showing the pin and block have been drawn and that the draftsman has also drawn the plan view of the block. In order to show the pin in the plan view, it is necessary to determine angle *F*, after which angle *E* may be readily calculated. The formulas for obtaining these angles are,

$$\text{Tan}\ F = \frac{\tan\ B}{\tan\ D}$$

and

$$\text{Tan}\ E = \sqrt{\tan^2 B + \tan^2 D}$$

As an example showing the use of these formulas let it be assumed that angle $B = 7$ degrees and angle $D = 10$ degrees. (See illustration.)

Then

$$\text{Tan}\ F = \frac{\tan\ 7\ \text{degrees}}{\tan\ 10\ \text{degrees}} = \frac{0.12278}{0.17633} = 0.69631$$

Thus

$$F = 34\ \text{degrees}\ 51\ \text{minutes}$$

Now

$$\text{Tan}\ E = \sqrt{\tan^2 7\ \text{degrees} + \tan^2 10\ \text{degrees}}$$
$$= \sqrt{0.12278^2 + 0.17633^2} = 0.21487$$

Therefore

$$E = 12\ \text{degrees}\ 7\ \text{minutes}$$

Cleveland, Ohio EDWARD HELLER

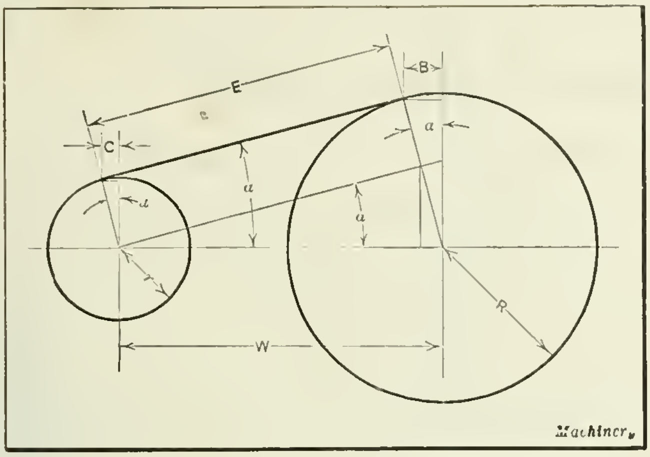


Fig. 1. Diagram used in finding Dimension E

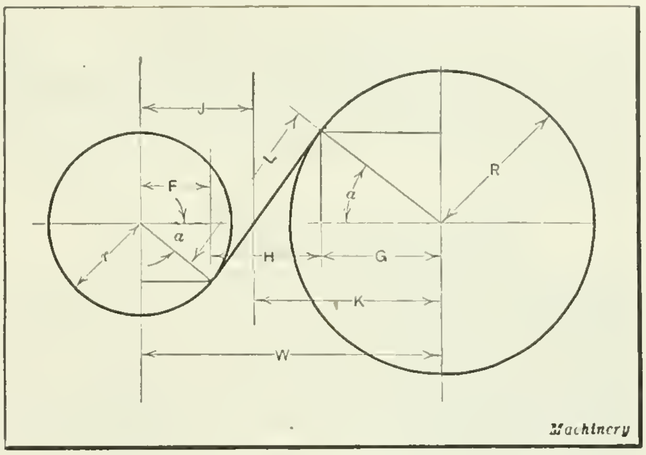


Fig. 2. Diagram used in calculating Dimension L

DETERMINING LENGTH OF TANGENT TO TWO CIRCLES

In tool-room work it frequently becomes necessary to determine the length of a tangent to two circles. Referring to Fig. 1,

R = radius of large circle;
r = radius of small circle;
W = center distance between circles; and
a = angle formed between the tangent and the horizontal center line.

With the values given it is required to find the following:

E = length of tangent;
B = length of horizontal line from point of tangency on large circle to the vertical center line; and
C = length of horizontal line from point of tangency on small circle to the vertical center line.

Now by trigonometry,

$$\text{Sin } a = \frac{R - r}{W} \text{ and } E = W \cos a$$

$$B = R \sin a \text{ and } C = r \sin a$$

When the tangent crosses a line passing through the centers of both circles, as shown in Fig. 2, the solution is somewhat different. In solving the latter problem let

R = radius of large circle;
r = radius of small circle; and
W = center distance between circles.

The dimensions that are required to be found are:

L = length of tangent;
F = length of horizontal chord from point of tangency on small circle to the vertical center line; and,
G = length of horizontal chord from point of tangency on large circle to the vertical center line.

By trigonometry we have

$J = r \sec a$; $K = R \sec a$; and $W = J + K$; or by substitution,

$$W = r \sec a + R \sec a = (r + R) \sec a$$

Now

$$\text{Sec } a = \frac{W}{R + r}$$

Also

$$F = r \cos a \text{ and } G = R \cos a$$

By subtraction,

$$H = W - F - G$$

Hence

$$H = W - r \cos a - R \cos a$$

or

$$H = W - (R + r) \cos a$$

Then, $L = H \operatorname{cosec} a$

By substitution, $L = [W - (R + r) \cos a] \operatorname{cosec} a$

These formulas are of considerable value in laying out complicated profile gages.

Flint, Mich. W. G. Holmes

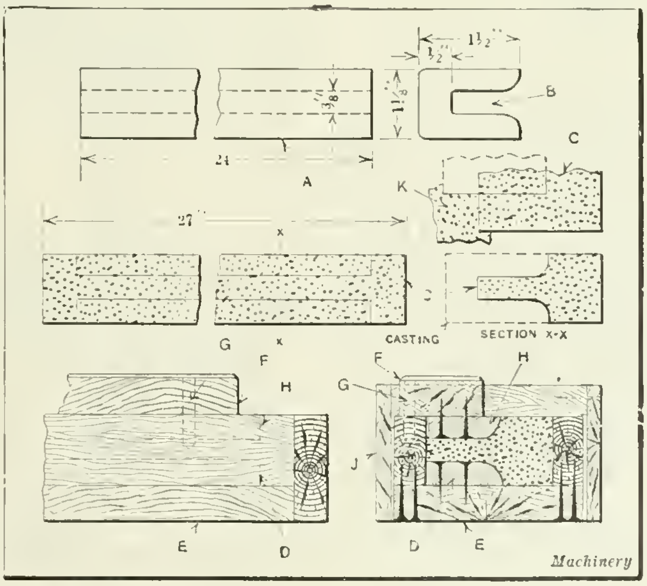
MAKING STEEL CASTINGS WITH LONG STRAIGHT SLOTS

Steel castings of the shape shown at *A* in the illustration are used in the construction of a certain type of monorail hoist. These castings are generally cut into short sections, 3, 3½, and 4 inches in length, as conditions demand. It is necessary that the slot *B* in the castings, as well as the casting itself, be straight and smooth. Slot *B* in the first lot of castings made was formed by using a flat slab core, but this method proved rather expensive, as considerable grinding was necessary to round the corners of the slot. The patterns were therefore changed so that a core of the shape indicated at *C* could be used, thus eliminating the grinding operation.

The first cores of this type to be used were made up by pasting two half cores together. This method of making a full core was unsatisfactory because of the difficulty of obtaining straight and flat core-drying plates. The concave and convex surfaces on the half cores formed by the uneven surfaces of the core-drying plates made it impossible to obtain a true straight core by pasting two halves together. To overcome this difficulty, the full core-box shown in the lower right-hand corner of the illustration was developed.

The piece *D* is fastened to the core-box *E*. The loose piece *F* is located and held in position on box *E* by the dowel-pins *G*. Piece *H* is fastened to *F* as indicated. The plain frame *J*, which has sides and ends only, is a loose fit around the outside of the core-box *E*. The sides of the frame *J* extend ½ inch above box *E*. The pattern proper (not shown in the illustration) is a plain rectangular piece, cut away at the corners to leave a square section *K* at each end of the mold. These square sections serve as stops or locating surfaces for the core *C*.

In molding the core, frame *J* is removed and the core sand filled into the slot by hand, and struck off in the usual manner. The loose

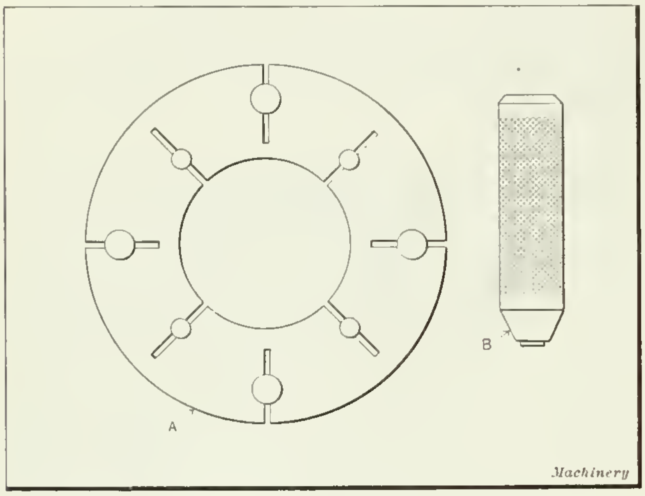


Method of making Straight Cores for a Slot in a Steel Casting pieces *F* and *H* are then lifted off. Frame *J* is next placed over the core-box in the position shown, and black or molding sand filled in and struck off even with the top of the frame. The finished core is rolled over on the drying plate, after which the frame *J* and core-box *E* are removed. The core then rests on the black sand base, ready for baking.

Kenosha, Wis. M. E. Duggan

RENEWABLE PLUG GAGES

Plug gages used for checking ground holes are worn down rapidly by the abrasive left on the work. Consequently the maintenance of gages for this kind of work is a source of considerable expense in some plants. In order to reduce this expense, an adjustable or renewable plug gage was designed which eliminates the necessity for scrapping the gage when it has been worn so that it is slightly under size. A gage of the renewable type is shown at *A* in the accompanying illustration. It will be noted that slots are cut at intervals around the edge and that taper pins are provided to permit the slotted segments to be expanded.



Plug Gage that can be expanded when Worn and relapped to Size

When the gage has been worn under-size the taper pins are driven into the gage and the outside lapped down to size. When in use the gage is fitted with a handle. A punch such as shown at *B* is provided for driving the pins into the gage. This punch was designed to drive each pin in the same distance, in order to insure uniform expansion. The projecting points of the taper pins are ground off flush with the body of the gage after being set. Alternate pin-holes are tapered from opposite sides.

Rochester, N. Y. George C. Hanneman

PLANING SIDES OF DEEP RECESS

Occasionally work having a deep recess, like that shown at *A* in Fig. 1, is sent to the planer to be machined. Here difficulty is often experienced in planing the sides of the recess. Tools of the usual type having sufficient length to reach the bottom of the recess are too springy and cannot be relied upon to do accurate work. Gooseneck tools have been used to a considerable extent for this kind of work, but they are generally unsatisfactory. The arrangement shown in Fig. 2 for planing the sides *B* and *C* of the recess in the trunnion bearing casting shown in Fig. 1 proved very satisfactory. The rigid manner in which the tool-bar *D* was secured enabled the sides of the recess to be planed parallel and accurate within the close limits demanded.

The special holder *F*, Fig. 2, is split and provided with a clamping screw which enables the bar *D* to be held firmly in place. The upper end of holder *F* is turned down to a nice fit in the hole in the square block *E* which is secured to the clapper-box. This construction permits no vertical movement, but allows bar *D* to be pivoted in a horizontal plane. The rear support for the tool-bar consists of a trunnion sleeve *G* mounted in two bearings *H* and *J* which, in turn, are bolted to a cast-iron cross-piece *K*. The cross-piece is rigidly secured to the rear of the planer housing. The rear bearing also permits a horizontal movement and allows the bar to be slid in and out, but does not permit a vertical movement. The two bearings were carefully tested for even height before sliding the bar *D* into place. All feeding movement of the tool in a vertical direction is done by loosening the set-screw *N* and adjusting the tool itself. The regular cross-feed of the planer head is used, to feed the tool across the face of the work, the bar *D* being swung from the position indicated by the dotted lines at *L* to that indicated by the dotted lines at *M*, in the upper view.

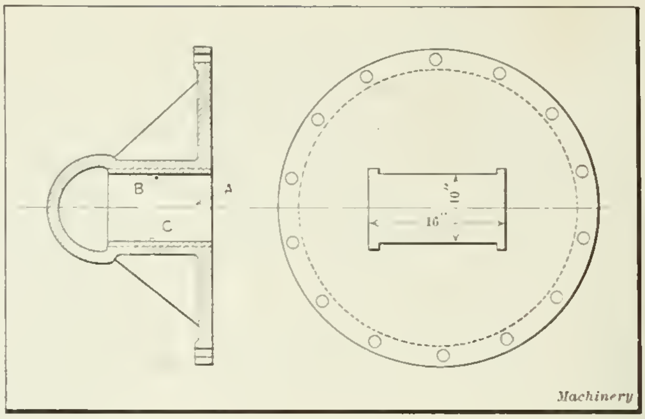


Fig. 1. Casting with Deep Recess machined on Surfaces B and C

Allentown, Pa. Joe V. Romig

* * *

Statistics of the Department of Commerce covering automobiles for 1921 indicate that of the 1,435,000 passenger cars built, 968,000 sold for $800 or less; 298,000 sold for from $800 to $1500; 128,000 sold for from $1500 to $2500; 33,300 sold for from $2500 to $3500; and 7870 were sold at a price above $3500. About 147,000 motor trucks were built, of which 27,000 were of ¾ ton capacity or less; 96,000, from 1 to 1½ tons; 16,500, from 2 to 3 tons; 6420, from 3½ to 5 tons; and 1100, over 5 tons.

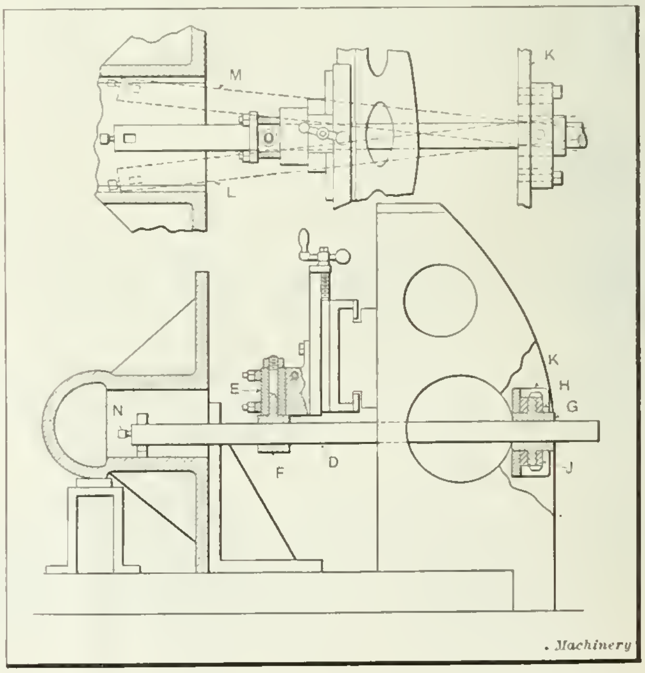


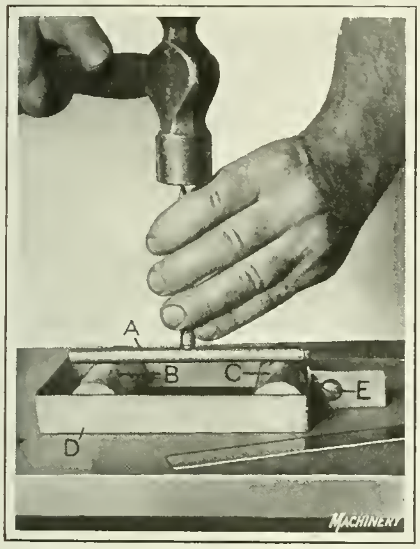
Fig. 2. Planer Set-up for machining Work shown in Fig. 1

Shop and Drafting-room Kinks

STRAIGHTENING SMALL SHAFTS

The fixture shown in the accompanying illustration was designed for use in straightening small shafts such as the one shown at *A*. Many of the shafts were bent slightly in one place only, while others were bent in two and some even in three places in a length of approximately 6 inches. While the work did not call for extreme accuracy, the shafts were required to be straight in the generally accepted sense of the word.

The straightening fixture consists simply of two pieces of round cold-rolled steel *B* and *C* enclosed by a strip of sheet metal *D*, the ends of which are brought together and secured with a machine screw *E*. A V-groove is cut in the middle of each roll to hold the shaft in place while it is being straightened by means of a hammer and punch. A flat plate held at a convenient distance above the bench is used to test the shafts for straightness. As the shafts are rolled along this flat plate, any bends are easily detected by a "light" test.



Method of straightening Small Shafts

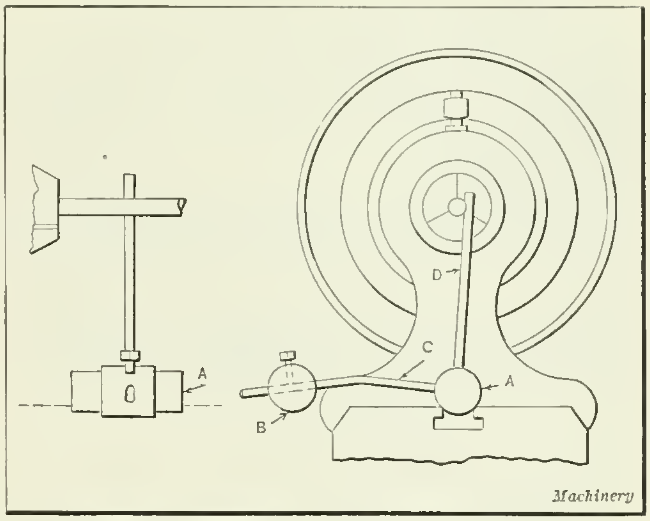
After marking the bent places on the shaft with chalk, it is placed in the vees of the rollers to be straightened. The rollers are then rolled in or out the required amount to permit proper straightening, as determined by the chalk lines. For instance, if a shaft were bent at one end in one direction and in the opposite direction at the other end, the rollers would be brought together to support the shaft at each side of one bend for the first straightening operation, after which the rolls would be rolled further apart to permit the whole length to be straightened. It will be noted that the large end of the punch is placed in contact with the work when straightening a shaft. The fixture shown was quickly made up and it answered the purpose remarkably well.

Rosemount, Montreal, Canada HARRY MOORE

BENCH LATHE STEADYREST

Most toolmakers who have ground small cylindrical pieces on a bench lathe with the work held in the draw-in collet have experienced difficulty in obtaining a good finish that is devoid of chatter marks. The accompanying illustration shows a simple steadyrest that has been found of assistance in overcoming this difficulty.

The part *A* is made of machine steel and is about ¾ inch in diameter by 1⅜ inches long. A piece of machine steel *B*, about ¾ inch in diameter by ¾ inch long is adjustably mounted on rod *C*. Thus the pressure exerted on the work by the arm *D* can be easily adjusted to counteract the pressure of the grinding wheel by moving weight *B* in or out as conditions require. The part *A* simply rests in the T-slot in the bench laid bed. When new work is to be inserted, the whole steadyrest outfit can be easily laid aside. D. R. G.

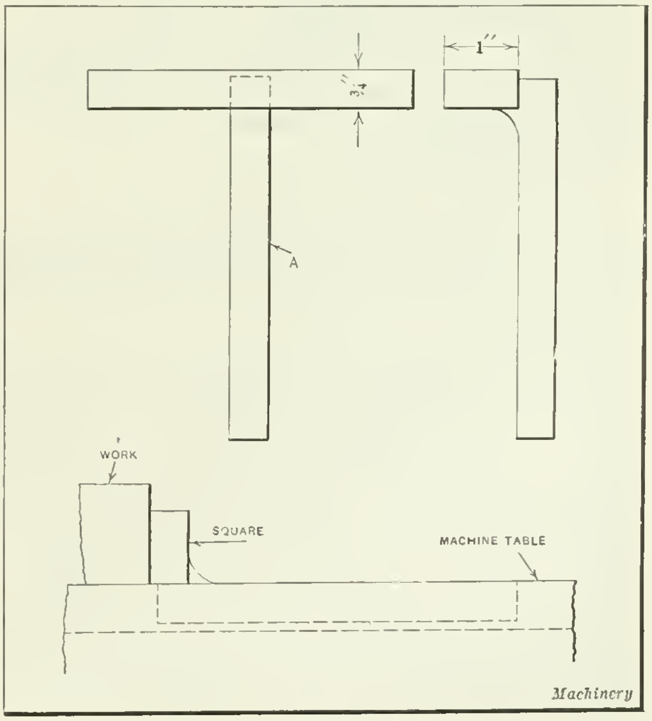


Steadyrest used in grinding Small Cylindrical Work on a Bench Lathe

MACHINE SQUARE

The simple tool shown in the accompanying illustration is designed for use in squaring up work on machine tool tables. It is hardened and ground, and will remain accurate for a long time, as it is forged in one piece. The lower part *A* is made to fit the T-slot in the machine tool table. The dimensions given in the illustration are for a light machine square suitable for use in the tool-room. Larger sizes adapted for use on heavy machine tools will also be found useful. The lower view in the illustration shows clearly the method of using the square.

Ontario, Cal. CHARLES HOMEWOOD



Square for locating Work on Machine Table

Questions and Answers on Practical Subjects

SHADED LINES ON DRAWINGS

E. R. P.—What is the present practice regarding the use of shaded lines on machine drawings? At one time most of the leading machinery manufacturers seemed to favor shading. While it requires a little longer to make a shaded drawing, it seems to me that this slight additional expense is well worth while.

A.—Very few working drawings are shaded at the present time. While it is true that shading does make some drawings clearer, the advantage in this respect is slight in most cases, and is not considered worth while by a large percentage of the machinery manufacturers in this country. This applies to detail or working drawings particularly. Assembly drawings are sometimes shaded, especially when they are to be used for purposes of illustration. Patent Office drawings are also shaded, as well as the line illustrations used in many technical periodicals and books.

CHECK MARKS ON STEEL TOOLS

J. A. P.—When grinding high-speed steel tools very small cracks or check marks sometimes appear on the surface. What is the cause of this and how can it be prevented?

A.—The cracking or checking which sometimes occurs when grinding high-speed steel tools is attributed to the use of cooling water while rough-grinding the tool, especially if excessive pressure is applied. The water, playing upon the steel which is quite hot at some points due to the friction, is said to cause the minute cracks or check marks. A method of avoiding this difficulty is to rough-grind the tools on a dry wheel before hardening. The tool is rough-forged approximately to the required shape, and it should preferably be ground slowly at first until the steel has been heated somewhat; then the grinding may be done quite rapidly without injuring the tool, but water should not be used during this preliminary grinding.

IS AN UNREGISTERED TRADEMARK VALID?

M. L. H. Co., Inc.—We have been using a trademark for the last few years, but have failed to have it registered in the U. S. Patent office. Are we protected, and what is the value of a trademark?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

You have a right to your trademark under the common law, but when registered you have *prima facie* evidence of ownership. The decision of one U. S. Court, should litigation develop, will in most cases be given full credit in all of these courts.

The value of a trademark consists of an assurance to a manufacturer or merchant of protection in the exclusive use of the name, sign, or symbol, by which his product becomes known. The trademark is a guarantee of the genuineness of the marketed article, and may be said to be, in this respect, the commercial substitute for an autograph. The trademark distinguishes the goods of one manufacturer or merchant from those of another. Thus he is enabled to secure such profits as result from a reputation for superior skill, industry, or enterprise, or from the expenditure of large sums of money for advertising purposes. The protective value of the trademark may be compared with the protection afforded by a fundamental patent, as the trademark is used not only in connection with patented articles, but also with commodities not patented nor patentable.

TENSILE STRENGTHS OF DIFFERENT MATERIALS

G. H. T.—What is the tensile strength of ordinary cast iron, and how does it compare with semi-steel? Also please give the tensile strength of steel castings and steel forgings.

A.—The tensile strength varies considerably for different compositions, especially in the case of steel, and should be determined by actual test when accuracy is essential. The following figures are intended only as a general guide and represent values commonly used in design when adequate factors of safety are allowed and the exact value for the tensile strength is not necessary.

The tensile strength of gray cast iron is ordinarily given as 15,000 pounds per square inch. Semi-steel may be anywhere from 25 to 60 per cent stronger than gray cast iron. Some semi-steels may have 10 per cent of steel, whereas others have double this amount, which affects the strength decidedly.

The tensile strength of steel castings ordinarily varies from 60,000 to 80,000 pounds per square inch. In fact, these are the minimum and maximum figures for the three grades of steel castings specified by the American Society for Testing Materials.

As to steel forgings, the strength ordinarily ranges from 75,000 to 90,000 pounds per square inch, although these values are subject to considerable variation, since they depend upon the kind of steel and may also be decidedly affected by changes in physical properties due either to forging processes or heat-treatment.

BENDING BUTT-WELDED PIPE

M. L. F.—When bending butt-welded pipe, should the seam be at the side of the bend in preference to the inside or outside of the curve? When the seam is on the outside of the curve it is where the greatest stretching of the metal occurs, but one contention is that since this stretching is in line with the seam, there is less tendency to cause rupture than when the seam is at the side of the bend.

A.—This question was submitted to a prominent manufacturer of pipe and tubing, and the following information obtained.

The general practice in bending butt-welded pipe is to have the seam at the side of the bend. This is based on the assumption that in making a bend, the neutral axis is midway between the inner and outer curves, and therefore this part of the pipe is not subjected to extension or compression while bending. If the method of bending or the equipment used conforms to the assumption referred to, then the foregoing rule is correct; but in actual practice there is more or less deviation, depending on the type of equipment and the nature of heating. For example, it has been found in some experiments in making hot bends according to the best practice, that curvature is more the result of compressing the material on the inside then stretching it along the outer curve. In such cases, the neutral axis would lie somewhat outside the center line. One manufacturer, who has been very successful in making bends, lets a stream of water flow over the outer curve, while making a hot bend, so that practically the entire bend is obtained by compressing the material. This is considered good practice, since there is a minimum stretching and thinning of the pipe wall. When this method is employed, the seam should be along the outer curve because in any other position there would be a tendency toward buckling or shearing stresses which might result in splitting.

CHECKING DRAWINGS

By WILLIAM H. KELLOGG

The detection of errors in a complicated detail drawing requires extreme care on the part of the checker. Even the most proficient find it difficult to locate all the errors without making a systematic and painstaking search. With reference to checking lists, the writer might mention that he read with interest the article "List for Checking Drawings" in May Machinery on page 739. The practice described in the present article, which relates to the same subject, is not intended to be taken as a hard-and-fast rule, but it covers several points that the writer's experience has proved desirable. It is the writer's belief that when a good rule or program is once mastered by a worker in any line it is not necessary for a written outline to be kept constantly before him. Nevertheless, a good method of checking must consist of a complete program covering various classes of investigation. It must be so arranged that when completed every practical point involved in the drawing will be covered.

The most difficult errors to detect are those of omission. A mistake in dimensioning may be found by checking the figures carefully, but if the dimension does not appear at all, the omission may escape the checker's notice. For this reason any method of checking should include some provision for detecting errors of this nature. Obviously the best plan of procedure is to have a tabulated list of every important point that must be considered. These points should be grouped in a number of general divisions or classes of information, all of which go to make up the substance of the completed drawing. Each division should have a definite heading, and the entire list, although compact, must include every item that a drawing of a machine detail may contain.

The most common class to be considered in the list is that of dimensions which pertain to the body of the piece, but two other important items which may often be overlooked, are the shape or general outline of the piece and the connection or interference with other parts of the machine. This is perhaps the part of the work on which the draftsman puts most of his time, and it would be well to consider it first. In this connection, such points as pertain to molding and machining should be given careful attention.

Check List to be Memorized

The tabulated list might well be arranged in the following order: Outline of the piece and general design; finish marks or notes calling for finish all over; dimensions of the body of the piece, excluding items covered by the following class: specifications for holes and slots, including such information as required for drilling, reaming, tapping, sawing, keyseating, cutting special threads, and cutting gear teeth, etc. At this time it is also best to see that specifications for screws, bolts, and other parts are correct and listed either on the drawing in question, or in their proper place on another drawing, or in the stock list. This investigation should, of course, be arranged in accordance with the regular procedure of the concern where the work is done. The next point to be checked might be classed as special treatment, covering such operations as hardening and heat-treating, nickeling, enameling, and possibly other processes of a similar nature. Following this it should be noted if the material is correctly specified; number of parts required noted; identification or name of piece. The latter includes such items as appear in the title space—the date, scale, drawing number, name of machine or detail, and the signature of the draftsman and checker. All information on the drawing pertaining to bolts, screws, number of pieces, material, etc., should be checked in connection with the stock list or bill of material, and the assembly drawing. The pattern and part numbers should receive attention, as well as references to other drawings with their correct numbers.

The foregoing list covers the general scope of work performed on any machine detail, and when thoroughly comprehended and memorized, it becomes a program that the checker will automatically follow out without reference to the printed list. It then becomes a guide that will serve to guard the checker against all errors, as he will mentally go over all the details. Thus his mind is relieved of many worries that generally arise from going over the work in a more haphazard way. The time spent in going over the list mentally is very small in comparison to the time that might be lost if one of the many details escapes notice.

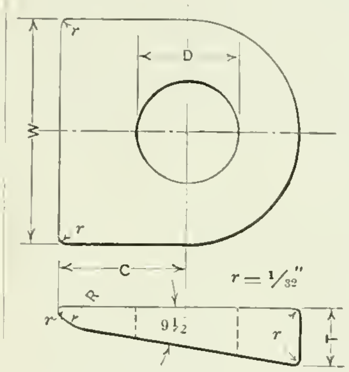
The checking of the dimensions is decidedly the greater part of the whole proceeding, and it is suggested that this part of the work be more fully systematized by a similar method of classification.

* * *

TAPERED WASHERS FOR ATTACHING HANGERS TO I-BEAMS

By MARTIN H. BALL

The attaching of hangers, brackets, auxiliary beams, etc., to structural steel members having 9½-degree tapered sections is greatly facilitated by the use of tapered washers under the heads or nuts of the fastening bolts. The accompanying table gives the specifications for a line of 9½-degree tapered washers for bolts ranging in size from ⅜ to 1 inch in diameter. The washers should be either malleable iron or mild steel castings. By using washers of this type a good bearing surface is provided for both the head and nut of a fastening bolt. The straight thin edge of the washer prevents it from turning and also serves to locate the washer in accordance with standard practice for structural steel.



Dimensions for 9½-Degree Washers

No.	Size	D	C	W	T	R
1	⅜	7/16	⅝	31/32	11/32	¼
2	½	9/16	23/32	1¼	7/16	5/16
3	⅝	11/16	⅞	1½	7/16	11/32
4	¾	13/16	27/32	1¾	½	7/16
5	⅞	15/16	1¼	2⅛	9/16	11/16
6	1	1 1/16	1 7/16	2⅜	⅝	13/16

Machinery

* * *

In a paper on semi-steel recently read before the Institute of British Foundrymen, the author, J. Cameron, briefly reviewed the methods of making a semi-steel, and pointed out its advantages. Semi-steel is made by adding mild steel to the pig iron and scrap in the cupola. The proportion of steel used varies from 15 per cent for light castings to 40 per cent for heavy castings. The resulting metal is a high-grade cast iron with fewer impurities and better physical structure than ordinary cast iron, and while this metal has practically no elongation or ductility, it is stronger than gray cast iron under transverse, tensile, compression, and impact tests, and is superior in elasticity, toughness, and resistance to shock and wear. When properly made, it is close-grained, homogeneous, and free from hard spots and blow-holes. It is greatly superior to gray iron for machinery, and takes on a finer polish, and permits the cutting of clean screw threads. It is especially good for such castings as cylinders, pistons, and gears, and other parts which are subjected to wear and friction.

The Machine-building Industries

IN general, says a banking authority, business men can be divided into three classes: (1) Those interested only in their own factory or office; (2) those interested only in the industry in which they themselves are engaged, and (3) those who have come to realize that not only their own factory, but their entire industry, is completely interwoven in the national business fabric. It is a healthy and encouraging sign of our times that many of those in the first two classes are coming over into the third. It is with this broad and more intelligent view that MACHINERY in its monthly survey of the machine-building industries covers not only the manufacture of machine tools, small tools and shop equipment, but in broad outline, at least, reports for the whole field of industry upon which the prosperity of the machine tool business depends.

A broad review of the industrial situation shows clearly that substantial improvement has been made in the business structure. During the month of October—the last month for which complete statistics are available—substantial increases were made in production in all the basic industries. The production of pig iron and the consumption of cotton were the largest in two years—showing practically normal activities in two widely separated and basic fields of industry. The number of railroad cars loaded reached nearly a maximum, and the car shortage on this account was very severe. There is less unemployment than there has been since the end of the high pressure period in 1920; steel mills, mines, and building contractors report a shortage of skilled labor; and there has been an increase in the hours of work and in overtime employment.

The Department of Commerce notes, as the outstanding feature, the large increase in production in basic commodities, and specifically mentions that the output of pig iron, steel ingots, coke, copper, zinc, petroleum, and cement exceeds that of any previous period since 1920. It is encouraging to note that, notwithstanding many unfavorable conditions, such as coal shortage, car shortage, and delayed freight shipments, the main trend of business continues steadily upward. The export trade for October, including all classes of goods, was the largest for any month since March, 1921, in spite of the fact that exports of iron and steel declined. The liabilities in the business failures in October were lower, with one exception, than during any month since November, 1920.

The Machine Tool Industry

In the machine tool industry a marked improvement developed during the latter part of the year, although December did not bring as many new orders as previous months, due to the pre-inventory period, which always slackens the pace of trade. The railroads have been fairly active in buying machine tools, as have also the railroad equipment companies—the builders of locomotives and cars. The outlook in the railroad field for 1923 is considered good. Orders booked during the past year have been quite numerous, but much smaller as a rule, than during the period from 1915 to 1920. A great many of the inquiries have not yet resulted in orders, and if only part of these materialize, it will mean a lot of business for machine tool manufacturers in 1923. The automobile shops are continuing to buy, but in most cases their purchases are confined to special rather than standard machine tools. Further price advances are expected when conditions improve and the demand makes it possible to take actual costs into consideration.

In the special machinery field there is healthy activity Firms designing special equipment say that their business has shown marked improvement. The demand for gear-cutting machinery is probably better than for most other classes of machine tools, and one of the leading plants in this field runs at two-thirds capacity at least, while another is unable to handle any more business than it has on hand at present, owing to the scarcity of experienced help.

Conditions in the small tool industry continue to improve steadily. Compared with three years ago, the business is, of course, not very active as yet, but in comparison with a year ago it is in very satisfactory shape. Generally speaking, the present year closes with an average amount of business in this field of about double what it was at the end of 1921. Business in metal-cutting and woodworking circular saws is good—a reflection of the activity in the steel mills, saw mills, and woodworking industries.

One of the difficulties the special tool shop still has to contend with is price-cutting by shops determined to obtain work at any cost. In some instances these shops obtain business at an actual loss, because the prices quoted are so low that they barely pay for material and direct labor. In one extreme instance the bids originally varied from $600 to $1100, but the work was finally let at $380.

The Iron and Steel Industry

Unfilled orders on the books of the U. S. Steel Corporation have been steadily rising during eight consecutive months and are now the largest in two years. The corporation operates at over 80 per cent capacity, and although independent steel manufacturers are not doing quite so well, the steel industry leads all other basic industries in recovery from post-war conditions. There are indications that when complete statistics have been compiled for steel production during the past year, the figures will show 75 per cent above 1921, and more than 10 per cent above 1912 and 1913—the two biggest years before the war. Additional blast furnaces which have long been idle have recently been blown in.

The Automobile Industry

The production of automobiles continues with unslackened pace. The October output of 217,000 cars was probably exceeded in November, although complete figures are not yet available. Never before has the automobile industry enjoyed such a volume of sales at this time of the year. The total number of passenger cars built this year will reach nearly 2,400,000; the number of trucks built averages over 20,000 a month. The buying of trucks is scattered among practically all lines of business and over most sections of the country. This activity in the automobile industry is naturally helping automobile parts manufacturers and one maker of automobile axles states that the present volume of business in his line is more than 50 per cent greater than last year. A survey made by one of the associations of manufacturers in the automobile field forecasts a continuance of keen competition during 1923, which will strengthen the well-established, well-managed, and well-financed companies, but is likely to put many of the weaker ones to the final test.

This ends MACHINERY'S series of reviews for the year 1922. From the very beginning, notwithstanding the great uncertainty, 1922 had a hopeful aspect and developed into a real but slow recovery for the industries of America. The political developments making for world peace and tranquility are shaping up for definite settlement in 1923. Who can doubt, with all the factors before him, that 1923 will surely see a great advance in the upward climb of the hill of prosperity?

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

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Davis & Thompson Continuous Drilling, Reaming, and Threading Machine

A HORIZONTAL type continuous multiple-spindle drilling, reaming, and threading machine has recently been developed by the Davis & Thompson Co., 251 Reed St., Milwaukee, Wis. The illustrations show this machine arranged for drilling cross-holes in automobile pistons. The production on this operation is from 300 to 400 pistons per hour, depending on the size, but production rates as high as from 1000 to 2000 pieces per hour are possible in handling small castings, pipe nipples, and similar parts, when the machine is equipped with an automatic loading attachment.

In setting up the work, the operator places the pistons on jigs which are located between two flanges as shown in Fig. 2. The flanges contain hardened steel bushings for guiding the drills, the bushings rotating with the drills so as to lessen the wear on the sharp edge of the drills. The springs that surround the drills prevent the bushings from coming out of the place during the drilling.

In the operation of this machine the spindle housings, which are shown in Fig. 3 disassembled from the machine, revolve with the work as it is carried away from the operator. It will thus be apparent that this is not an indexing machine. The spindles are moved to and fro by a cam which is located on the quill between the work-spindle and the main quill and between the housings. The ring gear seen in this illustration is bolted to the frame of the machine, and is mounted in a bearing that rotates in the same direction as the work. On the opposite end of the bearing for the pinion that engages the teeth of this ring gear is another

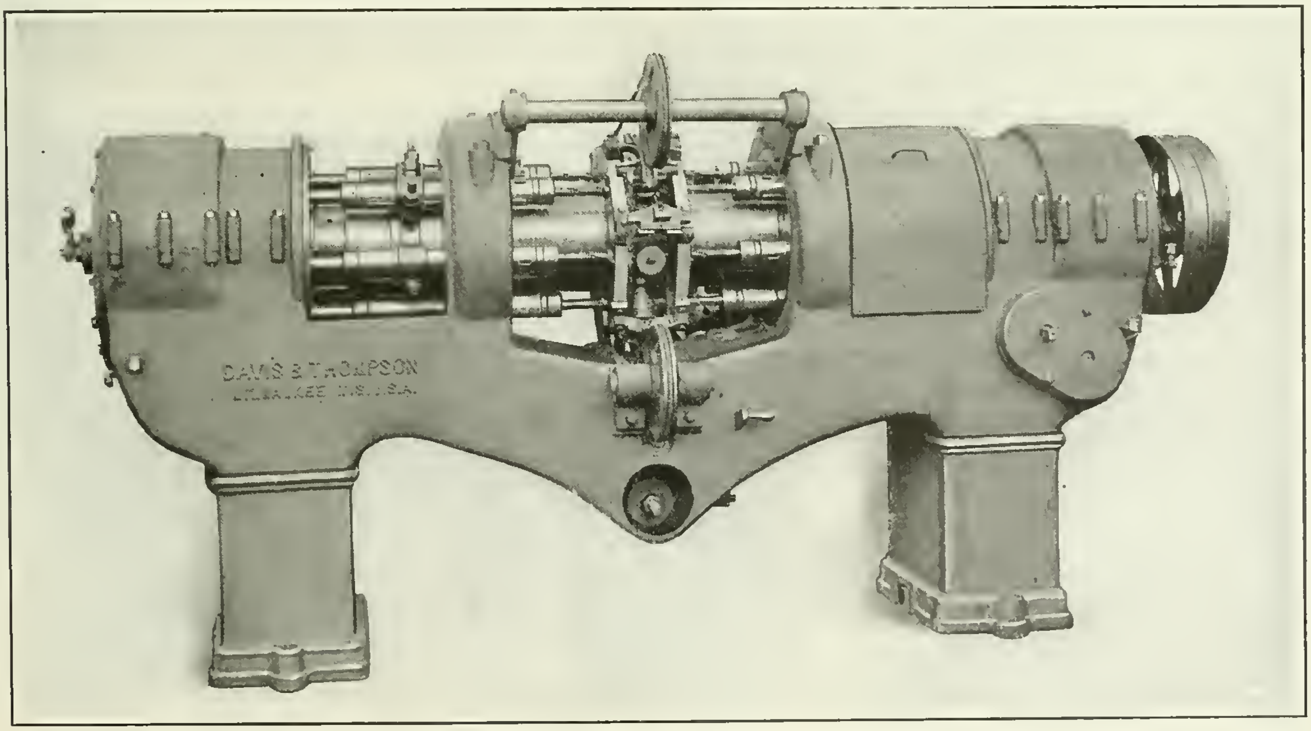


Fig. 1. Davis & Thompson Continuous Multiple-spindle Drilling, Reaming, and Threading Machine

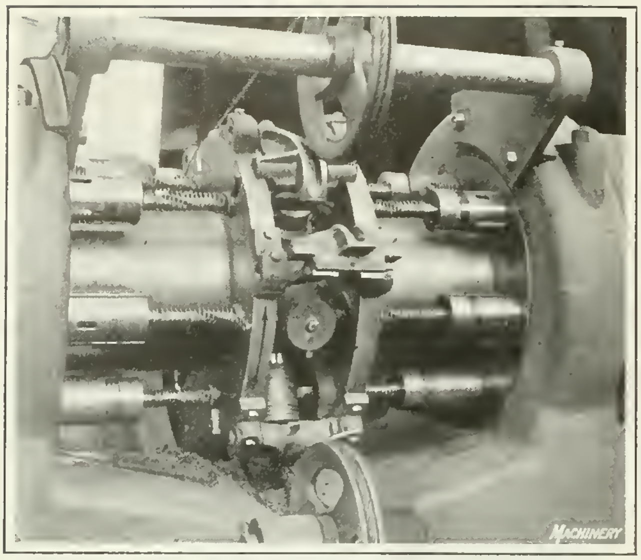


Fig. 2. Close-up View of the Work-carrier showing the Jigs, Equalizing Clamps, etc.

smaller pinion which engages a ring gear attached to the cam sleeve. The ratio between the pinion and the outer ring gear is the same as that between the smaller pinion and the cam gear, and as a consequence the cam is held stationary. A ball thrust bearing is furnished between the cam sleeve and the housing.

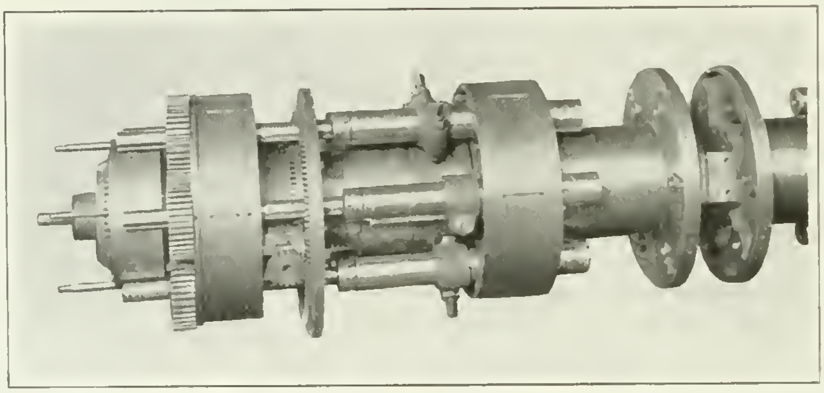


Fig. 3. Driving and Feeding Mechanism for the Spindles

The driving shaft runs through the center of the machine, and from Fig. 3 it will be seen that on the left-hand end of the housing of the spindle carrier, there is a jack-in-the-box gearing. A geared pump on this end supplies oil from the reservoir through the center of the driving shaft and through the pinions in the jack-in-the-box gearing, to lubricate all internal working parts of the machine. End adjustment of the spindles to suit the length of drill and the depth of drilling is accomplished by loosening a nut on the clamp on each drill spindle, and then applying a crank on a square portion of the spindle. There is a hardened steel roller under each spindle, which rotates in the cam.

The close up view in Fig. 2 shows equalizing cable shoes which compensate for uneven surfaces of the pistons held in the jigs. As the pistons revolve with the drum and the drill spindles, these shoes are closed by a cable, bringing pressure to bear on the pistons and holding them in place. From the rear view of the machine, Fig. 4, it will be observed that there is a spring mechanism enclosed in the bed which actuates levers to maintain tension on the cable and thus compensate for variation in the size of the castings.

Pick off gears for changing the ratio at which the work revolves relative to the speed of the driving shaft are enclosed in the cover at the right-hand end of the machine, as illustrated in Fig. 1. It will, of course, be evident that the output of this machine depends on the speed at which the twelve drill spindles and the work is revolved. When threading pipe nipples or light work, lubricant can be furnished to the cutting tools through the spindles. A water pump and pan can also be supplied. Because of the fact that work is being done through two-thirds of each machine revolution, the high production rates are obtainable without necessitating excessive speeds of the drills.

In Fig. 1 the machine is shown with a cover at one end only, but both ends are normally covered to protect the working parts from dust when the machine is in operation. Taper-shank drills up to 15 inches in length may be used. The cable arrangement for holding the work in the jigs is covered by patents.

CINCINNATI-ACME UNIVERSAL FLAT TURRET LATHE

Chuck work up to 20¾ inches swing and bar work from ¾ inch up to either 2½ or 3¼ inches in diameter, depending on the size of automatic chuck with which the machine is equipped, may be accommodated on the Cincinnati-Acme No. 2 universal flat turret lathe which is being placed on the market by the Acme Machine Tool Co., Cincinnati, Ohio. Both the flat turret and the auxiliary square turret have a cross power feed in addition to the longitudinal power feed. The square turret is intended for carrying tools to under-cut, form, face, and turn work at the same time that it is being bored or turned by tools mounted on the flat turret. All levers for controlling the rapid traverse, cross, and longitudinal power feeds and spindle speeds, binder handles, etc., have been centralized at the front of the machine. The head is cast solid with the bed to insure constant alignment of the spindle with the vees upon which the turret carriage travels.

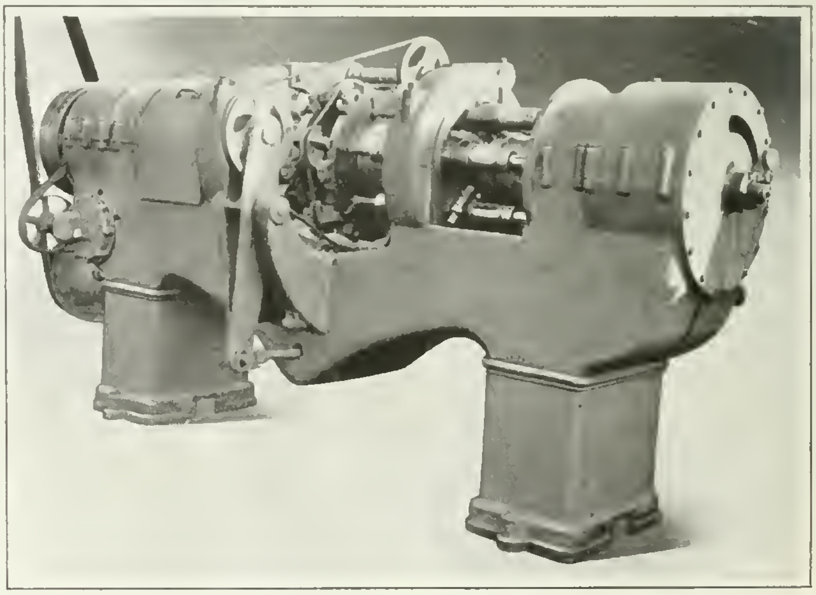


Fig. 4. Rear View of Davis & Thompson Drilling, Reaming, and Threading Machine

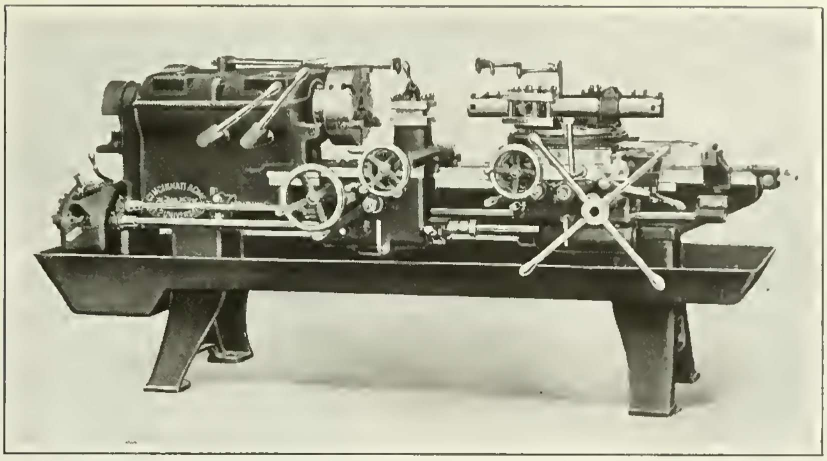


Fig. 1. Cincinnati-Acme No. 2 Universal Flat Turret Lathe arranged for Chuck Work

An all-geared head single-pulley drive supplies twelve speed changes from 18 to 318 revolutions per minute through sliding gears which are operated by means of two levers at the front of the headstock. The sliding and mating gears are made of chrome-nickel steel and heat-treated. Ample oiling of all head parts is accomplished through a splash lubricating system. The stopping and reversing lever is placed on top of the headstock and controls the operation of a friction clutch on the initial driving shaft. A hand hole in the top cover gives easy access for adjusting the friction of the clutch. A patented gear-shifting device makes it possible to change from one speed to another with one continuous movement of either of the speed-changing levers. When the lever has reached the point where one set of gears is out of mesh, the driving pulley is automatically disengaged from the friction clutch, and it is automatically re-engaged after a set of gears has been brought completely in mesh. This feature enables the gears to be shifted from one speed to another while they are revolving simply from their own momentum, thus eliminating shock and excessive clash.

The side carriage is constructed to clear the chuck, and it can be moved out of the way to permit the use of short tools on the flat turret. The latter is provided with six independent stops for the longitudinal movement. The square turret can be indexed to four positions and is held in place by means of a hardened lock-bolt located directly under the cutting tool. A vertical movement of the lever on top of the square turret unclamps and withdraws the lock-bolt. The cross-slide turret revolves on a ground taper stem, and is automatically locked in position by a tool-steel taper plunger located beneath the cutting tool, which enters taper bushings near the outer edge of the turret. The turret is held down at the outer edge by circular clamps.

Cutting compound can be fed through each turret tool for deep-hole boring. The cross-slide is also provided with an adjustable hardened center stop, and it can be fed by hand or power. A power rapid traverse is furnished in both longitudinal directions for the turret, the traverse being controlled by the lever which projects vertically at the front of the carriage. The operation of this lever automatically disengages the turnstile handle, thus making a fool-proof arrangement and insuring a stationary turnstile wheel while the rapid traverse is in motion.

There are twelve longitudinal stops, one independent stop for each turret position and six auxiliary stops. As many as seven different shoulder lengths can be machined by first using the independent stop and then the auxiliary stops. The gear-box at the head end of the machine furnishes ten feeds for the power cross and longitudinal movements of both the side carriage and the turret. An oil-pump supplies ample coolant to both turret and side carriage tools when the machine is running in either direction. A five-horsepower constant-speed motor running at 1200 revolutions per minute is required for the machine. It is recommended that the motor be mounted on the rear side of the head-end leg to make the drive self-contained and compact. All machines are planed and drilled to permit convenient change from a countershaft to a motor drive at any time.

A chasing attachment is located at the right-hand end of the carriage apron. One leader is included having five threads for cutting 2½, 3½, 5, 7, 10, 30, and 42 right-hand threads per inch, but additional leaders may be supplied for other threads. Left-hand leaders are necessary for cutting left-hand threads. A taper-turning attachment can be furnished for the side carriage to permit of turning tapers up to 3 inches per foot and 12 inches in length.

The automatic chuck for bar work can be opened and closed while the machine is running by manipulating a long lever at the front of the head. Adjustments of 1/16 inch may be made to provide for variations in the diameter of work. The roller feed is simple in design and operation, only one adjustment being necessary. By adjusting the jaws to the size of stock with a spanner wrench and then slightly releasing them, the rollers will be given the proper tension. The roller feed is operated by the same lever that actuates the automatic chuck. Three roller-rest turners are furnished for bar work, and these are adjustable for any diameter of work within the capacity of the chuck.

Some of the important specifications of this machine are as follows: Maximum diameter that can be turned, 20¾ inches; swing over carriage cross-slide, 14 inches; cross travel of turret, 7½ inches; longitudinal travel of turret, 30 inches; weight of machine with chucking equipment, 5050 pounds; and weight of machine with bar equipment, 5000 pounds.

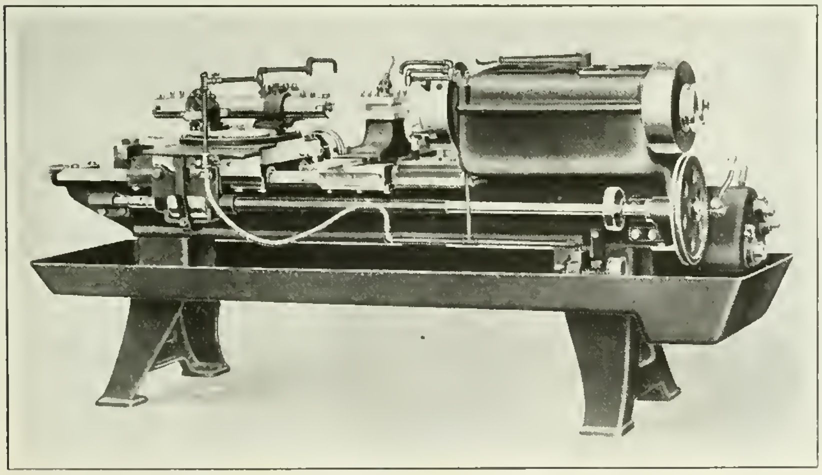


Fig. 2. Rear View of the Cincinnati-Acme Flat Turret Lathe

BADGER AUTOMATIC GRINDING MACHINES

A machine for automatically rough-grinding the parallel sides of individually cast piston-rings was described in May, 1921, MACHINERY, at the time that it was being introduced to the trade by the Badger Tool Co., Beloit, Wis. This machine is now also built for grinding other parts somewhat similar to piston-ring castings. In one instance it is being used for rough-grinding the sides of hardened steel thrust washers. With this particular equipment the grinding disks are replaced by abrasive wheels which are held in chucks, and a wet grind-

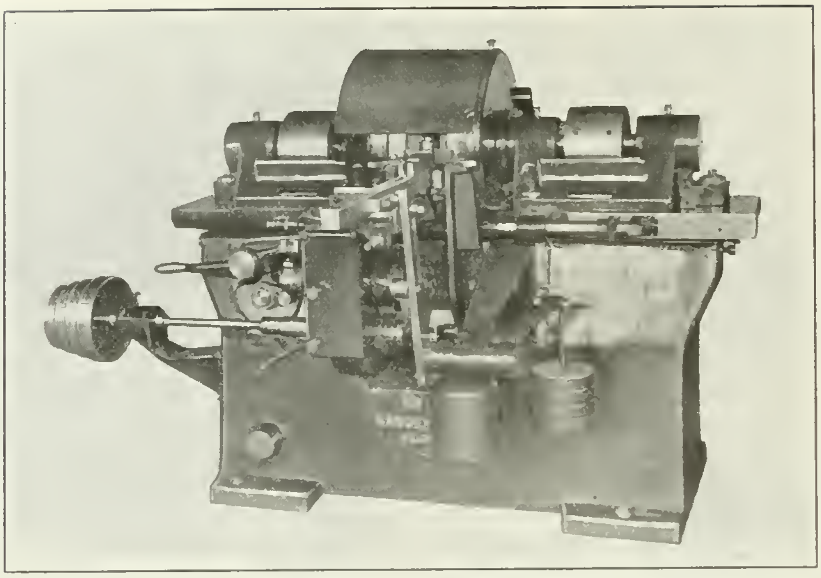


Fig. 1. Badger Automatic Grinding Machine arranged for grinding the Edges of Automobile Door Hinges

ing system is employed.

An example of how the machine is arranged for handling pieces of irregular shape is illustrated in Fig. 1, where it is shown grinding the opposite edges of automobile door hinges. Work of this nature is not passed entirely through the wheels and out at the rear, but instead is located on a reciprocating fixture bar, on the top of which is placed a suitable holder. The holder is so designed that the edges of the hinges are ground in the proper relation to the central bosses so that the male and female parts of the hinge will be interchangeable. The heads are opened and closed automatically and timed in the correct relation to the forward and backward stroke of the fixture bar, the length of which can be varied to suit conditions.

Automobile door hinges are made of various metals, most of them being either malleable-iron castings or steel forgings. Malleable-iron hinges are ground dry on abrasive cylinder wheels, while steel hinges are ground wet. Obviously, greater production rates are obtainable on the malleable-iron hinges than on those made of steel. A wheel-dressing attachment, placed at the rear of the machine, enables the wheels to be trued in about three minutes, without disturbing the setting of the machine or stopping it.

The machine illustrated in Fig. 2 is arranged for grinding coil springs to length, thus producing flat seats which are square with the axis of the coil. The springs are carried between the two grinding wheels on a revolving carrier, which has four sets of jaws, one jaw of each set being fixed and the other pivoted. As this carrying head revolves, the movable jaw opens to receive the spring, grips it while passing between the grinding wheels and then releases it, allowing the finished spring to fall down a chute. The jaws are fitted with hardened V-blocks, which are removable so that work of different diameters and lengths, can be accommodated by simply substituting different sets of blocks. The operator places the springs in the jaws as the head revolves. However, with some types and sizes of springs it is possible to load the carrier head automatically by employing a hopper or gravity feed. Most coil springs are ground wet on abrasive cylinder wheels.

The wheel-dresser of the automatic spring grinder is shown in Fig. 3 mounted on the rear of the machine. It is of the same type as is supplied on the piston-ring and hinge grinding machines, and, as previously mentioned, it takes only about three minutes to dress the wheels, and this may be done without shutting down the machine or altering the setting. As the surfaces to be ground on the work must be passed over certain parts of the grinding wheels, and as the work must travel at a predetermined rate of speed, provision is made in these machines so that the desired results can be definitely accomplished. On some classes of work it is necessary to set the wheels at a slight angle, and so the machines are designed in such a way that the wheels can be opened either at the front, back, top, or bottom. Each of the machines of the belt-driven type weighs approximately 4500 pounds.

AMERICAN KRON RIVETING HAMMER AND CONCRETE DRILL

Wear and tear on the driving mechanism and reciprocating parts is always an important factor in the design of vibratory equipment such as portable riveting hammers, due to the shock which may be transmitted to these parts as the hammer blow is struck. An outstanding feature of the portable electric riveting hammer and concrete drill, which is now being introduced on the market by the American Kron Scale Co., 430 E. 53rd St., New York City, is that

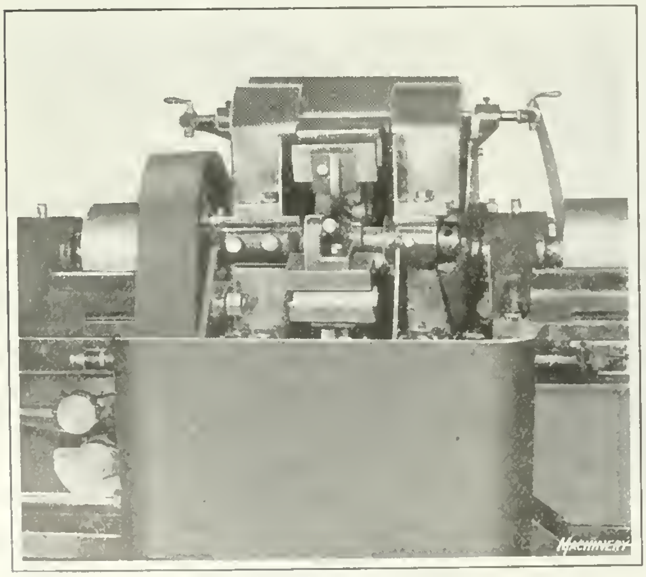


Fig. 2. Close-up View of Machine arranged for automatically grinding Coil Springs

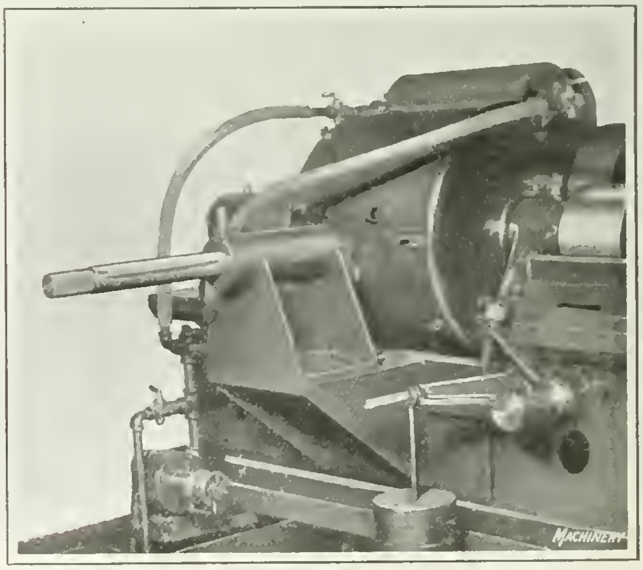


Fig. 3. Wheel-dressing Attachment at the Rear of the Spring Grinding Machine

there can be no effect on these parts from the hammer blow because the hammering member is automatically disconnected from the driving members at the moment the blow is struck. This automatic disconnection of the hammering mechanism also insures against overloading of the motor. This tool can be used advantageously for drilling concrete when installing new equipment in the shop.

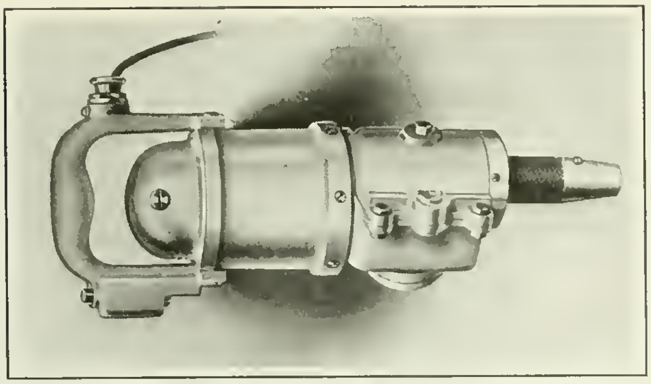


Fig. 1. American Kron Riveting Hammer and Concrete Drill

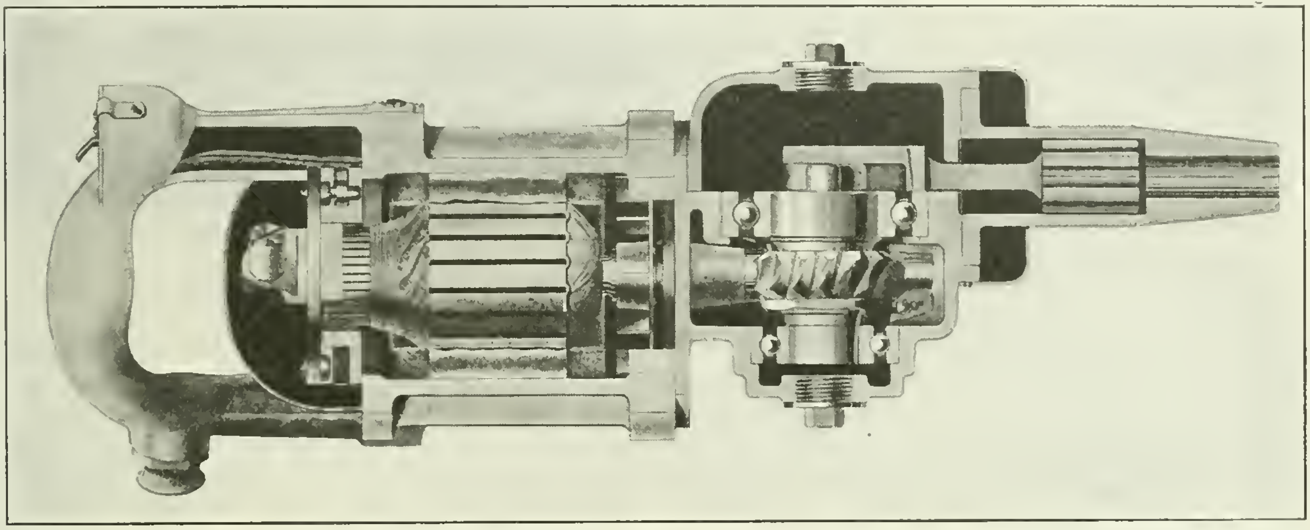


Fig. 2. Sectional View taken through the Motor and Driving Mechanism Compartments

The ingenious construction of this hammer will be apparent by reference to the sectional views presented in Figs. 2 and 3. The motor is contained in the head end in a compartment into which oil cannot leak. It is cooled by a fan mounted on the armature shaft close to the bearing through which the shaft extends into the lower compartment of the body. The motor is of the G. E. universal type, operating on either alternating or direct current, has a capacity of 1/3 horsepower and runs at 6500 revolutions per minute. The motor switch is assembled in the handle, and is conveniently opened and closed by simply gripping and releasing the handle. The switch is designed for functioning with either 110- or 220-volt current.

At the lower end the armature shaft is slotted, as shown at *C*, Fig. 3, to receive the tongued end of steel worm *D*. This worm drives the bronze worm gear *E*, the ratio being such that the speed of the worm-gear is approximately 1600 revolutions per minute.

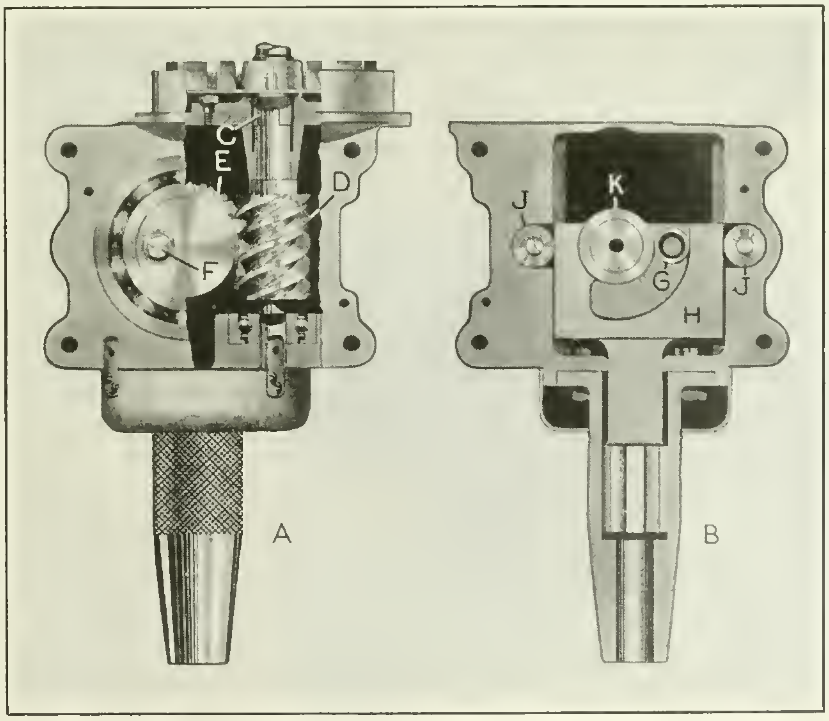


Fig. 3. Views of the Driving Mechanism and Reciprocating Hammer

On one side of the worm-gear there is eccentrically located a pin *F*, over which is slipped the roller *G* shown at *B* lying loosely in the groove of hammer *H*. Pin *F* is contained in a hardened steel bushing in the worm-gear, so that it is free to revolve. It will be apparent that the sectional view at *B* fits over the sectional view at *A* when the hammer is assembled.

As worm-gear *E* revolves in a clockwise direction, pin *F*, with roller *G* around it operates in the groove of hammer *H* and against roller *K*, causing the hammer to reciprocate backward and forward at each revolution of the worm-gear. At the moment that the lower end of the hammer strikes the tool in the socket, the position of pin *F* and roller *G* in the groove is about as indicated at *B*, and thus the hammer, as it rebounds from the blow, has a slight longitudinal movement relative to roller *G* and pin *F*. Consequently the entire driving mechanism is free from the hammer at that instant and receives none of the shock resulting from the blow. The driving mechanism remains in operation, however, so that roller *G* and pin *F* immediately withdraw the hammer as they follow the groove to the lower end. When they reach this point pin *F* passes above the axis of the worm-gear and follows up the groove again, drawing the hammer downward for the next stroke.

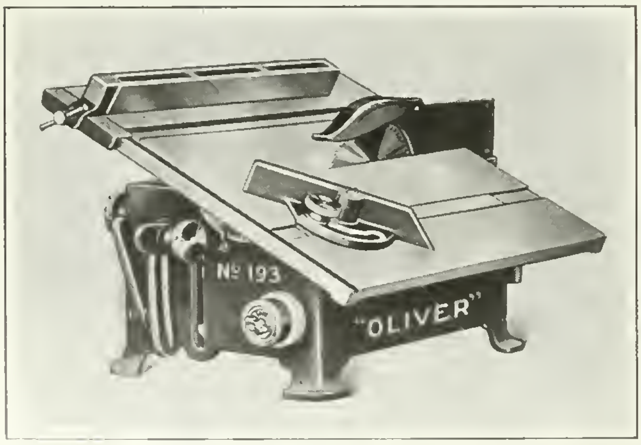
Especial care was taken in the designing stage to eliminate wear as far as possible. Hammer *H* reciprocates on rollers *J*, which are mounted on pins, and as there are no side thrusts, wear does not occur on the guiding surfaces of the body in which the hammer slides. Two Hess-Bright self-aligning radial ball bearings are supplied on the worm-gear shaft, and there is a thrust ball bearing for both the worm and the armature shaft. Plugs are provided in the lower compartment, so that the driving mechanism may be kept supplied with oil, it being necessary to replenish the supply only every few months. All driving parts, except the worm-gear, are made from chrome-vanadium steel, and are hardened and ground. One of the hammers has been in constant use in the shops of the manufacturer for over one year without any noticeable wear. The lower end of the hammer is grooved so that air in the socket may escape as the hammer is operated.

The size of hammer now being placed on the market has a capacity for driving up to ½-inch round-head rivets at the rate of about seven seconds per head under normal conditions. It may also be used for driving ⅝-inch rivets of the flat-head type. In operating on concrete with a 1-inch special star drill, a depth of about 6 inches per minute has been drilled: and with a 2-inch star drill, a depth of about 4 inches per minute has been drilled. In such jobs the drill is revolved slowly by means of a ratchet, so that the powdered concrete can pass more easily up along the flutes. The weight of this portable tool is 26 pounds.

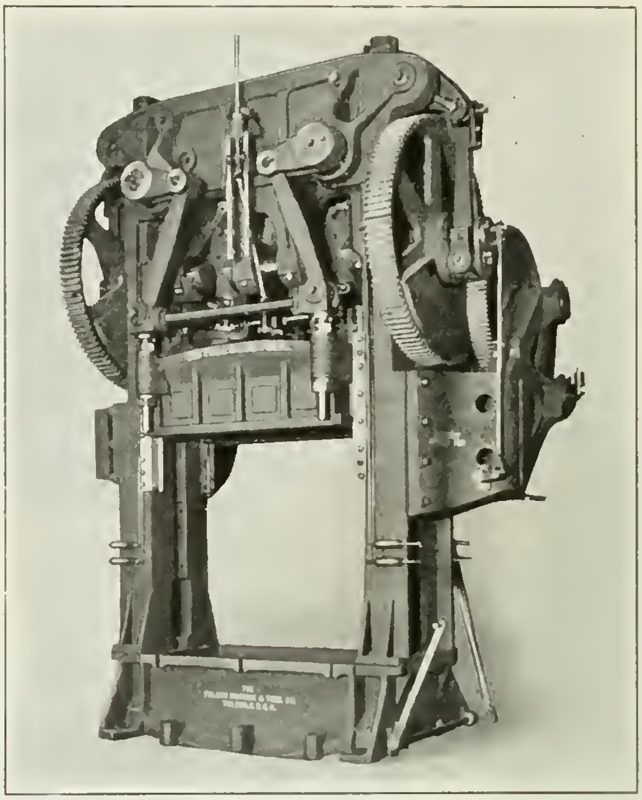
OLIVER SAW BENCH

A motor-driven saw-bench with a saw 7 inches in diameter, which cuts stock up to 2 inches thick and dadoes up to ⅜ inch in width, is being placed on the market by the Oliver Machinery Co., Grand Rapids, Mich. The motor is of ½ horsepower capacity, runs at about 1800 revolutions per minute, and, through pulleys and belting, drives the saw arbor at a speed of 5000 revolutions per minute. The equipment is portable, and can be driven from an ordinary electric light socket. The arrangement of the motor is such that the driving belt is always tight.

The table measures 21 by 24 inches, and is grooved to receive a sliding cut-off gage, which may be used on either side of the saw, set at any angle, and arranged to receive a wood face-piece when desired. The ripping gage is instantly locked in position by means of a knob. The table may be tilted to different angles up to 45 degrees, and has a graduated dial which indicates the angularity of the setting at all times. The saw guard is adjustable vertically to allow for cutting different thicknesses of stock, and is mounted on a splitter guard at the back of the table, which serves to prevent the stock from pinching the saw. The bench type of machine illustrated is 10 inches high, and when it is mounted on the floor column, with which it may be furnished, the height to the top of the table is 32 inches.



Oliver Seven-inch Self-contained Saw Bench



Toledo Double-crank Toggle Press for All Kinds of Drawing, Deep Stamping and Forming Operations

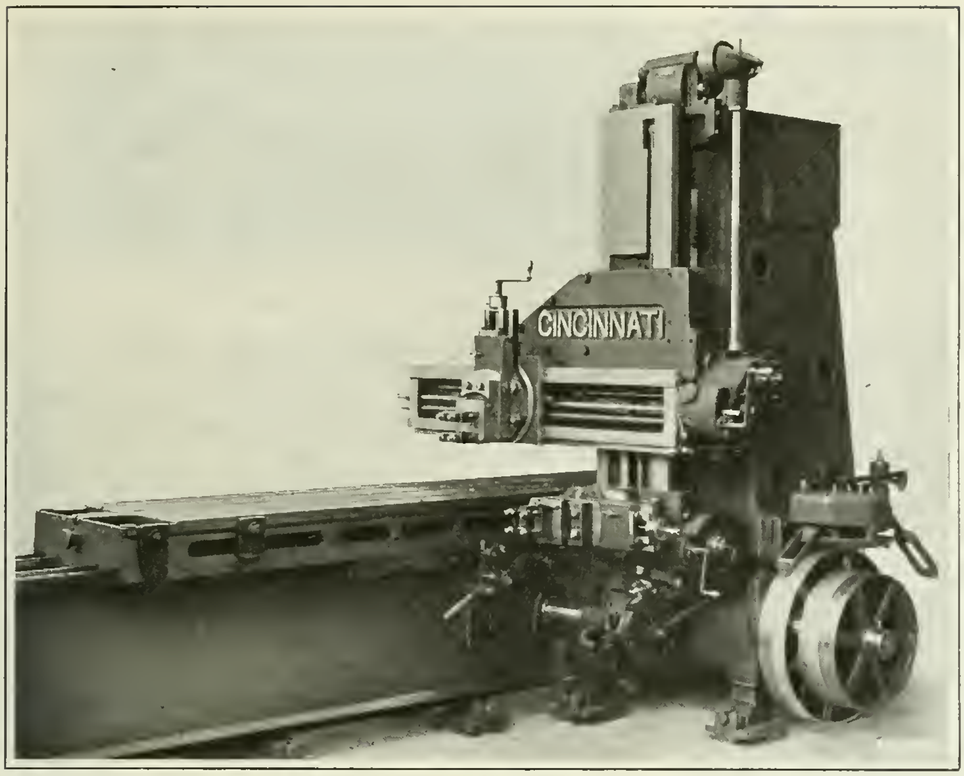
TOLEDO DOUBLE-CRANK TOGGLE PRESS

All kinds of drawing, deep stamping, and forming operations required in the manufacture of automobile bodies, cowls, fenders, engine pans, radiators, etc., and in the production of similar metal parts may be handled on the double-crank toggle drawing press here illustrated, which is built in a number of sizes by the Toledo Machine & Tool Co., Toledo, Ohio. Smooth action, accurate timing, and an absolute dwell of the blank-holder slide were among the aims of the designers in developing this machine. The drive to the crankshaft for operating the inner or drawing plunger is through twin gears at each end of the crankshaft, the teeth of the gears being machine cut.

The outer or blank-holder slide is operated by cranks which have universal connections to the twin gears on the crankshaft. Each blank-holder crank is directly connected by means of a link to a lever located at each end of the crown. The latter is of a heavy double-web cross-section, which permits running large shafts from the front to the back of the machine for carrying the levers. The levers are connected to links which control the toggle mechanism, the latter being likewise mounted on shafts which run from the front to the back of the machine. When straightened out, the toggle arms and levers transfer the blank-holder pressure directly to the frame of the press, and permit the entire power of the crankshaft to be used for the drawing operation. The press is controlled through a friction clutch of a construction that enables the operator to start or stop the machine at any point of the stroke. There is a forced-feed lubricating system to all main bearings.

CINCINNATI OPEN-SIDE PLANER

A number of improvements have been incorporated in the design of a 30- by 30-inch open-side planer which is now being introduced to the trade by the Cincinnati Planer Co., Cincinnati, Ohio. The convenience and rigidity of the design will be apparent by reference to the illustration. The table is gibbed on the operating side of the machine, so that regardless of how much overhang there is to the work,



Cincinnati 30- by 30-inch Open-side Planer of Improved Design

there is no danger of tipping the table. It also fits between the two vees in such a manner that no matter how far out from the table cuts are being taken on the work, the table cannot be twisted sideways out of the vees. For cases in which the work is much wider than the table and of considerable weight, an auxiliary table may be furnished to support the overhanging section of the work.

The bed is closed between the vees, and is cast extra heavy on the operating side, particularly at the housing cheek. This is carried up four or five inches higher than the remainder of the table so as to provide a greater surface for fastening the column. The column is ribbed thoroughly on the inside in such a way that spring is practically eliminated, and it is bolted, doweled, and tongued to the bed.

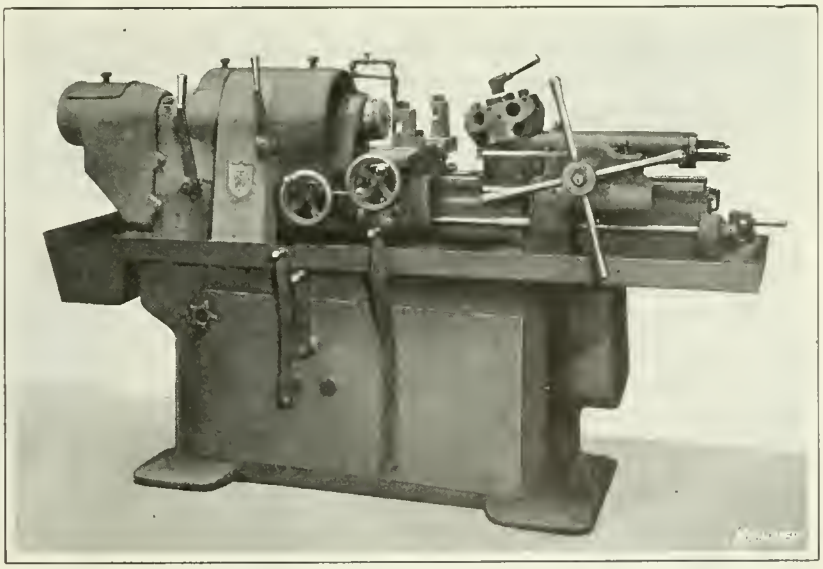
As on previous Cincinnati planers of the open-side type, the rail is mounted on a knee which is bolted directly to the column, two large T-slots being provided in the column for this purpose. Instead of using an ordinary bolt head or short nut, a sliding nut is placed in the T-slots. The construction is such that there is no possible chance of locking the knee under any condition. A gib at the front end of the knee furnishes a narrow guide bearing on the side of the column end eliminates any tendency of the rail to tip. The gib can be adjusted to obtain a sliding fit, and this adjustment cannot be changed except at the will of the operator. The rail is also gibbed at the outer end of the housing to provide a narrow guide bearing at this location. which prevents the rail from tilting or sagging even when all clamping bolts are loosened.

SELF-CONTAINED TILTED TURRET LATHE

With a view to obtaining maximum convenence and economy in the installation and operation of turret lathes or screw machines, the Wood Turret Machine Co., Brazil, Ind., has developed the self-contained tilted turret machine here illustrated. All overhead shafts, hangers, pulleys and belts are eliminated, with a consequent reduction in power loss and equipment expense and a conservation of space and light. The machine is mounted on a cabinet base, there being a rear cover plate inside the cabinet on which the motor is mounted. This plate is disassembled to remove the motor. A silent chain drive connects the motor with the main driving shaft at the center of the cabinet, the transmission of power being controlled through a cone friction clutch of the full-floating type.

The drive then passes through a change-gear box, which furnishes six spindle speeds on a plain head machine and twelve on a back-geared machine. Thus there are twice as many speeds as on the regular belt-driven machine, and there is the additional advantage of a reverse for every forward speed, which is accomplished through a patented device. All gears in the gear-box run in oil. From the gear-box power is delivered to the spindle through two 12-inch pulleys, between which a belt tightener is placed. All controls are centralized at the front of the machine for the convenience of the operator. The knob at the left of the base controls the belt tightener, the short hand-lever on the base controls the speed changes; and the long hand-lever controls the starting, stopping, and reversing of the machine.

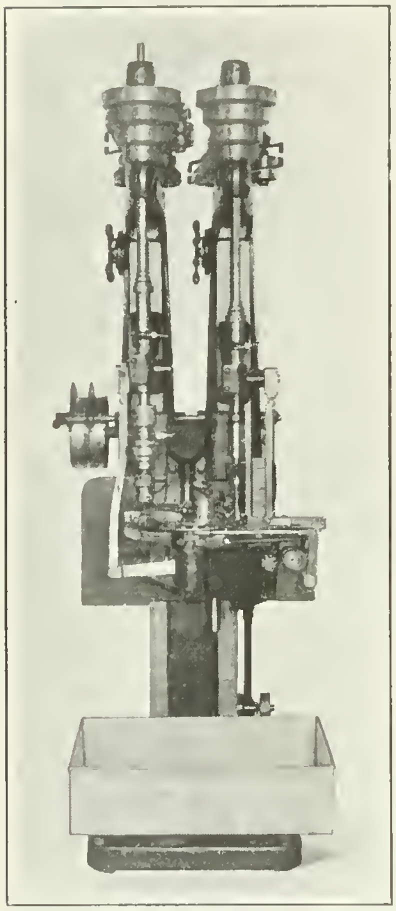
Full inspection of the motor-driving unit is possible by removing the front cover of the cabinet. Air-holes in both ends of the cabinet provide an ample circulation of air for cooling the motor. The machine is said to incorporate all the best features of a geared-head single-pulley driven machine. The belt pull is in a downward direction on the headstock casting, instead of upward against the main bearing caps. All revolving parts are guarded to protect the operator and the machine. The motor is supplied for either direct or alternating current, and may be of the constant or variable-speed type. When desirable, the machine can also be driven by belt through a single pulley by mounting a jack-shaft on the rear cover plate in place of the motor



Wood Tilted Turret Lathe or Screw Machine arranged as a Self-contained Equipment

EDLUND DRILLING, COUNTERSINKING AND TAPPING MACHINE

The No. 2B sensitive drilling machine built by the Edlund Machinery Co., Box 57, Cortland, N. Y., has been arranged, as illustrated, for automatically drilling, countersinking, and tapping automobile fender blocks. It will be noted that the regular table has been replaced by a special fixture to which the work is fed from a magazine, so that the only labor on the part of the operator is to keep the magazine filled. The fender blocks are made of 1/4- by 5/8-inch flat stock, 2 inches long, and the hole is drilled 17/64 inch deep and tapped to a 5/16-inch U. S. standard thread. Production rates up to 500 pieces per hour can be obtained with this machine. It is also adapted to a large variety of small work.

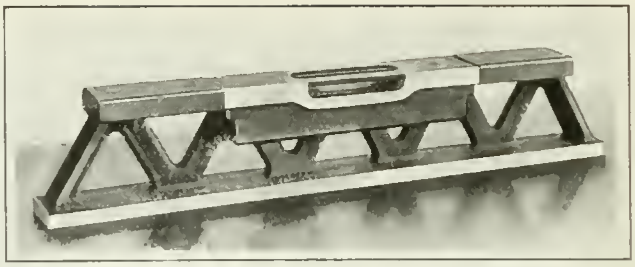

Edlund Automatic Drilling, Countersinking and Tapping Machine

The drive for all mechanisms is transmitted from the pulley shaft through miter gears. The work is fed on a plate which has several slots in it and which is indexed by means of a cam. The drilling is done with the right-hand spindle, the countersinking with an auxiliary spindle operated from beneath the work, and the tapping with a special tapping attachment used on the left-hand spindle. A stationary cam which is attached to the top plate ejects the work into a pan.

The feed for the spindles is obtained by means of racks which mesh with gears cut on the ends of the feed pinions, the racks being actuated by cams mounted on the same shaft as the indexing, locking, and feeding cams, so as to eliminate any possibility of the machine getting out of time. A generous stream of compound is supplied to the drill, countersink and tap, thereby keeping the tools and work cool, and washing all chips into a reservoir. This reservoir and guards for the cams were removed from the machine at the time the photograph was taken in order that the working parts could be more fully observed.

PRATT & WHITNEY PRECISION LEVEL

An accurate level which is especially advantageous in setting up precision machines is manufactured in different degrees of sensitiveness by the Pratt & Whitney Co., Hartford, Conn. What is known as a "10-second" level is recommended for general use. With this level, each 1/10-inch division that the bubble runs indicates a variation from the horizontal of 0.0005 inch in one foot. It has a vial ground to a radius of curvature of about 170 feet, and is as sensitive as is found practicable for setting up fine machine tools and similar work. A "3-second" level having a proportionately larger radius of curvature is more sensitive, but it requires several minutes for the bubble to come to rest, and so is too sluggish for shop use.

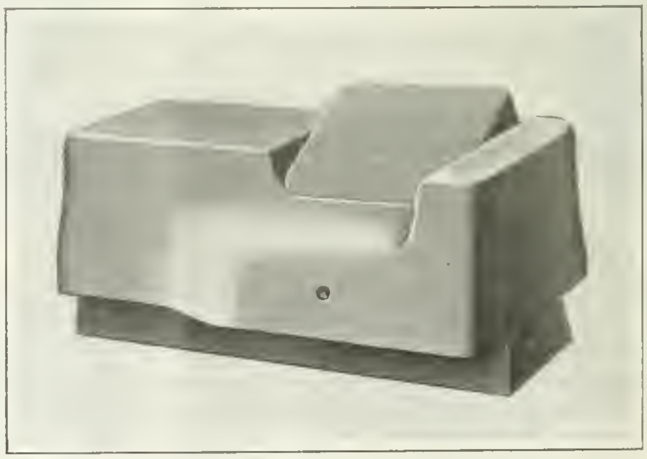

Pratt & Whitney Precision Level

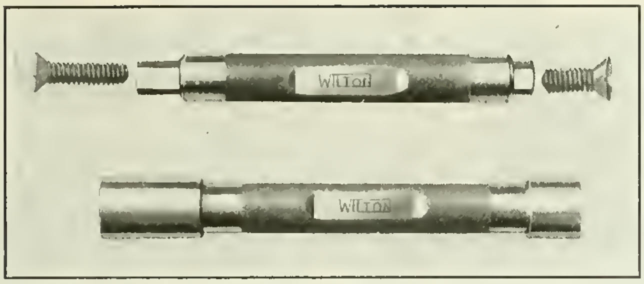
The truss construction of the frame not only provides a level that is light, rigid and convenient to handle, but also, one that is not very sensitive to changes of temperature. The frame is 15 inches long. Insulating grips are provided which prevent the heat of the hands from expanding the frame and causing errors. To check the instrument on a surface which is approximately horizontal, the level is set down, its location marked, and the position of the left end of the bubble noted, say, for example, three divisions from the center. The level is then reversed, care being taken to see that it is set in the same spot on the surface, and the position of the left end of the bubble again observed. If the reading is still three divisions from the center, the level is in proper adjustment; if the reading should differ, an adjusting screw is turned until the two readings agree. The vial carriage may be removed from the frame by withdrawing four screws.

BEAUDRY TAPER HAMMER DIE

For use in forging taper work such as chisels, calking tools, railroad spikes, rocker arms, valve yokes, keys, gibs, and wrenches, Beaudry & Co., Inc., 45 Bromfield St., Boston, Mass., has brought out a new combination hammer die. This die can be furnished for any make or size of trip, air, or steam hammer, and it is said that by its use one man can draw in one heat any taper that can be produced under a hammer. As will be seen from the illustration, one end of the die is provided with a tilting face which moves freely on a fixed axis. Thus, by merely shifting the position or angle of the work and striking a light blow, the operator automatically adjusts this tilting face to the desired angular position relative to the top die of the hammer. With this construction any taper can be produced.

Scale which may happen to fall between the tilting face and the die-holder works through grooves into a pit and is forced out through a hole in each side of the holder, which insures that the tilting face will work freely at all times. The fixed plain part of the die face can be used for general forging, the same as any ordinary die.


Beaudry Tilting Hammer Die for forging Tapers



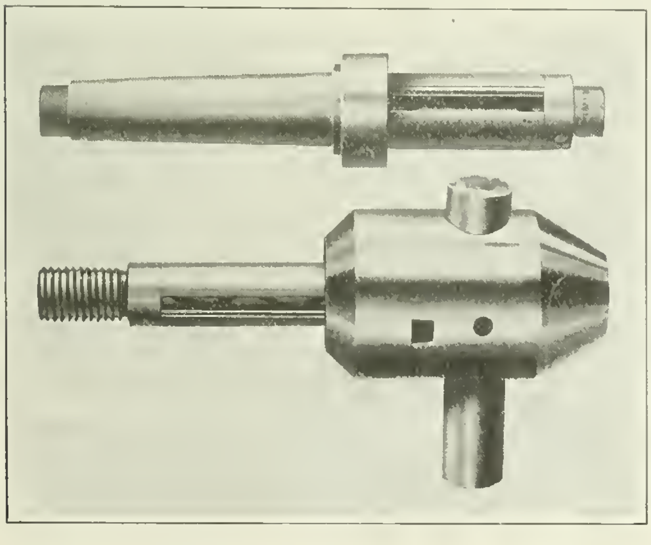
Wilton Gage with Reversible Plugs made of Stellite

WILTON REVERSIBLE-PLUG GAGE

Stellite is used for the gaging members of a "Go" and "Not Go" reversible-end plug gage manufactured by the Wilton Tool Co., 2121 Grand River Ave., Detroit, Mich. When any appreciable amount of wear has developed on these gaging members, they may be turned end for end so as to bring a new end into use. It is claimed that the stellite plugs possess from three to seven times the life of ordinary steel plugs. The handle is made from steel, as it is not subject to wear. A pilot at each end of the handle enters a hole in the corresponding gaging member. There is a flat on each pilot which coincides with a flat in the hole of the plug so as to prevent the plug from turning on the pilot. The "Go" end is made longer than the "Not Go" end so that the two ends can be readily distinguished.

"ETTCO" SELF-GRIPPING MANDRELS

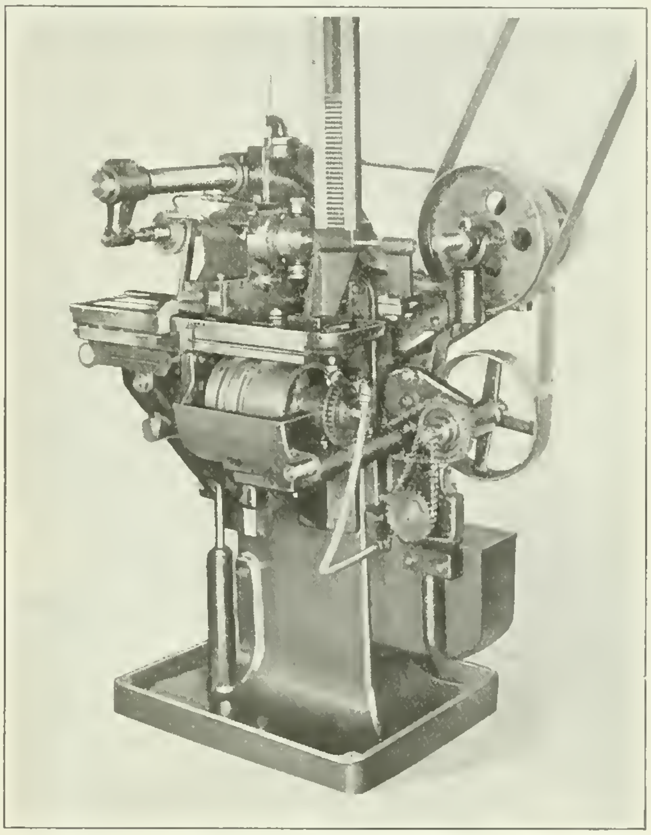
In the production of automobile parts, there are numerous instances in which it is preferable to machine the work while it is mounted on a mandrel, and it is to enable such parts to be seated on a mandrel without the application of an external force such as is usually applied by means of an arbor press, that the Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y., have brought out the self-gripping mandrels shown in the accompanying illustration. They are also intended for use in the quantity production of bushings in plants other than those engaged in the manufacture of automobile parts. These mandrels are constructed on the same principle as the self-gripping line presented to the trade several years ago by this company. Each has a solid steel body in which there are three grooves, and each of these grooves contains a roller, made of hardened drill rod and a long flat spring that acts against the roller to hold it in the gripping position. The work is simply slipped on the mandrel, and when a cut is started, the roller automatically grips the work. The special mandrels are made to fit "Lo-Swing" and Fay automatic lathes, as well as various makes of engine lathes.



"Ettco" Special Self-gripping Mandrels

STANDARD AUTOMATIC MILLING MACHINE

High rates of production can be maintained in milling square ends of taps and other small work by the use of an automatic machine recently developed by the Standard Engineering Works, Pawtucket, R. I. As is apparent from the illustration, the work is fed from a magazine to a collet which is mechanically opened and closed. When released from the collet, the work falls on an inclined screen on the table and rolls down a chute into a box on the floor. Two cutters on the arbors straddle-mill the work, which is withdrawn from between the cutters after the first pass, automatically indexed 90 degrees, and then again traversed past the cutters for milling the other two sides. An adjustable stop insures the cut being taken to the same length each time.

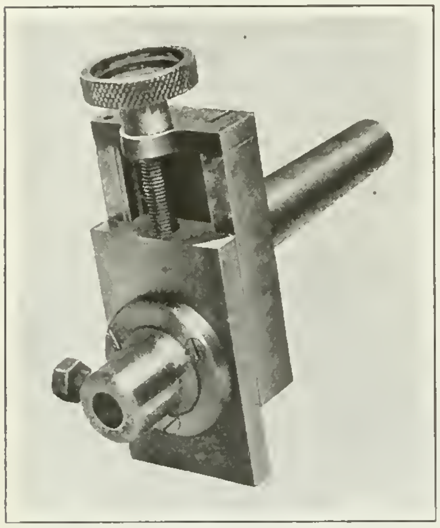


Milling Machine built by the Standard Engineering Works for milling Square Ends on Small Work

The drive is transmitted from a countershaft to the rear shaft of the machine by belt, and then to a jack-shaft directly below the rear shaft. It is next transmitted through a silent chain to worm-gearing, which drives a drum cam that moves the table as desired. The spindle is mounted in phosphor-bronze bearings provided with means for taking up wear, and it is driven by belt from the rear shaft. A crank provides for turning the machine over by hand when changing the setting to accommodate different sizes of work. Oil is supplied to the cutters from a tank located at the rear of the machine by a chain-driven geared pump. The oil drains from the table through flexible hose back to the tank, which has two compartments that are provided with a fine-mesh screen so that only clear oil is drawn into the pump. One man can operate three machines of this type, as the only labor necessary is that required to keep the magazines loaded. The normal production on ⅜-inch stock is about 500 pieces per hour per machine. The machine occupies a floor space of about 27 by 38 inches, and weighs approximately 1200 pounds. A one-size collet, countershaft, and wrenches are supplied with the machine as regular equipment.

BRUCE ECCENTRIC BORING HEAD

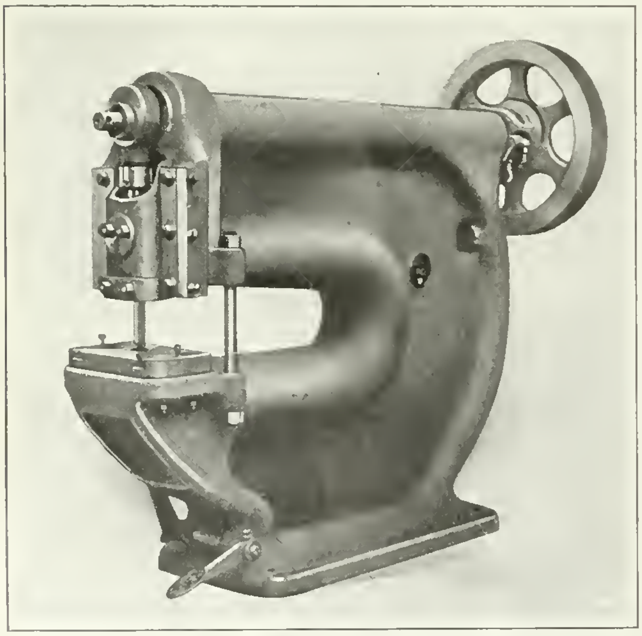
Jigs, fixtures, and similar work can be accurately bored on drilling and milling machines by the use of an eccentric head which has been added to the line of precision equipment made by the Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa. This head is especially useful in index boring operations. Wear of the sliding member is compensated for by a gib. The adjusting screw for this slide has a handle which is graduated to 0.001 inch to permit accurate settings to be readily made. The shank on the stationary member is machined to fit the spindle of the machine for which the head is intended, and the adapter on the slide takes various sizes of tools. The head is made in four sizes with respective capacities of 3/8 to 1 1/2 inches; 1/2 to 2 1/2 inches; 3/4 to 4 inches; and 1 to 6 inches. Each head is supplied with a set of six boring tools, a chuck, and a test indicator.



Bruce Eccentric Boring Head for Precision Work

FERRACUTE PUNCHING PRESS

One of the features of a deep-throated punching press, which has recently been developed by the Ferracute Machine Co., Bridgeton, N. J., is the use on the driving shaft of an eccentric which may be simply changed in order to alter the stroke of the reciprocating members. Besides this advantage, the construction also permits the shaft to be almost the full diameter where it projects from the front bearing. The eccentric is fitted on a taper bearing, and is held in place by means of a large nut; it is driven through a feather in the tapered portion of the shaft. The design permits the shaft to be quickly assembled and disassembled without withdrawing keys. The machine is designed to exert a pressure of 35 tons, and will shear 5/8- by 5-inch flat iron or soft steel, punch a 1-inch hole through 7/16-inch metal, or cut off 1 1/8-inch round bar stock. It is known as the "P-43."



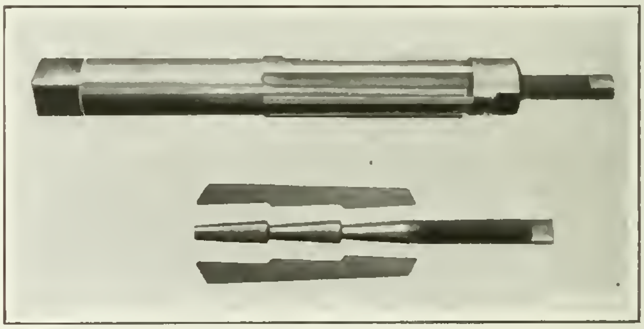
Ferracute Punching Press of 35-ton Capacity

The shaft is 3 1/2 inches in diameter, and has a large collar forged to it, in which the clutch mechanism is mounted and which serves as a brake wheel. The ram is guided between two gibs to facilitate making adjustments to compensate for wear. The pitman contains a pivot so mounted in the ram that a large bearing surface of solid metal is obtained. The pitman stem is gripped by a telescopic nut, which is made in halves, clamped together by means of large bolts.

The stay-rods shown in place on the machine prevent any tendency to spring when the press is being worked to the limit of its capacity, but they are said to be really unnecessary from the standpoint of strength. A motor shelf may be attached to the back of the frame. Some of the principal specifications of this machine are as follows: Stroke, 1 1/2 inches; ram adjustment, 3 inches; depth of throat, 42 inches; flywheel diameter, face, and weight, 35 inches, 6 inches, and 700 pounds, respectively; over-all height, 7 feet; and approximate weight, 5350 pounds.

REIFF & NESTOR ADJUSTABLE-BLADE REAMER

One of a line of adjustable-blade reamers now being offered to the automobile and general machine building and repair fields, by the Reiff & Nestor Co., Lykens, Pa., under the trade name of "Maxpan" is here illustrated. The smaller sizes of this reamer have an expansion of 1/16 inch, and the larger sizes 1/4 inch; there is practically no lateral travel of the blades in the body when an adjustment is made. The central adjusting screw has three conical surfaces which contact with correspondingly tapered steps on the reamer blades, and thus a forward adjustment of the screw, after the single binding nut has been loosened, causes the reamer blades to expand radially.



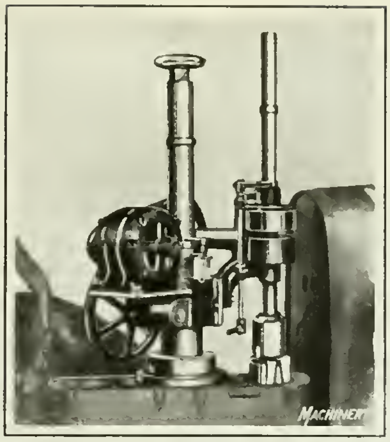
"Maxpan" Adjustable-blade Reamer

Both ends of each blade are finished at an angle with the cutting edge, and when the blade is assembled in the body, one end contacts with a similar angular surface on the slot in which the blade happens to be placed, while the other end contacts with a beveled annular groove in the binding nut. The blades are not only held firmly in place by this method of assembly, but they are also pressed radially inward and seated rigidly on the central adjusting screw. The reamer is made in fourteen sizes, ranging from 1/2 to 2 9/16 inches in diameter, and is provided with from six to eight blades, according to the size.

The body is made of tool steel; the binding nut is made of high-carbon steel and hardened; the adjusting screw is of tool steel and hardened and ground; and the blades of a special alloy steel. The design of the reamer is changed slightly and a shank added when the tool is to be used in a machine.

STORM PORTABLE REBORING MACHINE

Reboring automobile cylinders without removing the cylinder block from the chassis may be accomplished by means of the Model S portable machine which is now being introduced to the trade by the Storm Mfg. Co., 406 Sixth Ave., S., Minneapolis, Minn. This machine is clamped on top of the cylinder block by means of a bolt and yoke, after the cylinder head and pistons have been removed. The bolt is dropped through the cylinder, and as this is done, a swivel cross-member on the bolt automatically catches fast. The main bearings for supporting the boring-bar are cast integral with the body casting to insure perfect alignment of the various machine members. Adjustment of the bearings is possible through split taper bushings and adjustable collars. Storm patented cutter-heads are used on this machine, but, while they embody the same principle as the cutters used on heavier machines built by this company, they are not interchangeable with those heads. The motor drive is standard, but the machine can also be so arranged as to derive its power from an electric drill.


Storm Reboring Machine

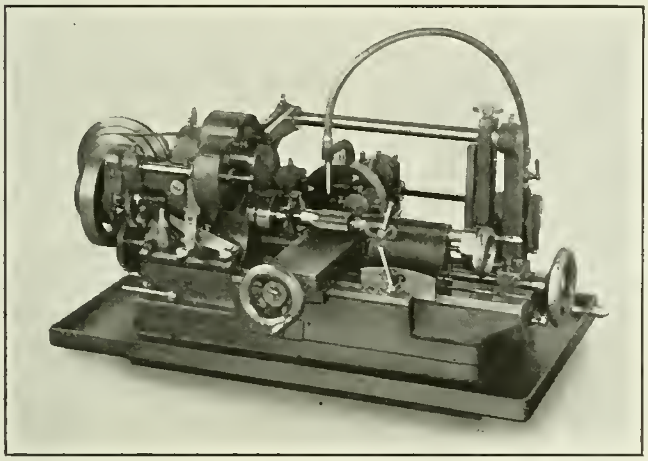


Fig. 1. Waltham Thread Milling Machine arranged for relieving Taps, Hobs, and Cutters

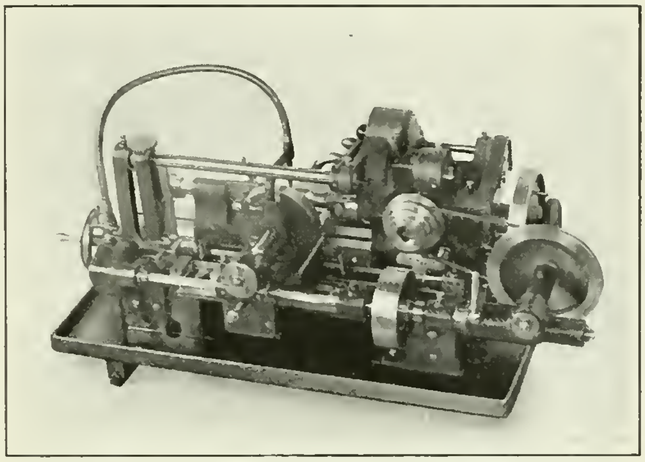
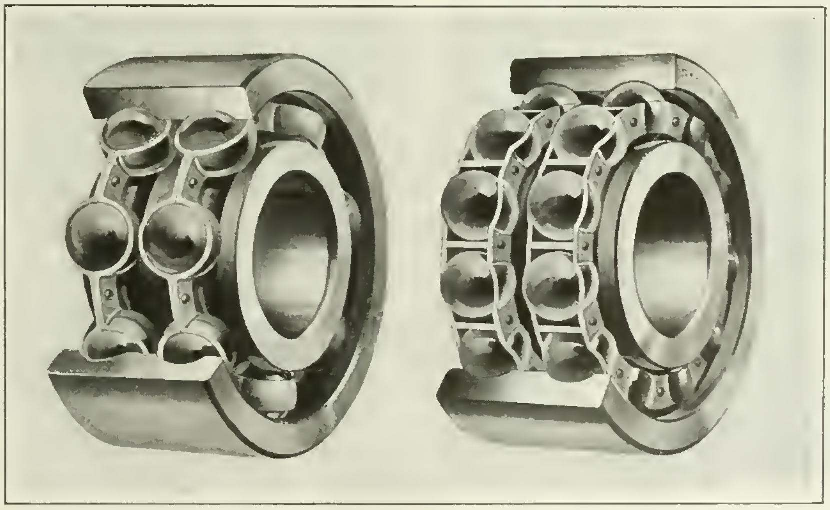


Fig. 2. Rear View of the Waltham Thread Milling Machine illustrated in Fig. 1

"STROM" DOUBLE-ROW RADIAL BALL BEARINGS

Double-row radial ball bearings of the types illustrated have been added to the line of "Strom" bearings manufactured by the U. S. Ball Bearing Mfg. Co., 4563 Palmer St., Chicago, Ill. These double-row bearings are known as "standard" and "maximum," respectively. The "maximum" bearings have 25 per cent greater capacity than the "standard" bearings of the same size, and for both types the permissible thrust load is 25 per cent of the available radial capacity. Special attention is called to the retainer construction of these bearings, two independent riveted retainers being provided, one for each row of balls. The new bearings are designed to carry heavy radial loads, but they are also capable of supporting thrust loads. They are especially adapted for installations requiring unusual bearing capacity in a limited amount of space.


Two New Types of "Strom" Radial Ball Bearings

RELIEVING ATTACHMENT FOR WALTHAM MILLER

To provide for relieving taps, hobs, and milling cutters, the Waltham Machine Works, Newton St., Waltham, Mass., are now prepared to furnish the thread milling machine of their manufacture with a compound taper attachment to replace the standard taper attachment regularly supplied with the machine. The compound taper attachment is arranged to travel forward and backward, being actuated by a cam through levers which may be adjusted to give the desired amount of relief to the work. The cam makes one revolution for each flute, and it can be cut for milling either concentrically, with ordinary reliefs, or with a combination of both.

In order to use the gearing necessary for operating the relieving attachment, according to the required number of flutes, a special driving mechanism is attached to the top of the work-head. There are two starting levers, one of which is used when relieving operations are being performed, and the other for ordinary threading operations. These levers are so arranged that when one is being employed, the other is locked. The compound taper attachment can be used for machining plain tapers in either direction, for straight milling, and for a combination of straight and taper milling. The change from the straight to the taper can be made automatically at any predetermined point. Spiral-fluted as well as straight-fluted work, and multiple threads as well as single threads may be relieved.

LE BLOND HEAVY-DUTY LATHE

A heavy-duty single-pulley-driven geared-head engine lathe is being placed on the market in two sizes, 25- and 27-inch, by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. The geared headstock furnishes sixteen selective speeds, and drives through a multiple-disk clutch. The lathe also embodies an improved change-gear mechanism and a one-piece box-section apron having a positive-jaw feeding clutch. The various spindle speeds are obtained by manipulating two levers on the headstock, and any speed may be immediately selected. The sliding gears are made of a nickel steel alloy and are heat-treated. The teeth are of stub form, rounded to permit easy engagement. The driving clutch may be operated by a lever at the front of the headstock and by a lever on the carriage. The latter feature provides for starting and stopping the spindle with the carriage at any position along the bed, which is invaluable on a long-bed lathe. Upon releasing the driving clutch, the lever also applies a friction brake to stop the spindle instantly. The headstock is kept flooded with oil from a submerged pump.

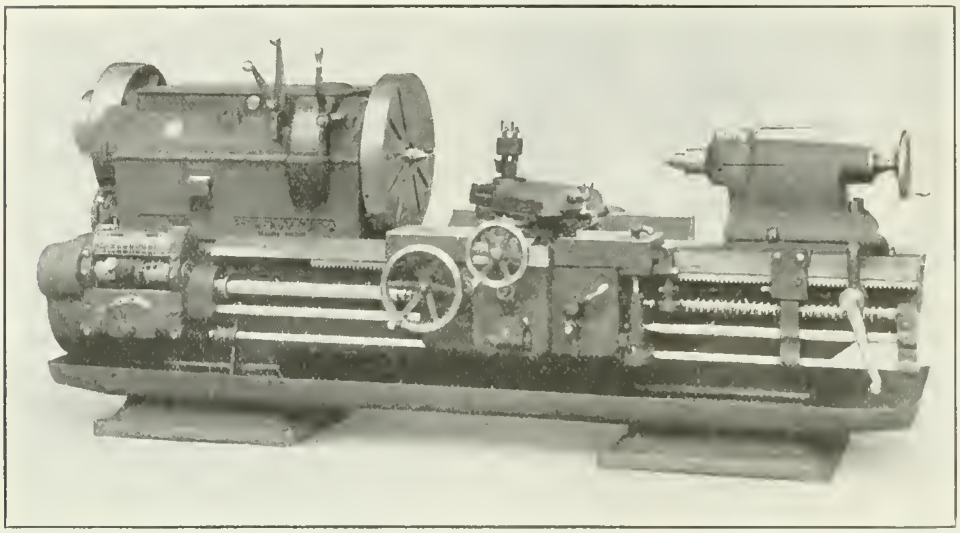


Fig. 1. LeBlond Heavy-duty Single-pulley Geared-head Engine Lathe

The bed has what is known as an "improved compensating vee." With this construction the back of the carriage travels on a flat surface, while the front slides on a guide which is approximately V-shaped, one side being machined at an angle of 15 degrees, and the other at an angle of 70 degrees. The 15-degree angular surface presents a thrust bearing at right angles to the resultant pressure on the tool, and automatically compensates for wear of both the carriage and bed. All tendency of the carriage to climb under heavy cuts is said to be eliminated by this vee construction.

The apron is of a patented construction in which both feeds are actuated by means of a single positive-jaw clutch. The feed is tripped in or out of mesh by a lever at the front of the apron, and the change from a horizontal to a cross feed, or vice versa, is accomplished by means of a sliding gear transmission operated through a knob which is located just above the feed clutch. When this device is set to a central position, all gears are disengaged. The compound-rest swivel is graduated in degrees for angular turning and taper boring, and adjustable taper gibs are provided to compensate for wear on all sliding surfaces The collar on the top slide screw is graduated to thousandths of an inch.

The carriage is accurately held on the bed by means of adjustable gibs, and a drop-forged clamp provides for locking it in position for facing operations. This clamp is tightened and loosened through a bolt, the hexagonal head of which is on the top of the carriage. The tailstock is held in alignment with the headstock by a vee at the rear, the front of the tailstock sliding on a flat surface. A tongue on the base of the tailstock fits a groove in the top member to keep the spindle in alignment with the headstock spindle. The tailstock is moved along the bed by a rack and pinion.

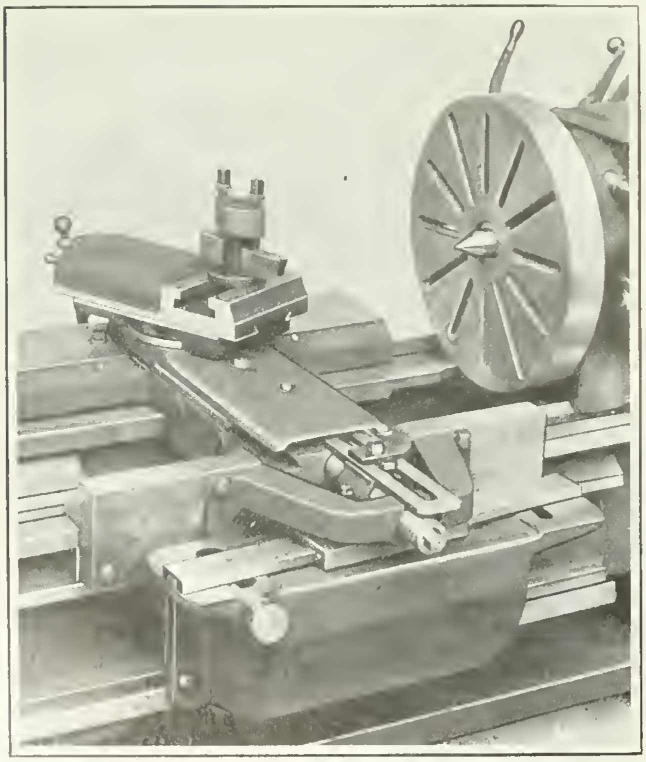


Fig. 2. Close View of the Taper Attachment and Carriage from the Rear of the Bed

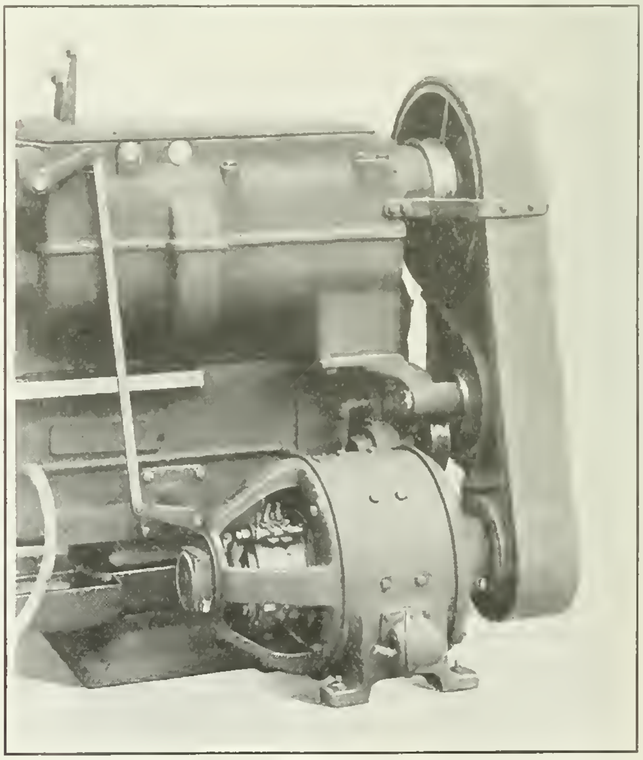


Fig. 3. Location of the Motor when the Drive is by Belt from a Constant-speed Motor

The quick-change gear mechanism is of the same general construction as has been supplied on LeBlond lathes for a number of years, but it has been improved and is of a heavier design. The range of threads and feeds has been selected to cover the usual requirements, the threads being forty-eight in number and ranging from ¾ to 46 threads per inch. A quick-change gear-box, arranged to provide for cutting a full commercial range of metric threads, may also be furnished, in which case the lead-, cross-feed and compound-rest screws have the threads cut according to the metric system. The lead-screw thread is regularly of special U. S. standard form, 1-inch pitch and 2 3/16 inches in diameter. A chasing dial provides for catching any thread without reversing the lead-screw.

The taper attachment is mounted on a bracket at the rear of the bed, as illustrated in Fig. 2, and may be moved to any position along this member. The guide bar is adjusted to suit the desired taper by means of a knob and graduations on the end of the bar. A steel draw-bar is provided for continuous heavy taper turning and boring operations, thus relieving the cross-feed screw of all strains.

Arrangements of Motor Drive

Three types of motor drive are furnished: A belted drive for constant-speed motors, either alternating or direct current; a constant-speed geared drive, for either alternating or direct current; and a variable-speed drive for direct-current variable-speed motors. In the belted drive, the motor is mounted on a hinged plate attached to the base of the lathe, as illustrated in Fig. 3, and a belt tightener pulley mounted on Hyatt roller bearings serves to increase the contact area of the belt on the motor and driving pulleys.

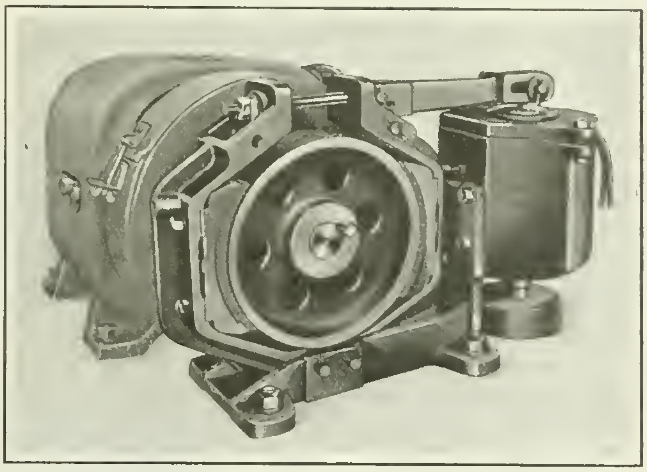
In the constant-speed geared drive, the motor is mounted on the top of the headstock and drives through a pinion and intermediate gear to a wide-faced gear substituted for the driving pulley. With direct-current motors an electrical control may replace the mechanical one on the apron. With alternating-current motors on which dynamic-brake controllers cannot be obtained, the spindle is controlled mechanically. However, it may be controlled electrically if the motor has a reversing control on which the first point of reverse is used for a brake. In the variable-speed geared drive, the motor is also mounted on the headstock and an electrical control is supplied. For constant-speed drives, a 15-horsepower motor running at 1750 revolutions per minute is recommended, and for a variable-speed drive, a motor of the same horsepower capacity, running at from 500 to 1500 revolutions per minute.

Specifications

Some of the principal specifications of this lathe are as follows: Swing over shears, 27½ inches on the 25-inch lathe, and 29½ inches on the 27-inch lathe; swing over carriage, 18¼ inches on the 25-inch lathe, and 20¾ inches on the 27-inch lathe; distance between centers on the 25-inch lathe with a 12-foot bed, 5 feet 9 inches, and on the 27-inch lathe, 5 feet 7 inches; range of spindle speeds, 8 to 300 revolutions per minute; range of feeds, 0.003 to 0.184 inch per revolution; approximate weight of a 25-inch lathe with a 12-foot bed, 10,100 pounds, and of a 27-inch lathe (12-foot bed), 10,520 pounds.

WHITING SOLENOID BRAKE

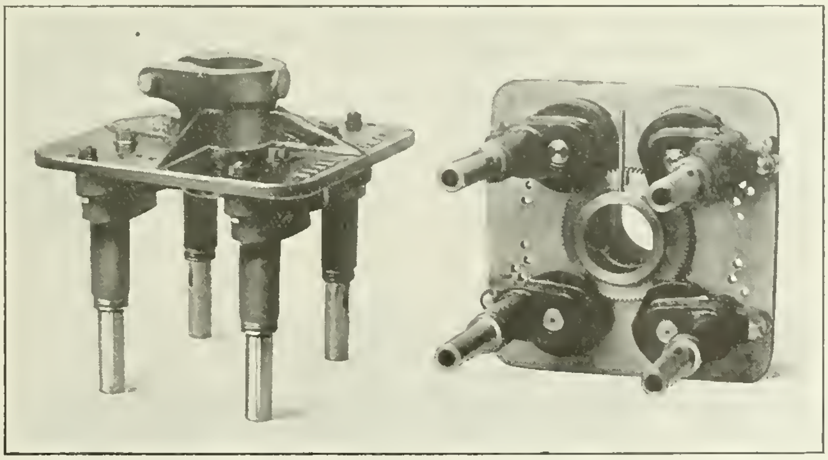
A quick-acting solenoid brake known as the Type C, which is designed especially for crane and other severe service, is now being manufactured by the Whiting Corporation, Harvey, Ill. The brake arms are so pivoted that the shoes release equally at all points, and thus eliminate any chance of their dragging at the lower end. The shoes are iron castings, while all parts subjected to stress are made of cast steel. The shoes are filled with asbestos composition which has been tested to be durable and heat resisting. In replacing a shoe, it is only necessary to remove four cap-screws and slide the shoe out.


Whiting Solenoid Brake for Cranes and Other Severe Service

On direct-current brakes the plunger is a piece of soft iron of large diameter, which gives a fast-operating solenoid even at light loads. The direct-current coil is designed to operate the brake at about 40 per cent of the full-load current and remain open at 10 per cent or less of the full-load current. The plunger on the alternating-current brake is made of laminated iron.

SELLEW ADJUSTABLE DRILL HEAD

An adjustable drill head on which the spindles can be set quickly and accurately, and positively locked in a predetermined position relative to each other, within a certain range, is being brought out by the Sellew Machine Tool Co., Pawtucket, R. I. The spindles of this head are held in position by means of two bolts, one of which is removable so that it can be inserted in the proper hole for the desired set-up. It is by this method that the correct locating and positive locking is assured. The head illustrated is intended for drilling six different sets of four holes each, at the corners of different sized rectangular parts, such as the feet of small motor frames that are produced in small lots, and require frequent resetting of the spindles. The body of the head is attached to the drilling machine quill with the central driving gear on the outside of the spindle nose, thus reducing the overhang of the auxiliary spindles to the minimum. The head is manufactured in several different sizes.


Sellew Adjustable Drill Head on which the Spindles may be quickly positioned

NEW MACHINERY AND TOOLS NOTES

Bench Drilling Machine: Joseph W. Jones, 29 W. 35th St., New York City. A bench drilling machine having a capacity for drilling holes up to ¼ inch through steel. The spindle motor is started and stopped automatically when the operator manipulates a handle to feed or elevate the spindle. This eliminates wear and tear, and reduces the current consumption. The machine is portable, weighing only 18 pounds, and can be driven from an electric light socket.

Wrenchless Chuck: Thomas Elevator Co., 24 S. Hoyne Ave., Chicago, Ill. Several changes have been made in the construction of the Barker wrenchless chuck, including a redesigned cam mechanism which gives greater strength and increased travel of the jaw. This makes it possible to handle a wider range of irregular work. In the smaller sizes, trunnion arms are eliminated by using a box cam, while in the larger sizes the arms have been redesigned to obtain greater strength and a wider range of movement. These changes make it possible to apply a long leverage without damaging the chuck.

Butt-welding Machine: Thomson Electric Welding Co., Lynn, Mass. A line of butt-welding machines especially adapted for making flash welds. In the smaller sizes pressure is applied to a movable slide by a toggle mechanism which provides a wide range of adjustment for the movable slide and enables the operator to apply the maximum welding pressure at the moment the toggle straightens out. In the larger sizes, the pressure is applied by hydraulic cylinders. The transformers are of the open type and of ample cross-section to carry all normal currents without resistance heating; they are also air-cooled.

* * *

TELLING HALF-TRUTHS TO ESCAPE OBLIGATIONS

By CHARLES W. LEE

Some wise person has said, "A little truth like a little learning is a dangerous thing," which reminds me that once upon a time when I was running a small toolmaking shop I received an order one day from a concern about fifty miles away for some tools to make an article, a sample of which came with the order. After two or three months of unsuccessful attempts to collect the bill for the tools, they were returned with the information that "they didn't work." Later, I learned, from a man who had worked for the concern fifty miles away, that the idea of making the article for which the tools were ordered was abandoned before the tools had ever been put to work.

And right here is where the little truth or the half-truth comes in. As the article was never made, the tools certainly did not work, and this little truth certainly was a dangerous thing to me to the extent of the amount of the uncollected bill.

Of course, such practices as these may be termed by some "lack of common honesty," and they are; the sooner the machine shop industries can be freed from concerns who conduct business on this basis, the better. If it were possible to arouse the builders of machinery and tools to common action in combating trade abuses, as referred to on page 228 of November MACHINERY, something might be accomplished that would discourage those who are not willing to fill their obligations.

* * *

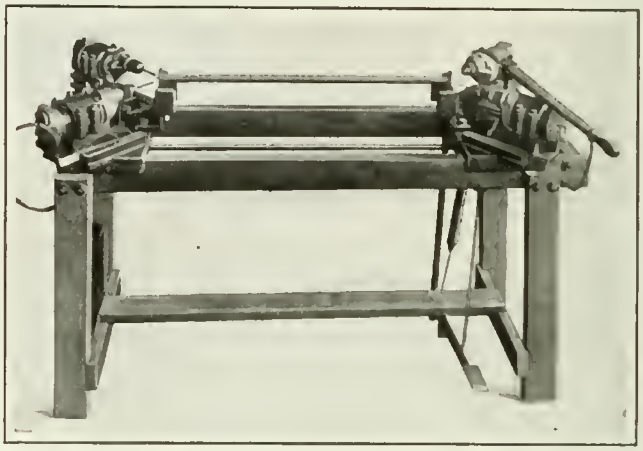
CORRECTION

In the foot-note accompanying the article "Simmons Method of Hob Making" in December MACHINERY, page 255, the address of the National Tool Co. was given incorrectly. The note should have read as follows: All the manufacturing rights of the Simmons Method-Hob Co. have been acquired by the National Tool Co., Cleveland, Ohio.

DRILLING HOLES IN SPOOL HEADS

A machine comprising four portable electric drills mounted on a stand for simultaneously drilling four holes angularly in the heads of textile spools or bobbins, wire spools, etc. is shown in the accompanying illustration. These holes receive wooden dowel-pins for holding the heads to the center or body, and insure against the heads unscrewing or loosening. A spool which measures 35 inches between the heads is shown ready for the drilling operation.

The electric drills are of standard make, and each is mounted on an adjustable base with the center of the spindle at an angle with the center line of the spool. The spindles may be fed either by hand or foot, or by both, as the actuating levers are connected. The motion is transmitted to all four drills through a splined shaft, rack, and pinion. The right-hand drilling unit can be adjusted to any point along the ways of the stand to accommodate spools of various lengths. The work is simply held in vees by the operator, as there is no tendency for it to turn or shift. The vees are adjustable vertically to suit different diameters of spools. The machine was built by Mulliner Bros., 445 S. Warren St., Syracuse, N. Y., for a textile machine manufacturing concern.


Machine for simultaneously drilling Four Holes in Each Head of Spools

* * *

LOCATING THE DECIMAL POINT IN SLIDE-RULE CALCULATIONS

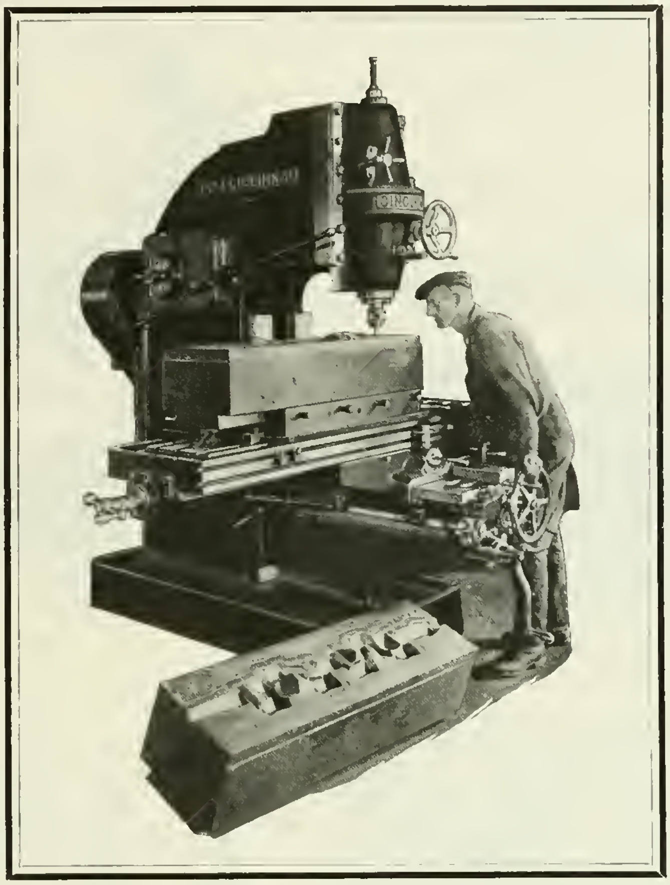
By HENRY R. BOWMAN

Many users of slide-rules have difficulty in memorizing the rules for pointing off the correct number of places. This difficulty may be overcome by simply marking the ends of the slide-rule. With a sharp-pointed scribe, mark the right-hand end of the D scale with the notation × —1 and under this mark ÷ + 1. These characters or notations indicate that in multiplying, if the slide projects to the right, the number of digits in the characteristic of the result is equal to the sum of the digits in the characteristics of the two factors less one; and that in division, if the slide projects to the right, the number of digits in the characteristic of the quotient equals the number of digits in the characteristic of the dividend minus the number of digits in the characteristic of the divisor plus one.

If desired, the left-hand end of the D scale can be marked × + and ÷ —, to indicate that when the slide projects to the left in multiplication, the number of digits in the characteristic of the result is equal to the sum of the digits in the characteristics of the two factors, and that in division, the number of places equals the number of digits in the characteristic of the dividend minus the number of digits in the characteristic of the divisor.

The simple plan outlined will aid in overcoming this trouble so often met with in the operation of the slide-rule.

CINCINNATI MILLERS



CINCINNATI No. 4 VERTICAL

DIE SINKING

Complete control from one position enables the operator to handle heavy dies with ease.

The convenient location of the power feed control levers (cross, vertical and longitudinal) encourages the operator to use the *power* feeds for roughing out the die. The right feed for any given cut is obtained through the movement of a single lever, without changing position.

An auxiliary hand wheel at the front of the saddle for the longitudinal table feed, is convenient when hand profiling.

And the spindle head can be instantly adjusted vertically.

For the long table adjustments the power quick traverse is used.

Have our Specialist make a study of your work

THE CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio

PERSONALS

George U. Hatch has been elected vice-president in charge of sales of the Millers Falls Co., 210 River St., Millers Falls, Mass.

Finley L. Walton has been appointed general sales manager of the Drop Forge Division of the Union Switch & Signal Co., Swissvale, Pa.

A. A. Heller has taken over the management of the International Oxygen Co., Newark, N. J., succeeding L. W. Hench, formerly secretary and general manager.

A. E. Jones, who has been sales engineer in the New York office of the Terry Steam Turbine Co., is now connected with W. B. Connor, Inc., 90 West St., New York City, in a similar capacity.

E. C. Brandt, works manager of the Westinghouse-Krantz Works, has been appointed works manager of the new plant now being erected by the Westinghouse Electric & Mfg. Co. in Homewood, Pittsburg, Pa.

T. A. Martin, for many years connected with the George H. Smith Steel Castings Co., Milwaukee, Wis., became general superintendent of the Farrell-Cheek Steel Foundry Co., Sandusky, Ohio, on December 1.

C. G. Taylor has been appointed director of purchases of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. C. G. Bunnell has been appointed purchasing agent of the East Pittsburg Works to succeed Mr. Taylor.

George Macnoe, manager of the Boston office of W. B. Connor, Inc., has been transferred to the main office at 90 West St., New York City, to take charge of the contractors' sales department, which handles heating and pumping equipment.

G. A. Sawin, assistant to the manager of the supply department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been elected chairman of the committee on instruments and measurements of the American Institute of Electrical Engineers. He has been a member of the committee since 1920.

S. L. Ayr has become manager of the Detroit territory of the Bantam Ball Bearing Co., Bantam, Conn. His headquarters will be at 905 Dime Bank Bldg., Detroit, Mich. Mr. Ayr has been assistant general manager of the Central Products Division of the General Motors Corporation, and previous to that was for twelve years production manager of the Truck Division of the Packard Motor Car Co.

L. F. Carlton, who was connected with the Consolidated Press Co. for eighteen years and consequently has a wide acquaintance among power press users, has been appointed western sales manager of the V. & O. Press Co., Brooklyn, N. Y., manufacturer of power presses and sheet-metal working machinery. The western office of the company is located at 549 Washington Blvd., Chicago, Ill. A stock of presses will be carried in Chicago, available for immediate shipment.

Arthur L. Collins, for the last six months associated with the Standard Steel & Bearings, Inc., has entered the tool and alloy steel department of Horace T. Potts & Co., Philadelphia, Pa., as sales metallurgist. His work will be with the various mills turning out the Potts brands of steels and with the users of these steels in advising on applications and heat-treatments. Mr. Collins graduated from Stevens Institute of Technology in 1914, and was with the Atlas Ball Co. as engineer of tests and metallurgist until 1920. He has been secretary and treasurer of the Philadelphia chapter of the American Society for Steel Treating since its inception.

L. M. Waite has been appointed general manager of the Garvin Machine Co., Spring and Varick Sts., New York City. Mr. Waite started his experience in the machine tool business with the Cleveland Automatic Machine Co., Cleveland, Ohio, as office boy and worked his way up until he became a salesman. He then entered the service of the National Acme Co., Cleveland, Ohio, and occupied positions in various capacities in both shop and sales work. He left the National Acme Co. after having been one of the company's sales managers for many years. During the following eight years he was identified with the machine tool industry in New England in both a manufacturing and a sales capacity, and he was sales manager of the Garvin Machine Co. for a year and a half, until he was made general manager on December 1.

F. F. Rohrer, assistant to the manager of the power and railway departments of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been appointed general contract manager of the company. He will have general supervision of all contract and order work, and in addition to this general work will continue to have direct charge of the contract work of the power and railway departments. Mr. Rohrer became connected with the Westinghouse Electric & Mfg. Co. as a student in 1896. After serving in the shops for four years, he was transferred to the sales department. During the war he was a member of the committee of the War Industries Board appointed to conserve the production of turbine generating equipment for government needs, and after the signing of the armistice, he became the representative of the Westinghouse company in the settlement of contracts that were terminated as a result of the ending of the war.

* * *

OBITUARY

Henry L. Kinsley, Wellesley, Mass., New England representative of the Warner & Swasey Co., Cleveland, Ohio, died Wednesday, November 22, at the Natick Hospital, Natick, Mass., following an operation. Mr. Kinsley was born in Stoughton, Mass., sixty-eight years ago. Practically all his business life was spent in the machine tool industry. He represented the Warner & Swasey Co. with offices at Boston for more than fifteen years, and was one of the best known machine tool men in the New England territory. Previous to his association with the company, he was with the Fairbanks Co. and the Manning, Maxwell & Moore Co.

* * *

AUTOMOBILE AND TRUCK PRODUCTION

The following table gives complete figures of the number of passenger cars and trucks manufactured for the first eight months of 1922, as published by the Department of Commerce. The reports collected by the Department cover ninety passenger car manufacturers and eighty makers of trucks.

1922	Passenger Cars	Trucks
January	81,693	9,416
February	109,171	13,195
March	152,959	19,761
April	197,216	22,342
May	232,431	23,788
June	263,027	25,984
July	224,057	21,357
August	246,941	24,064

* * *

FOREIGN TRADE SERVICE

The National Foreign Trade Council, India House, Hanover Square, New York City, has started a department known as the Trade Advisory Service, the object of which is to provide a medium for the interchange of foreign trade information. Manufacturers with foreign trade problems may submit their problems in writing to the Trade Advisory Secretary at the office of the National Foreign Trade Council. These problems will then be submitted confidentially to three or more men with wide experience in the particular field to which the inquiry refers. The replies will be gone over and condensed into a single answer, containing as clear and concise information as possible. It is believed that this service will be of particular value to the manufacturer entering the export field, but it will also be of value to the manufacturer with past experience, as it will enable him to obtain opinions upon new policies and provide him with a method of checking up his present practice with the experience of others.

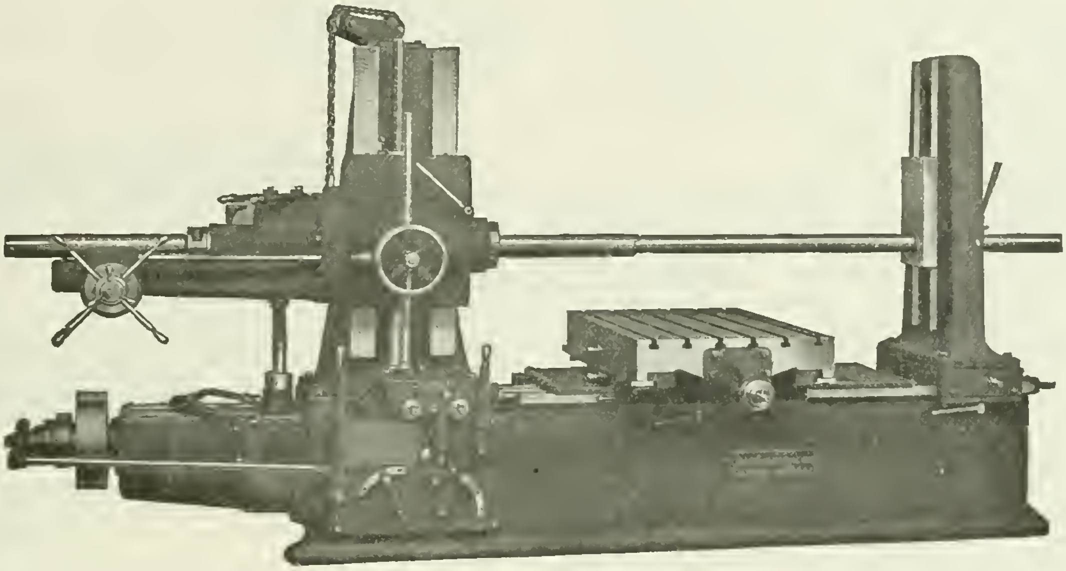
* * *

The United States Civil Service Commission, Washington, D. C., has announced a vacancy for a mechanical engineer of tests, in the aeronautical engineering laboratory at the Navy Yard, Washington, D. C. The duties of the engineer are to act as technical advisor and to take actual control of testing and designing work. Applications must be received not later than January 30. Further information can be obtained from the U. S. Civil Service Commission, Washington, D. C.

* * *

F. W. Aston of Trinity College, Cambridge, England, by his important experiments has laid a firm foundation for the belief that many substances hitherto regarded as elements are in reality not elements at all, but mixtures of "isotopes," that is, of genuine elements whose atomic weights are not far apart and whose chemical properties are identical, or at least so nearly so that chemical methods are incompetent to separate the constituent isotopes.

"A ship is a ship only when she's sailing"— And so a boring machine is a boring machine only when she's boring; and the same with a drilling or a milling machine.



When the

"PRECISION"

Boring, Drilling and MILLING MACHINE

is not doing one thing she is doing another, and often does all three at one setting of the work, therefore *Never Stands Idle.*

WE ALSO MAKE THE

LUCAS POWER

Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

TRADE NOTES

Arva Stroud announces the removal of the company's offices from 327 Broadway, New York City, to the Woolworth Bldg., 233 Broadway.

Larchar-Horton Co., specialists in advertising have moved into new and more commodious offices in the Franklin Block, 44 Franklin St., Providence, Rhode Island.

Air Reduction Sales Co. announces that the executive offices of this company are now located at 342 Madison Ave., New York City, and that the offices formerly maintained at 120 Broadway and 160 Fifth Ave., are now consolidated at the new address.

Monitor Controller Co., Baltimore, Md., manufacturer of the "Just-Press-a-Button" system of automatic control for motor-driven apparatus, has recently established a branch office at 1100 Elm St., Birmingham, Ala., of which William H. Neville is in charge.

Porter-Cable Machine Co., 1708-12 N. Salina St., Syracuse, N. Y., manufacturer of lathes and milling attachments, has appointed Wm. Battersby, 3325 N. 21st St., Philadelphia, Pa., exclusive agent in the Philadelphia territory, for the lathes manufactured by the company.

Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., manufacturer of air-operated chucking equipment and adjustable boring and reaming bars, has appointed George J. Keller district representative of the company for northern Ohio with headquarters at 14411 Savannah Ave., Cleveland, Ohio.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has taken a lease on a six-story building to be erected on a lot 100 by 150 feet, at Jones Ave. and Marietta St., Atlanta, Ga. The building, which is to be known as the Westinghouse Electric Bldg., will be constructed according to the company's specifications, and will be used as an office, warehouse, and service station.

Carpenter Steel Co., Reading, Pa., manufacturer of alloy and tool steels, announces that a report recently given wide publicity concerning the merger of the company with some other steel concern or its sale to other interests is entirely erroneous. No such negotiations are pending, and it is not contemplated that any change will be made in the present ownership and management.

Peter A. Frasse & Co., 417 Canal St., New York City, has been appointed exclusive eastern distributor for the electric carbon, alloy, and tool steels in bars, billets, and die-blocks manufactured by the Sizer Steel Corporation with plants at Buffalo and Solvay (Syracuse), N. Y. The Frasse Steel Works, Inc., Hartford, Conn., will act as exclusive New England distributor for the same company.

V & O Press Co., manufacturer of presses, dies, and sheet-metal working machinery, for many years located at Glendale, Brooklyn, N. Y., has started work on a new factory at Hudson, N. Y., to which the business will be moved about May 1, 1923. The new plant will provide increased facilities for the manufacture of the company's products, and will also enable the company to broaden the scope of its operations.

Canedy-Otto Mfg. Co., Chicago Heights, Ill., manufacturer of radial drilling machines of various types and other shop equipment, has put into operation a credit plan which permits the sale of the company's equipment by jobbers on terms of from four to twelve months. The plan is underwritten by the Continental Guaranty Corporation of New York, and will prove particularly advantageous to the garage or repair shop owner.

Ingersoll-Rand Co. and the A. S. Cameron Steam Pump Works announce the opening of a branch office at 718 Ellicott Square Bldg., Buffalo, N. Y. The new office is equipped to render full service to those interested in air, gas, and ammonia compressors, vacuum pumps, turbo blowers and compressors, condensers, oil and gas engines, pneumatic tools, rock drills, centrifugal and direct-acting pumps, and other products manufactured by these companies.

Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich., manufacturer of grinding machinery, will be exclusively represented by the following dealers in the territories specified: Manning, Maxwell & Moore, Inc., for the states of New York, New Jersey, Delaware, Maryland, and Pennsylvania east of Altoona; and Brown & Zortman Machinery Co. for the state of West Virginia, the western part of Pennsylvania, and the southeastern part of Ohio.

Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., has appointed the Kemp Machinery Co., 215 N. Calvert St., Baltimore, Md., exclusive representative for the sale of Diamant standard punch and die sets, in the territory covered by the states of Maryland, Virginia, District of Columbia, and West Virginia, consisting of Jefferson, Berkley, Morgan, Hampshire, Mineral Hardy, Grant, Pendleton, Randolph, Pocahontas, Green Brier, Monroe and Mercer counties.

Simonds Mfg. Co., Fitchburg, Mass., and Chicago, Ill., announces that the company's president, Alvan T. Simonds, has offered two prizes of $1000 and $500 for the best essays written by students of high schools and normal schools in the United States and Canada on the subject of "The Lack of Economic Intelligence and Some of the Injuries it has Caused Individual and General Welfare in the United States since 1860." Rules governing the contest may be obtained by addressing the Simonds Economic Prize Contest, 470 Main St., Fitchburg, Mass.

General Electric Co., Schenectady, N. Y., announces that a fund of $400,000 has been set aside to be known as the Charles A. Coffin Foundation, the income from which, amounting to approximately $20,000 a year, will be used for encouraging and rewarding service in the electrical field by giving prizes to its employes; by providing recognition to lighting, power, and railway companies that have instituted improvements in the service to the public; and by giving fellowships to graduate students for research work at technical schools and colleges.

Reed-Prentice Co., Worcester, Mass., announces that the company has purchased the good will, business, and part of the plant equipment of the Becker Milling Machine Co., Hyde Park, Mass.; and the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass. The Reed-Prentice Co. will in the future manufacture the products of the two companies mentioned in its own plant at Worcester. This gives the Reed-Prentice Co. a larger line of well-known machine tools, and makes it possible to run the company's sales, engineering, and operating divisions at greater capacity, whereas before, all three companies were burdened with decidedly over-expanded plants and organizations, due to the expansion that took place in practically every industry and every plant during the war. The products will carry their former names, but all manufacturing will be concentrated at the Reed-Prentice plant, and the selling will be done by the sales force of this company.

Roller-Smith Co., 233 Broadway, New York City, manufacturer of electrical instruments, meters, circuit breakers, and radio apparatus, has appointed the Electric Material Co. as its agent in the state of Washington, and parts of Oregon and Idaho. The Electric Material Co. has recently opened an office in the Hinckley Bldg., Seattle, Wash., and will handle the Roller Smith Co.'s line of electrical instruments in that territory. The main office of the company is at 589 Howard St., San Francisco, Cal., and it also has a branch office in the Title Insurance Building in Los Angeles, both of these offices also handling Roller-Smith apparatus. The Seattle office is in charge of R. F. Robinson, who has been engaged in the electrical industry since 1905, when he graduated from the University of Wisconsin with the degree of electrical engineer. He spent several years in the manufacturing department of the Western Electric Co., and later entered business for himself, first in the electrical supply line and later as a manufacturers' representative.

* * *

BUILDER OF CYLINDER BORING MACHINE

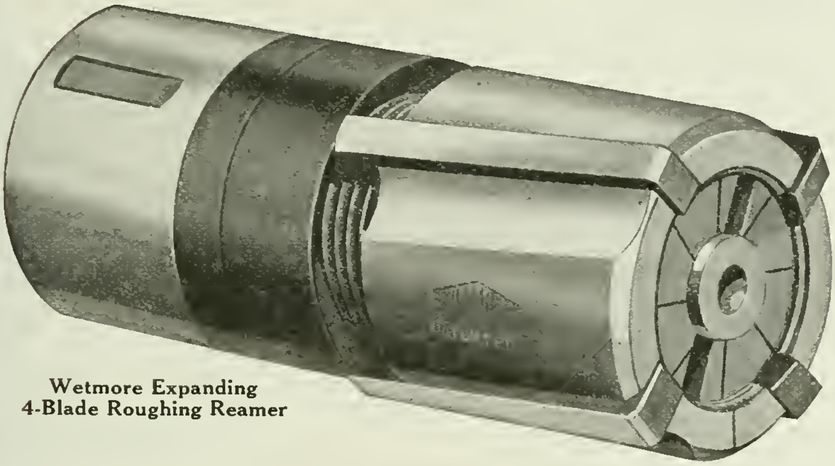
In the description of a machine designed by the Manufacturers' Consulting Engineers, Syracuse, N. Y., for boring air-cooled gas-engine cylinders and finishing the head of the cylinders at the end of the bore, which appeared on page 324 of December Machinery, it should also have been mentioned that this machine was built by the Meldrum-Gabrielson Corporation, Syracuse, for the H. H. Franklin Mfg. Co., of the same city.

* * *

METHODS FOR CHEMICAL ANALYSIS OF BABBITT METAL

The American Engineering Standards Committee, 29 W. 39th St., New York City, has approved as tentative American standard the methods for the chemical analysis of alloys of lead, tin, antimony, and copper—otherwise known as babbitt metal—submitted by the American Society for Testing Materials. Two methods of analysis are included in the procedure approved. The first is a quick and fairly accurate method intended for practical or shop use; the second is a slower, more elaborate, more expensive, but more exact method intended for reference purposes or for the settlement of disputed questions.

Every Reaming Operation is a WETMORE *Cost-Cutting Opportunity*



Wetmore Expanding
4-Blade Roughing Reamer

Look at the sturdy, compact construction of the Wetmore Expanding Four-blade Roughing Reamer (shown at the left). Its large chip clearance gives it an advantage for many jobs—particularly for reaming cored holes in rough castings. This 4-blade reamer works with very little friction, and it can stand up better and longer under the strain of heavy work. Blade replacement costs are less, too, with a Wetmore 4-blade.

WETMORE Expanding Reamers are specified in hundreds of the largest shops because they *cut production costs,* (1) by doing faster, more accurate work, (2) by their longer life. Here are a few Wetmore features that will interest you:

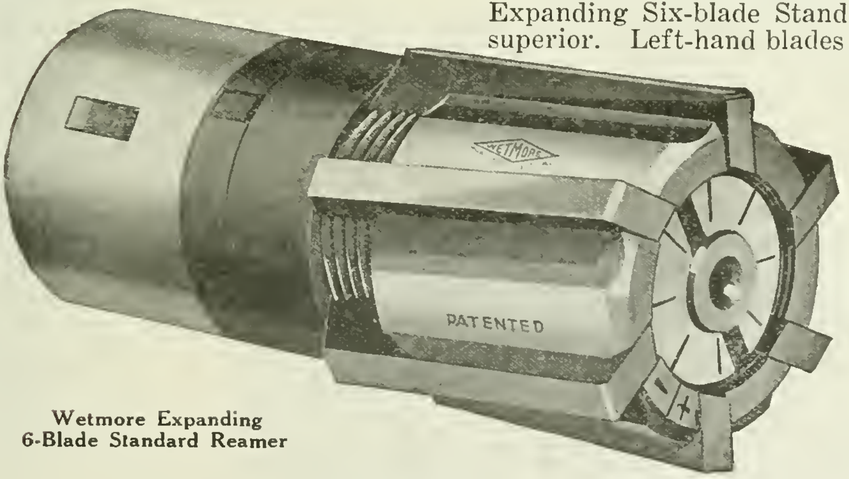
Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring of the reamer while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

For extreme accuracy and a glass-like finish, the Wetmore Expanding Six-blade Standard Reamer (at the left) has no superior. Left-hand blades of high-speed steel, hardened and ground—insure free cutting. Adjustments to .001 inch made rapidly and accurately by graduated screw at front of blades. *Solid* body is guaranteed against breakage.



Wetmore Expanding
6-Blade Standard Reamer

Free Handbook!

Write for your copy of the Wetmore Handbook of Expanding Reamers. New edition just off the press. Sent *free, postpaid,* if requested on your letterhead. No obligation to you.

WETMORE REAMER CO., 60-64 27th Street, Milwaukee, Wis.

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

COMING EVENTS

January 11-12—Annual meeting of the American Engineering Council at the new headquarters of the Federated American Engineering Societies in Washington, D. C. L. W. Wallace, 24 Jackson Place, Washington, D. C., secretary.

February 14-16—Convention of the American Institute of Electrical Engineers at the Engineering Societies' Bldg., 29 W. 39th St., New York City.

February 15-16—Winter sectional meeting of the American Society for Steel Treating, City Club, Chicago, Ill. National secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

February 17-22—Exposition of inventions and patents to be held at the Grand Central Palace, New York City, under the auspices of the Universal Patent Exposition Corporation. World's Tower Bldg., 110 W. 40th St., New York City.

February 19-21—Annual meeting of the American Institute of Mining and Metallurgical Engineers at the Engineering Societies' Bldg., 29 W. 39th St., New York City.

March 18-24—Second general meeting of the International Chamber of Commerce in Rome, Italy. Lacey C. Zapf, secretary American Section, Mills Bldg., Washington, D. C.

April 25-27—Tenth National Foreign Trade Convention in New Orleans, La. O. K. Davis, 1 Hanover Square, New York City, secretary.

April 30-May 3—Annual convention of the American Foundrymen's Association at Cleveland, Ohio. C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill., secretary.

NEW BOOKS AND PAMPHLETS

Tenth Annual Report of the Secretary of Commerce. 231 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C. Price, 25 cents.

A Study of Explosions of Gaseous Mixtures. By A. P. Kratz and C. Z. Rosecrans. 104 pages, 6 by 9 inches; 38 illustrations. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 133 of the Engineering Experiment Station. Price, 55 cents.

A Study of Air-Steam Mixtures. By Leroy A. Wilson and Charles Russ Richards. 96 pages, 6 by 9 inches; 29 illustrations, and 9 loose charts, 12½ by 14¼ inches. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill. Price, 75 cents.

Effect of Temperature, Deformation, and Rate of Loading on the Tensile Properties of Low-carbon Steel below the Thermal Critical Range. By H. J. French. 46 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 219, of the Bureau of Standards. Price, 10 cents.

Results of Some Compression Tests of Structural Steel Angles. By A. H. Stang and L. R. Strickenberg. 17 pages, 7 by 10 inches. Published by the Department of Commerce as Technologic Paper No. 218 of the Bureau of Standards. Sold by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 10 cents.

Fundamentals of Practical Mathematics. By George Wentworth, David Eugene Smith, and Herbert Druery Harper. 202 pages, 5 by 7½ inches; numerous illustrations. Published by Ginn & Co., New York City. Price, $1.20.

This is a text-book covering the fundamental arithmetical operations, ratio and proportion, mensuration, trigonometry, and the slide-rule. A great many exercises to be worked out by the student are included.

Engineering Work-shop Handbook. By Ernest Pull. 175 pages, 4¼ by 6¼ inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $1.25.

This book is of English origin, the author being chief instructor and lecturer at the London County Council School of Engineering. The object is to provide in as small a space as possible such information as would be required by a man starting to work in a machine shop.

Machine Shop Mathematics. By George Wentworth, David Eugene Smith, and Herbert Druery Harper. 162 pages, 5 by 7½ inches; numerous illustrations. Published by Ginn & Co., New York City. Price, $1.20.

This is a companion volume to the book "Fundamentals of Practical Mathematics." The user of this book is expected to have covered the work outlined in the previous volume. The present volume deals with measuring instruments, speeds and feeds, tapers and taper-turning, screw threads, indexing and spiral cutting, and gears.

Engineering Inspection. By E. A. Allcut and Charles J. King. 187 pages, 7 by 10 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $5.

The object of this book is to present in a compact and convenient form a description of the various principles involved in the inspection of machine shop products from the raw material to the finished article. The twelve chapters of the book cover the following subjects: Objects of Inspection; The Receipt and Storage of Material; Material Tests and Specifications; Inspection of Raw Materials; Inspection of Partly Finished Material; Inspection of Finished Material; Gages and Measuring Instruments; Machine Shop Inspection; Fitting and Erecting Shop Inspection; Final Tests; Repairs, Rectification, and Obsolete Parts; and the Human Element.

Tales from the Gangway. By Pat Dwyer. 450 pages, 6 by 9 inches. Published by the Penton Publishing Co., Cleveland, Ohio. Price, $3.

This is a collection of stories relating to foundry work, originally published in "The Foundry." Although told in story form, the book deals with actual phases of modern foundry practice, the purpose being to show the latest and most modern developments in the industry. One series of articles discusses pattern mounting methods, and another deals with cupola operation, gear and sheave molding, core making, and the preparation of sand. The aim is to present information required by the man who desires a comprehensive acquaintance with every branch of the business, including modern core making, molding, and cupola practice. The book is written in a humorous vein, and is illustrated with cartoons.

The Control of Quality in Manufacturing. By George S. Radford. 404 pages, 6 by 9 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $5.

This book is especially timely because of the efforts that are now being made everywhere in industry to cut costs and increase production. It shows how to control the quality of product to secure uniformity at minimum cost. The organization of an inspection department, and its relation to the department in charge of planning and operating, is discussed in detail. Other topics treated are measurement and errors; working standards; planning with material in process; problems of repetition manufacturing; and gages and gage-checking. As the principles of quality production, like those of quantity production are of universal application, the ideas can be applied to any industry.

Stores and Materials Control. By Madison Cartmell. 459 pages, 6 by 9 inches; numerous forms and charts. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $4.50.

This book covers store-keeping, manufacturing, and purchasing, treating all of these subjects from the point of view of the production executive. An effort has been made to explain in detail the procedure to be followed in an effective system of materials control in both large and small organizations. Special attention has been given to the procedure of the large plant, inasmuch as there the volume of work necessitates a close study of every detail and makes the problem a more difficult one. The book is divided into five main sections, of which the first deals with organization of a material control system, the second with the principles of control methods, the third with production control, the fourth with the work of the purchasing department, and the fifth with the methods used in formulating a system.

Production Grinding. By Fred B. Jacobs. 218 pages, 6 by 9 inches; 188 illustrations. Published by the Penton Publishing Co., Cleveland, Ohio. Price, $3.

This book describes grinding methods followed in representative plants engaged in the manufacture of accurate products. Much of the material was originally published in "Abrasive Industry," and the methods presented have been subjected to the test of successful commercial manufacture involving big output, accurately produced at proportionately low costs. The book illustrates and describes a great number of typical grinding operations, giving full data as to the wheels used, grinding output, methods of handling, etc. A variety of special fixtures and appliances for handling grinding room work are also illustrated and described. The material is intended for machinists, toolmakers, grinding machine operators, grinding room foremen, superintendents, production engineers, and plant managers. It covers the grinding of automobile parts, cams, ball bearings, dental parts, paper-mill rolls, milling cutters, dies, etc.

NEW CATALOGUES AND CIRCULARS

Whitman & Barnes Mfg. Co., Akron, Ohio, manufacturer of drills, reamers, and other small tools, is distributing a calendar for 1923.

Abrasive Co., Philadelphia, Pa. Booklet entitled "Borolon Polishing Grain," referring to various uses of this abrasive material.

Peter A. Frasse & Co., Inc., 417 Canal St., New York City. Stock list of "Frassteels" and seamless steel tubes, giving sizes carried in stock.

Wagner Electric Corporation, St. Louis, Mo. Card giving a brief description of the tests to which Wagner "Quality" transformers are subjected.

Linde Air Products Co., 30 E. 42nd St., New York City, is publishing a monthly bulletin called "Oxy-Acetylene Tips," the first issue of which appeared in August, 1922.

Union Switch & Signal Co., Swissvale, Pa., manufacturer of drop-forgings, is distributing a calendar for 1923, each sheet of which gives the calendar for three months.

Midwest Steel & Supply Co., Inc., 28 W. 44th St., New York City. Catalogue illustrating and describing Midwest steel sections for factory buildings, including box rails, "L" rails, and steel stringers.

Burke Machine Tool Co., 516 Sandusky St., Conneaut, Ohio. Circular illustrating and describing the Burke No. 10 automatic tapping machine, having a capacity for tapping from ⅛- to ⅝-inch holes in steel.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular illustrating Cleveland punching machines, shears, bending and straightening machines, rotary planers, wall radial drills, as well as punches, dies, and rivet sets.

Colonial Steel Co., Pittsburg, Pa. Booklet describing the character of Colonial No. 7 vanadium tool steel, and containing a statement of the classes of work for which this steel is adapted and the methods of heat-treating.

Griscom-Russell Co., 90 West St., New York City. Bulletins of the company's various products, including water heaters, oil heaters, evaporators, distillers, condensers, separators, and filters, bound together in a loose-leaf binder.

Marey & Co., Inc., Broome and Lafayette Sts., New York City. Catalogue of new and used machine tools and other metal-working machinery. The catalogue contains illustrations of the different machines and gives dimensions, capacity, weight, etc.

Colburn Machine Tool Plant of the Consolidated Machine Tool Corporation of America, 17 E. 42nd St., New York City. Bulletin D-104, illustrating and describing the Colburn No. 4 heavy-duty drilling machine. Important details in the design of the machine are shown and complete specifications given.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets No. 34 FE and 31 FE-s, giving capacities at various speeds of New Departure ball bearings of the double row, single row, "Radax" and magneto types. Sheet 151 FE, illustrating the application of New Departure ball bearings in metal-cutting band saws.

Alfred Herbert, Ltd., Coventry, England. Treatise on interchangeable threaded work, describing a limit gaging system embodying the essential principle of effective diameter control for screws, taps, and other threaded parts. The book contains a treatise on screw threads and on the application of the Wickman gage, together with tables of suggested tolerances for screw threads.

Waltham Machine Works, Waltham, Mass. Booklet entitled "Sub-presses and Dies," illustrating and describing cylindrical sub-presses and pillar sub-presses built by the company, as well as simple dies for blanking, piercing, bending, trimming, or shaving. The catalogue also describes tandem or follow-dies and compound dies, and indicates when the different types of dies ought to be employed.

Lees-Bradner Co., Cleveland, Ohio. Catalogue entitled "Gear Grinding," illustrating and describing the Lees-Bradner gear grinder, and containing a complete treatise on the company's gear grinding method. The book is profusely illustrated with line engravings and halftones, and deals with both the theory and practice of gear grinding, and the operation of the Lees-Bradner gear grinding machine.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Booklet entitled "Salient Facts on Silent Gears," the purpose of which is to acquaint the industrial gear user with the advantages of micarta gears. The booklet illustrates and describes the application of gears and pinions made from micarta, and also contains tables and gear data enabling the gear user to judge whether or not these gears would be applicable to the conditions met with in his types of machinery.

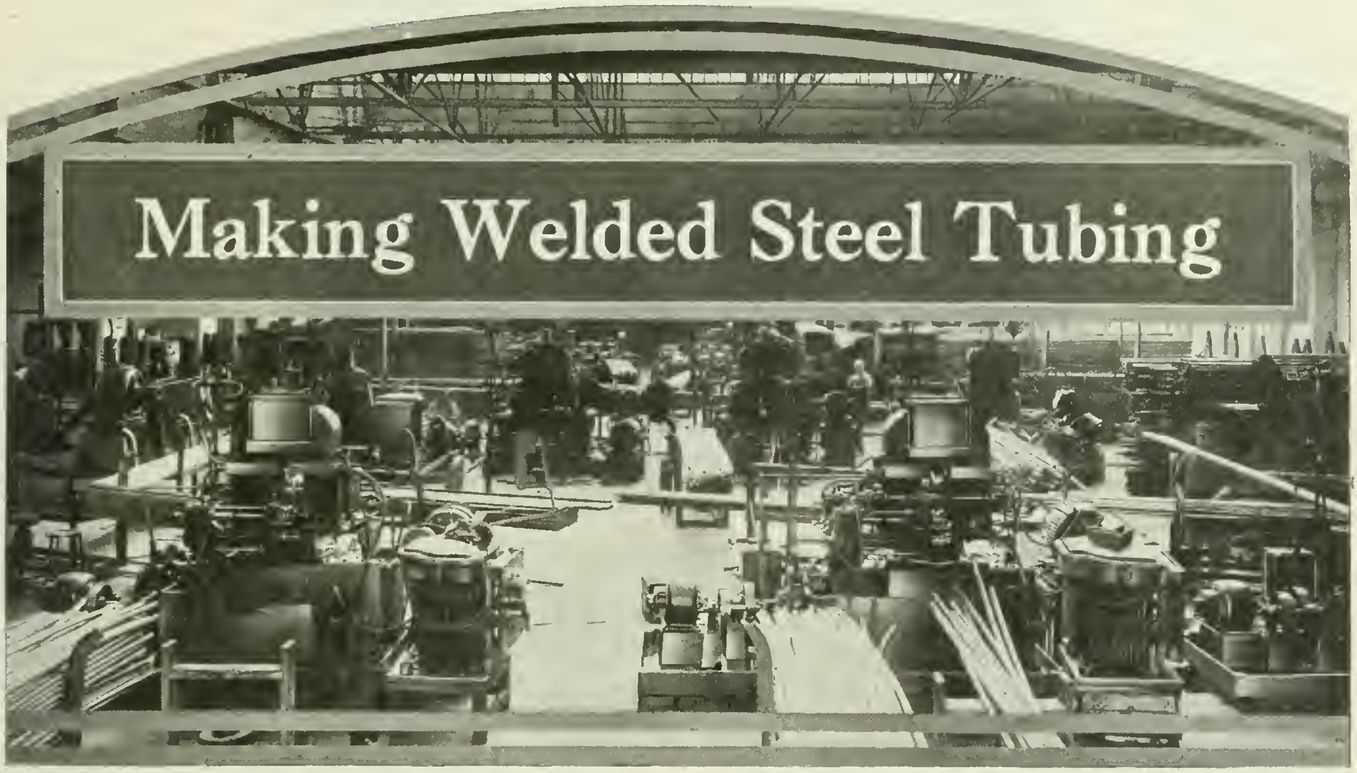
Adriance Machine Works, Inc., 82 Richards St., Brooklyn, N. Y. Catalogues, 6, 7, and 11, illustrating and describing, respectively, horning and wiring presses, double-action cam presses, and power punching presses. Tables of capacities and complete specifications are given for the different sizes of machines. Descriptions are also included of the Adriance positive clutch and the Adriance brake, with which all these presses are equipped.

Boston Gear Works, Norfolk Downs, Quincy, Mass. Catalogue 41, containing a complete list of 600,000 standardized Boston gears which this company carries in stock in 1500 different sizes. Dimensions and prices are given for the different sizes. In addition to the lists of gear sizes, a section of useful tabular matter is included, containing tables of circular pitch, diametral pitch, decimal equivalents, horsepower of belting and shafting, weights of brass rods, steel flats, and steel rounds.

Buffalo Forge Co., Buffalo, N. Y. General catalogue of the company's product, 180 pages, 8¼ by 11 inches, dealing with forges, hand blowers, tuyere irons, electric forge blowers and forges, post drills, hand and power drilling machines, power blowers and exhaust fans, hand and power punches and shears, bar cutters, bending machines, tire upsetters, universal woodworkers, heating furnaces, stationary forge shop equipment disk ventilating fans, heating, ventilating, drying, and mechanical draft apparatus.

FEBRUARY MACHINERY 1923

Making Welded Steel Tubing



Rolling the Tubing—Welding by Electric or Oxy-acetylene Process—Finishing the Welded Seam

By EDWARD K. HAMMOND

IN the manufacture of tubular pieces, such as steering columns, exhaust pipes, radius-rods and other automobile parts, as well as a variety of products for other industries, welded tubing is used in great quantities. The Standard Welding Co., Cleveland, Ohio, started to manufacture tubing in the days when the bicycle industry was at its height, and still supplies a large proportion of the material for frames, forks, and handle bars in that industry. The development of this department to its present size has gone hand in hand with the growth of the automotive industry, for there are no less than fourteen units in the chassis of an automobile for which this material is used. Welded tubing of the kind produced by this concern is made from flat stock, which is rolled into tubular form and then welded along the seam. In each case the material is delivered in the proper widths so that when it is rolled into shape the tube will be of the required diameter.

The tubing is rolled by a progressive set of forming rolls, as illustrated in Fig. 1. The approximate shape of the stock after it has passed between each pair of rolls is indicated in Fig. 3. The machine shown is equipped for forming round tubing, but this company also manufactures square tubing and other shapes. From Fig. 1 it will be understood that the strip steel from which the tubing is made is fed to the machine from a coil.

Various lengths are required, depending upon the use that is to be made of the tubing or the specifications of the customer. In order to obtain the proper length, the formed tube is run out of the machine on a bench which is marked in such a way that the operator can stop the machine when the end of the tube has reached a specified point and then cut off this length of tubing. The machine is then started again. This procedure is repeated until the complete coil of ribbon stock has been converted into tubes of the required length. Some customers order tubing with their company's name imprinted on it at specified intervals. When this is the case, a roll with the name embossed on it is set up on the machine ahead of the first pair of form rolls. This embossed roll is actuated in such a way that it is intermittently pressed against the stock as it passes through the machine.

After the tubes have been formed in this manner, the next operation is to weld the seam. Two different machines are employed for this purpose, one of which utilizes

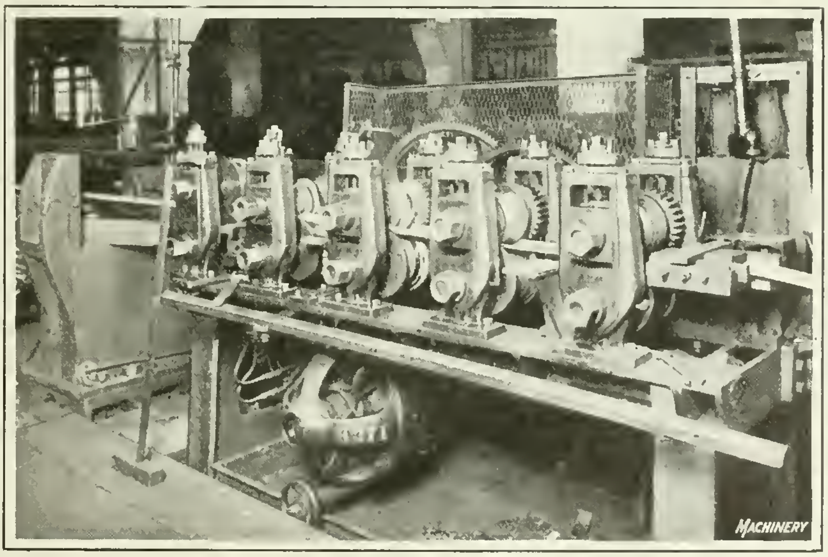


Fig. 1. Rolling the Strip Stock into Tubes in a Machine equipped with a Series of Rolls

electric current, and the other an oxy-acetylene flame. Both these machines are equipped with a feeding device to pass the tube under the source of heat and thus give continuity to the welded seam.

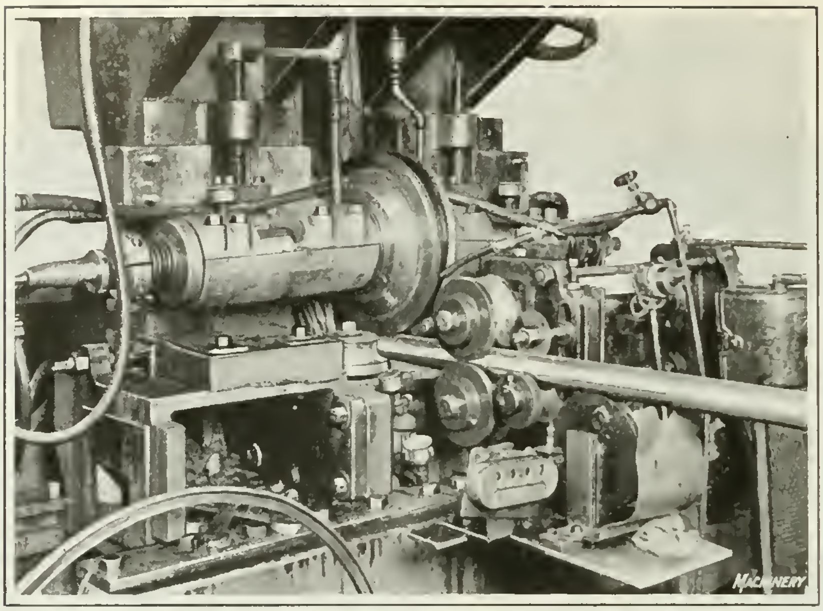


Fig. 2. Feeding Side of the Electric Welding Machine

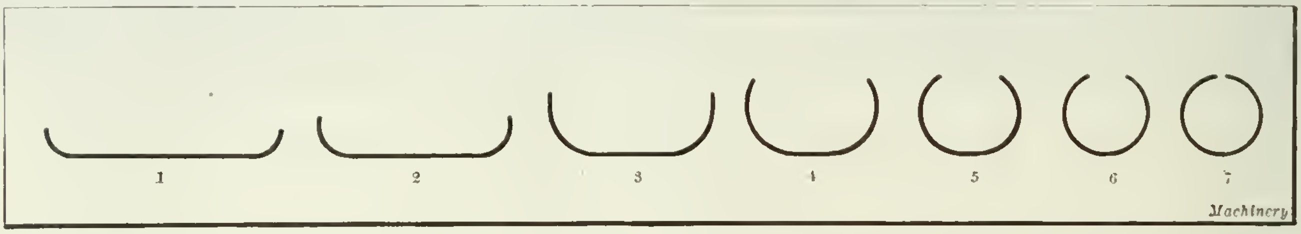


Fig. 3. Evolution of Tubing from Flat Stock

No metal is added in forming the weld in either the electric or the oxy-acetylene machine. In other words it is not the practice to melt metal from the end of a wire and allow it to flow into the joint as is often done in certain classes of welding. In the manufacture of steel tubing, as followed at the plant of the Standard Welding Co., the process is purely one of pressure welding, in which the application of heat raises the temperature of the steel to a point where cohesion is produced by the application of pressure.

Fig. 2 shows a close-up view of one of the electric welding machines in operation, and Fig. 4 shows the relation of the rolls and work during the process of welding. This machine contains pairs of traction rolls arranged at right angles to each other, which feed the tube through the machine. There is also a pair of large copper rolls which run in contact with the tubing at the point of welding, one of these rolls being the positive and the other the negative terminal of the electric circuit. The position of the welding rolls is shown in Fig. 4. A circular blade or spreader slides in the space between the two edges of the seam, thus serving the double purpose of guiding the tubing through the machine with the seam at the top, and keeping the two edges of the seam separated from each other until they reach a point directly beneath the copper welding rolls. The copper rolls, due to their design and angular position, press the edges of the seam into contact to facilitate welding, as the diagram shows.

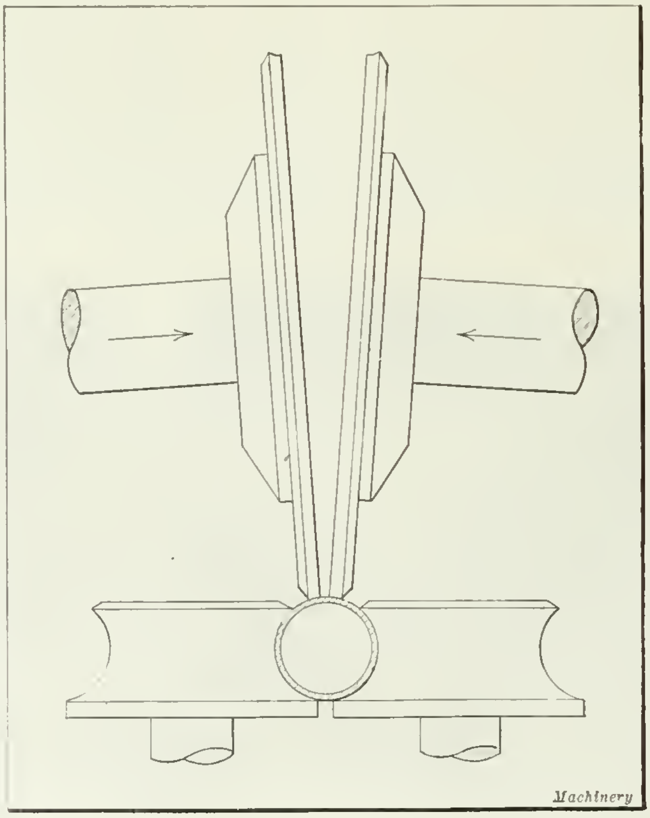


Fig. 4. Position of Welding and Feeding Rolls Relative to Work

The machines that use the oxy-acetylene flame for welding, instead of electric current, are to all intents and purposes exactly the same in design and operation as the electric welding machines. There are the traction rolls (see Fig. 6), which feed the work through the machine, and a blade which guides the tube through the machine with the seam at the top, and keeps the edges spread apart until they reach the welding point. But on these machines, the heat is supplied by an oxy-acetylene torch *A* of special design, which has orifices in it from which flames impinge upon the seam at the point where it is being welded.

Various methods are employed for removing the slight roughness along the surface of the welded seam, according to the purpose for which the finished tubing is to be used. Fig. 7 shows a machine for handling electrically welded tubing. It will be seen that the machine is furnished with a series of rolls which feed the tubing past three blades that take successive shearing cuts to remove the surplus metal along the seam. These feeding rolls are staggered in such a way that they also serve as straightening rolls.

Another method of finishing the seam in the tubing consists of grinding the entire length of the joint, and in still other cases a practice is made of simply grinding the points where the seam appears to be unusually rough When an exceptionally fine finish is required, the tubing may be ground all over, in addition to removing the surplus stock at the seam.

If the surplus metal is not removed from the seam by a combination machine of the type shown in Fig. 7, the tubing must be straightened in a separate operation, as illustrated in Fig. 5. This machine is provided with a yoke mounted on hollow trunnions through which the tubing is passed. Carried by the yoke there is a series of staggered rollers between which the tubing passes before emerging through the hole in the hollow trunnion at the opposite end. In operating this machine, the yoke revolves around the tubing, and the staggered rollers carried by it apply the necessary pressure to straighten the tube.

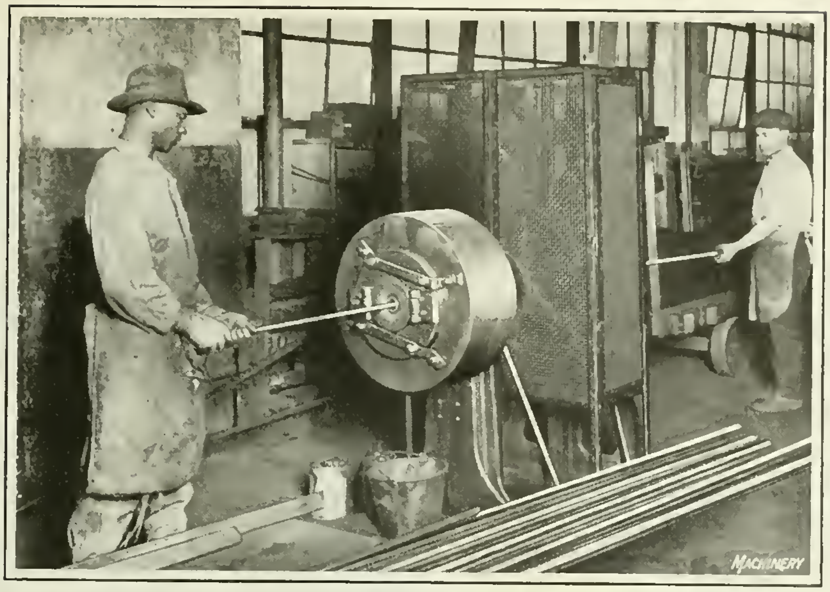


Fig. 5. Straightening Tubing in a Separate Operation

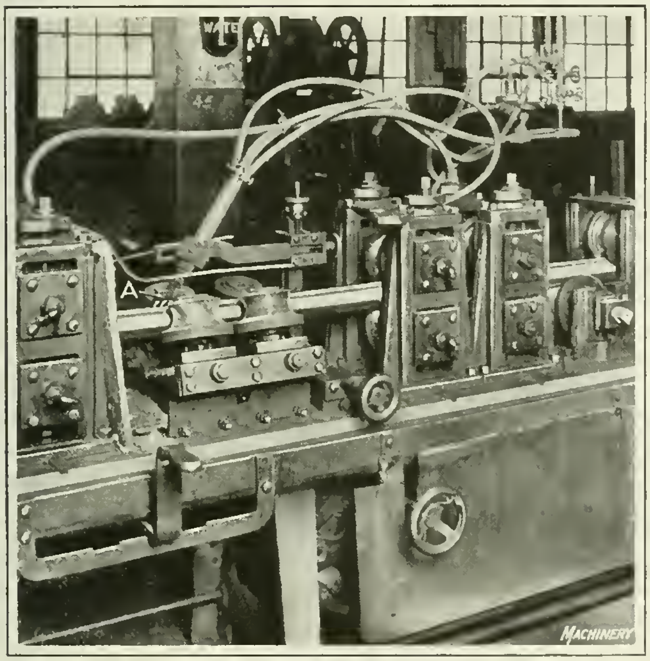


Fig. 6. Oxy-acetylene Machine for welding the Tubing

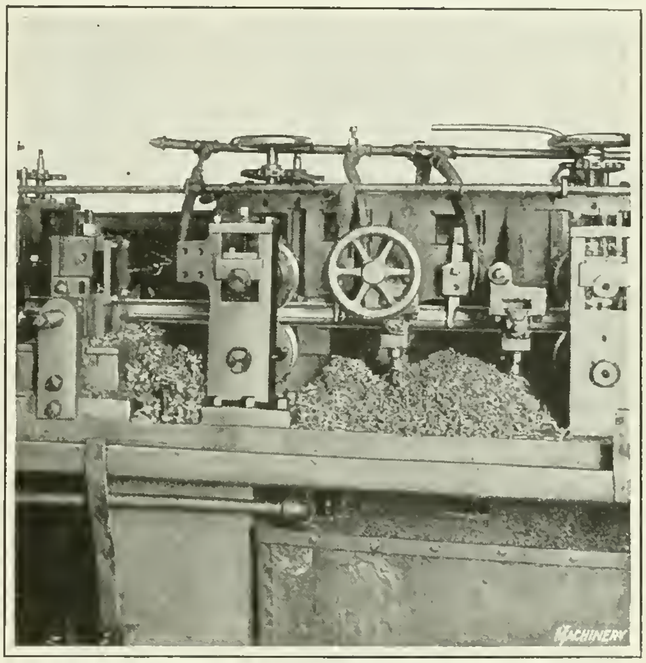


Fig. 7. Machine for finishing the Surface of the Welded Seam

Uses of Welded Steel Tubing

Mention was previously made of the fact that tubing is used by this company in the production of various products. Although it is not within the scope of this article to enter into a detailed description of the way in which such parts are made, it may be of interest to refer briefly to the procedure followed in bending the tubing, which is necessary in the manufacture of many tubular parts. In bending, there would be a tendency to crush the tube unless it were supported from the inside, and this is accomplished by filling the tube with melted rosin.

The tubes to be bent are placed vertically in a rack and paper plugs are inserted in the lower ends. Then melted rosin is poured in at the top until each tube is full. After the rosin has solidified, the bending is accomplished, either by bulldozers equipped with suitable dies or by bending rolls. Fig. 8 shows a bulldozer being used for the final operation on an automobile exhaust pipe. The operation consists of upsetting a flange at one end. All the other bends in the pipe were made previous to this on bulldozers equipped with dies of the required form. After all the bends have been made, the tubes go back to the department where they were filled with rosin. Here they are stood endwise over a trough and heat is applied with a torch so that the rosin melts and runs out.

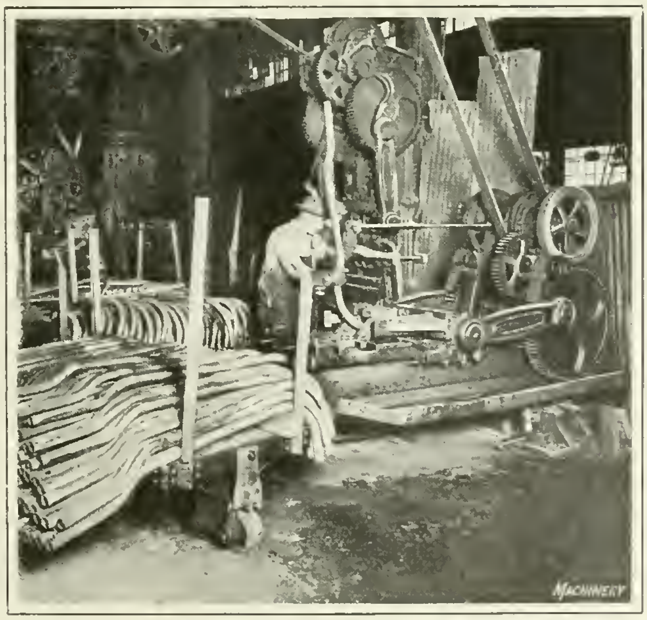
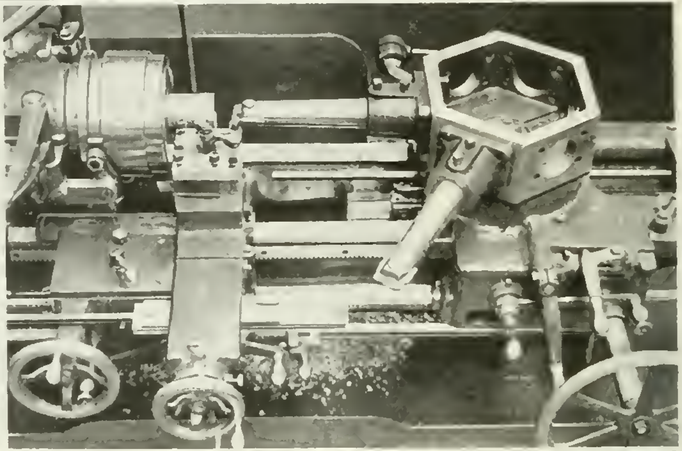


Fig. 8. Use of a Bulldozer for bending an Automobile Exhaust Pipe

The possibilities in the after-fabrication of welded tubing are quite varied. It can be bent to different radii, or swaged to varying diameters in one piece. Great accuracy as to gage and diameter may be secured.

Using the Turret Lathe for Small Lots



Examples Showing How Small Quantities of Castings and Forgings can be Machined Economically on the Turret Lathe

By ALBERT A. DOWD, President
Dowd Engineering Co., New York

THE suitability of the turret lathe for machining parts from bar stock when only a limited number of one kind is required was dealt with in the article "Using the Turret Lathe for Small Lots" in December MACHINERY. The value of this type of machine for small lots is not often recognized, and, in consequence, turret lathes frequently remain idle in many plants, when they could be profitably employed on duplicate work being produced on engine lathes. Work that is held in a chuck while being machined on a turret lathe, such as castings and forgings, presents more problems than bar work, and as there are frequently only a few pieces in a lot, the manufacturer often considers that it can be handled more economically on an engine lathe. In reality, much of this work can be handled more advantageously on a turret lathe equipped with adjustable standard tools. By selecting these tools judiciously, it is possible to machine a large variety of chuck work at a minimum cost.

It is of first importance that the operator be able to work with little loss of time or error in judgment in selecting the method he intends to use for a given piece of work. The handling of this work, of course, is entirely different from the normal production methods employed on the turret lathe. Tools on the cross-slide turret may be used to turn the different diameters on the first piece, and then, while the work remains in the chuck, the various tools on the hexagon turret can be easily set to the finished diameters. The stops for determining the different lengths of cuts can finally be adjusted to facilitate the machining of the remaining pieces in the lot.

Several examples of work that can be economically produced in small lots on the turret lathe are shown in Fig. 1. These parts are finished all over, with the exception of parts *C* and *D* on which the surfaces to be machined are indicated by finish marks. On casting *A*, the concentricity of the hole and the external cylindrical surfaces are not of great importance, but the diameter of the hole must be within ordinary commercial limits. Example *B* is a solid steel forging having a center hole about ¼ inch smaller in diameter than the finished hole, drilled through it before it is brought to the turret lathe. The example shown at *C* is a steel casting. The flywheel pulley *D* is made of cast iron, and part *E* is a forging which comes from the hammer as a solid steel billet forged roughly to shape on the outside. Collar *F* is made of bronze and threaded on the outside cylindrical surface after all surfaces have been finished. The tooling equipment used in machining each of these pieces is described in the following.

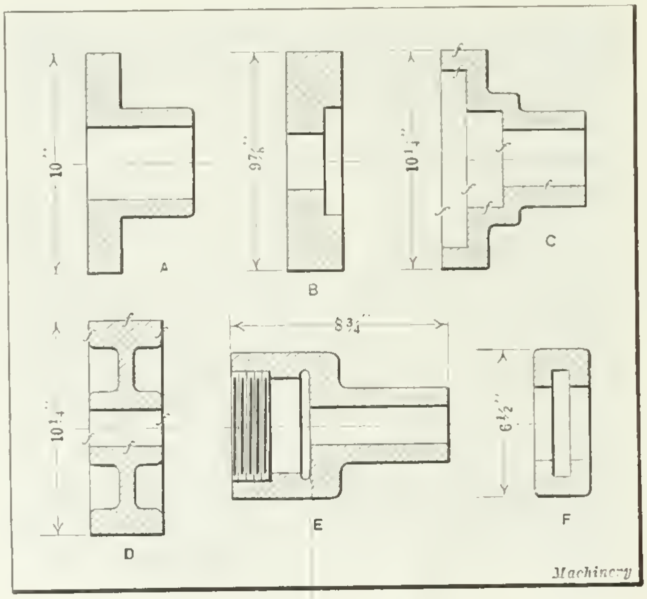


Fig. 1. Examples of Castings and Forgings that can be machined profitably in Small Lots on the Turret Lathe

Selection of Tooling Equipment

It will be assumed that the parts shown in Fig. 1 are machined on a turret lathe built by the Warner & Swasey Co., Cleveland, Ohio. Fig. 2 shows a flexible lay-out of standard tools for such a machine, suitable for handling a considerable range of chuck work. Tools *A*, *B*, and *C* are standard turning and facing heads, so designed that boring-bars *E*, *F*, and *G* can be used in connection with single or multiple cutter-bars *H*, *K*, and *L*. Each turning and facing head has holes at various distances from the center to accommodate these cutter-bars. This provision makes it possible not only to set up tools to turn several surfaces at one time, but also to determine shoulder distances with precision when it is necessary to set the bars forward or backward.

The vertical slide tools *M* and *N* are utilized for boring, back-facing and recessing, and as they have two holes for bars, it will be seen that a number of different conditions can be met. The slides have a micrometer dial, which facilitates the making of accurate settings. The last turret face is provided with a standard tool-holder *O* intended to hold a boring-bar, reamer, or special tool. All tools in this set-up can be readily removed and replaced in a short time to enable parts of unusual shape to be handled. However, the flexibility of the equipment is such that many pieces can be handled without any change except in the adjustments of the cutting tools. The square toolpost

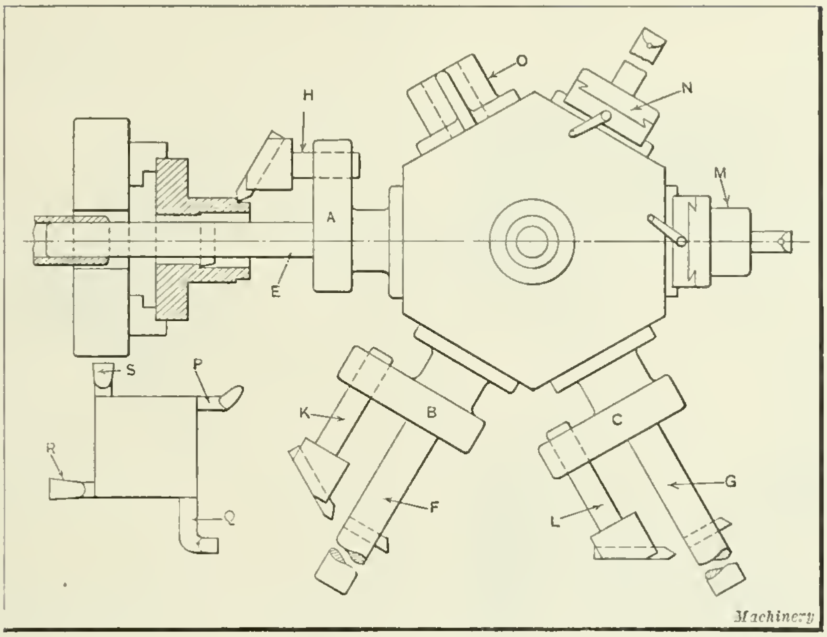


Fig. 2. Turret Lathe Tooling Equipment which provides for handling a Large Range of Chuck Work

or turret of the cross-slide carries forged tools *P*, *Q*, *R*. and *S*. These may be used for turning, facing, or grooving, as the occasion requires, and can be quickly and easily replaced when special tools are necessary.

The first operation in machining part *A* Fig. 1, consists of boring the hole by means of a cutter in boring-bar *E*, Fig. 2, turning the cylindrical body with the adjustable tool in holder *H*, indexing the turret, finish-boring the hole with the tool in boring-bar *F*, and finish-turning the body with the tool in holder *K*. While these cuts are being taken, the end of the piece is rough- and finish-faced by tools *P* and *Q* on the cross-slide turret. After these cuts have been taken on the first part in a lot, the turret and cross-slide stops are set so that all parts of the same lot can be readily machined to the same dimensions. For this job the lathe is equipped with a three-jaw universal chuck having hardened removable and reversible top jaws. These can easily be replaced by soft or special jaws when needed.

After these cuts are taken on all parts of the lot, the chuck is provided with a set of soft jaws, as shown in Fig. 3, to suit the second operation. In the first step of this operation, the work is again bored by a tool in boring-bar *E*, and the periphery of the flange is turned by the tool in holder *H*, these tools, of course, having been adjusted prior to this step. At the same time tool *P* on the cross-slide turret rough-faces the flange.

Then in the second and final step on the part, the hole is finish-bored by the tool in boring-bar *F*, the flange periphery finish-turned by the tool in holder *K*, and the flange finish-faced by tool *Q* on the cross-slide turret. It might be possible to dispense with boring the hole in this operation, because extreme accuracy of the hole is not required. In that event the tool could be removed from boring-bar *F* and the bar used simply as a pilot to give additional stiffness to the set-up and thus insure the accuracy of the turned diameter.

In machining forging *B*, Fig. 1, it will be found more profitable to rough-drill the hole prior to the turret lathe operation. However, if it is desired to produce the rough hole while the work is mounted in the turret lathe, a drill may be inserted in holder *O*, Fig. 2, for the purpose. Assuming that the hole has been drilled in a previous operation, the work is held in the chuck by the same set of standard jaws as is shown in Fig. 2. Before the first operation on the part, as shown in the upper part of Fig. 4, the turning tool-holder is removed from head *A*, although it would be possible to employ this tool for turning off some of the stock on the cylindrical surface of the work. In this case less stock would need to be removed later.

First Operation on Part B

In this step the hole is bored by the tool in boring-bar *E*, tool *P* on the cross-slide turret being utilized at the same

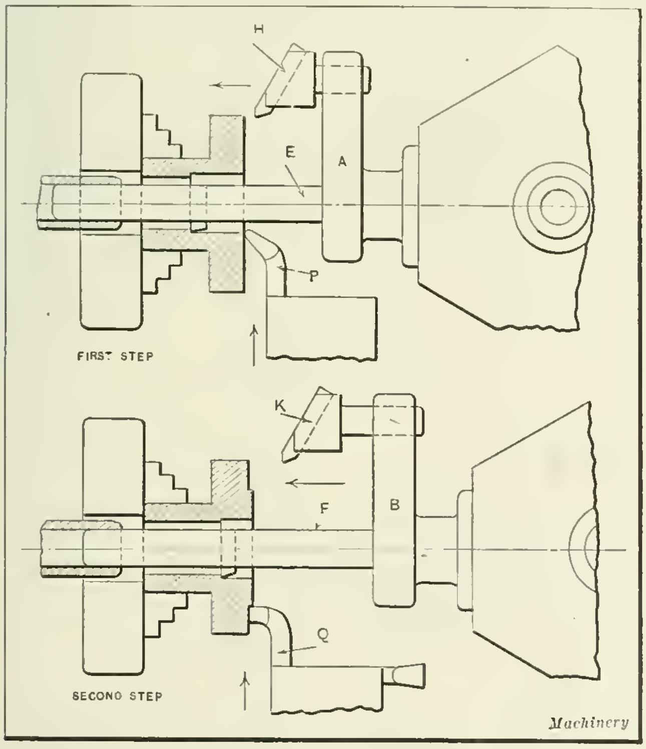


Fig. 3. Two Steps in the Final Machining Operations on the Part shown at A in Fig. 1

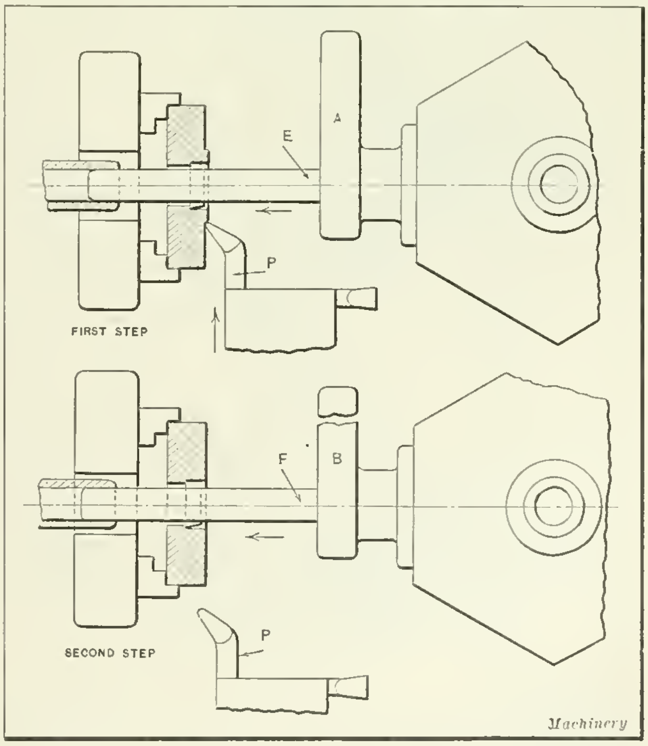


Fig. 4. Rough- and finish-boring the Hole of Part B, Fig. 1, and facing One Side

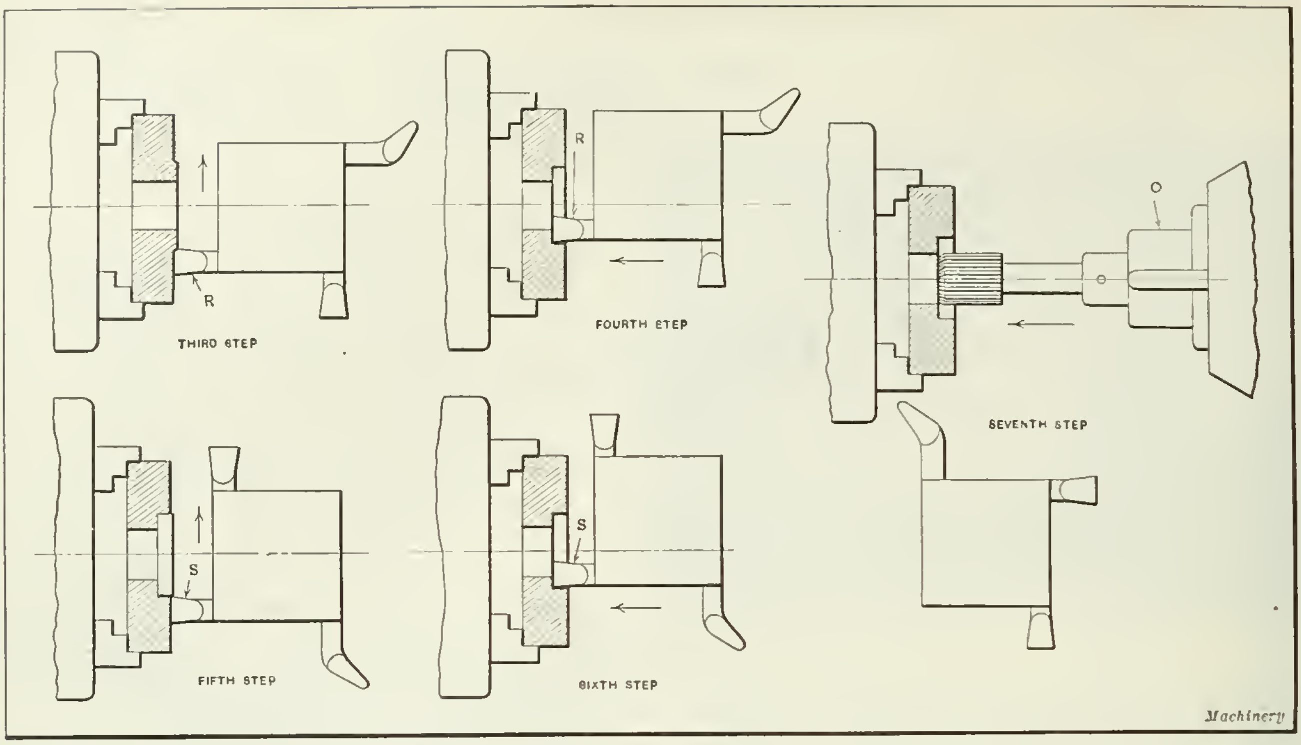


Fig. 5. Four Facing and Recessing Steps in which Tools on the Cross-slide Turret are employed, and a Final Reaming Step accomplished by Means of a Reamer on the Hexagon Turret

time for removing the scale on the face of the forging. In the second step, the hole is finish-bored by the tool in boring-bar *F*. As the facing cut in the first of these steps is somewhat longer than the boring cut, the tool in boring-bar *E* may be fed partly through the work before the facing cut has been completed. By using a somewhat coarser feed for the cross-slide than for the hexagon turret, both rough-boring and rough-facing cuts could be completed at approximately the same time. Such a procedure would permit the second boring step to be taken at a faster rate of feed than the first boring operation as the cross-slide turret tool would not need to be taken into consideration.

For the third step, the hexagon turret is moved away from the work and the cross-slide turret tool *R* is used for facing the part, as shown in Fig. 5. By setting this tool in such a manner that the heel drags slightly across the work and removing only a small amount of stock, a coarse feed may be employed, thus reducing the time of the cut.

In the fourth step, the pocket or recess is roughed out by means of tool *R*. Two methods of feeding the tool are possible in removing the stock from this pocket; the cross-slide may be fed longitudinally, or the tool may be started at the edge of the smaller hole and fed radially outward, as indicated by the arrows. Whichever method is used,

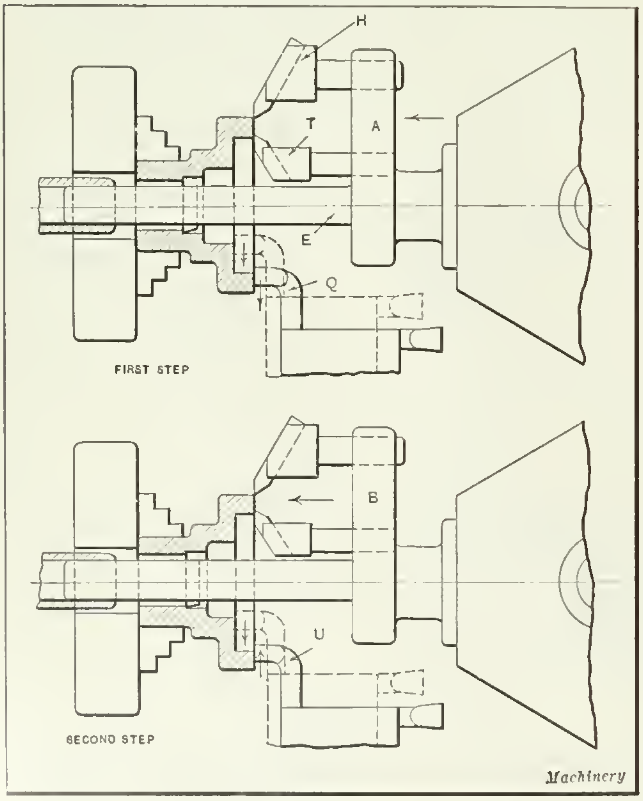


Fig. 6. First and Second Steps in which Certain Surfaces of Part C, Fig. 1, are rough- and finish-machined

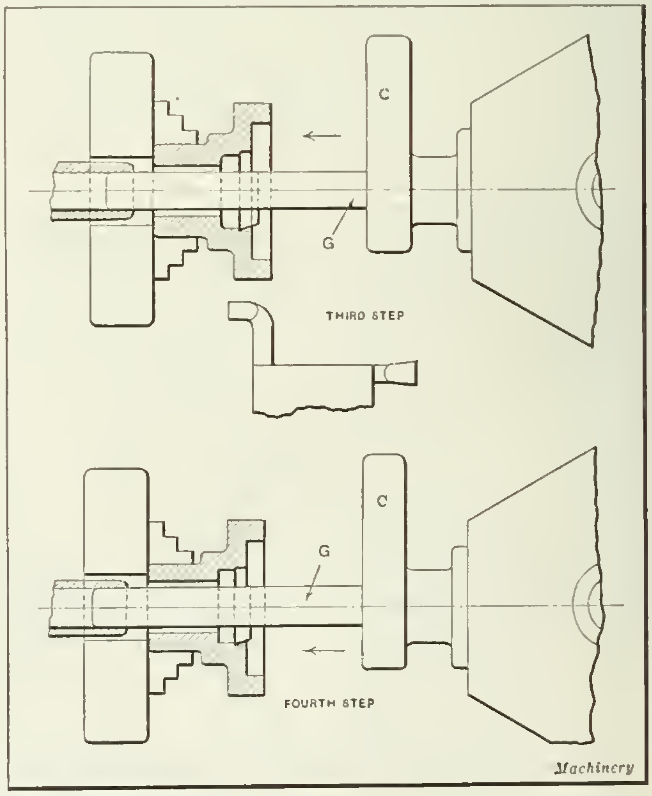


Fig. 7. Third and Fourth Steps on Part C in which the Second Internal Pocket is rough- and finish-bored

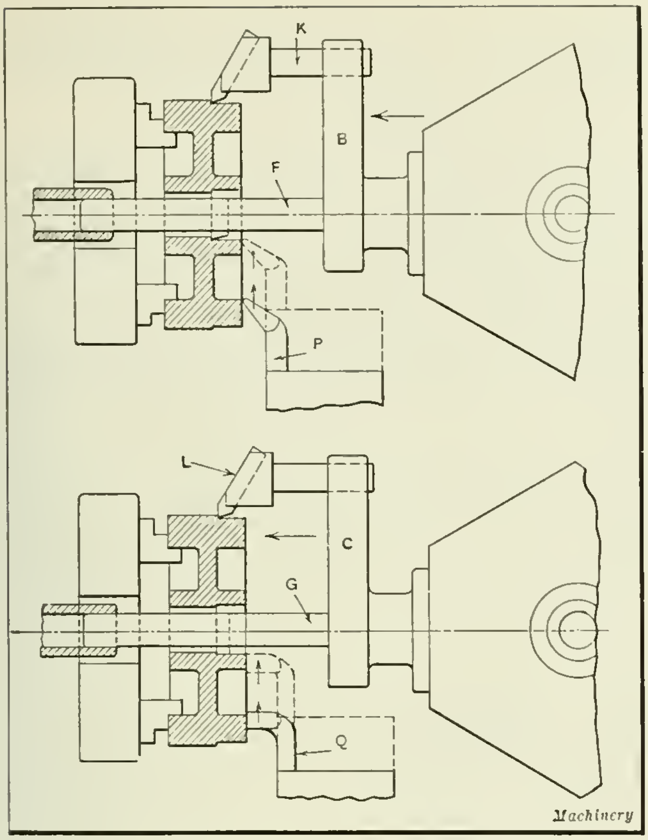


Fig. 8. Rough and Finish Turning, Facing and Boring Steps on a Flywheel Pulley

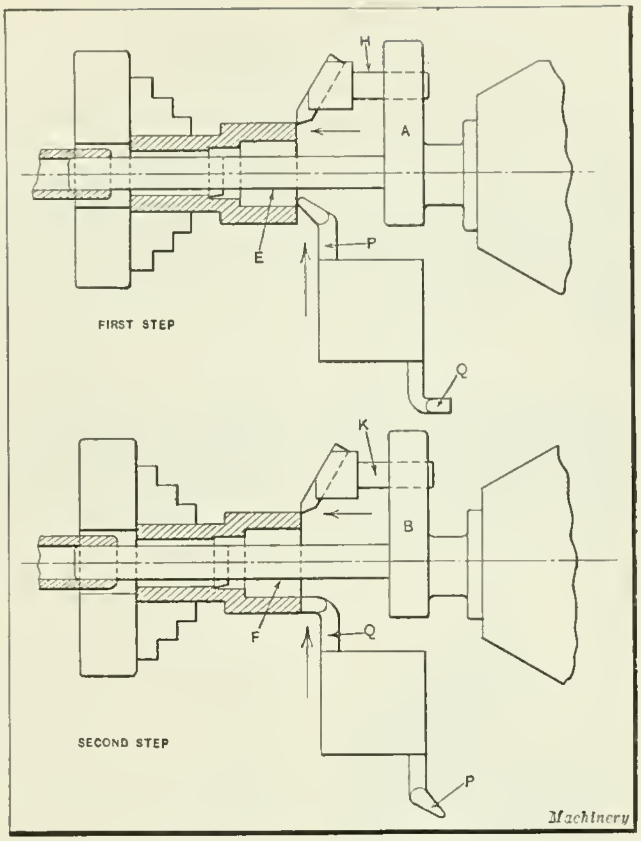


Fig. 9. Preliminary Steps on a Steel Billet, in which the Piece is rough- and finish-turned, faced, and bored

the final sizing of the shoulder should be accomplished by moving the cross-slide longitudinally because greater accuracy can be obtained in this way. If a tool of this type is fed longitudinally against the work, when much stock is removed considerable chatter is likely to develop. However, this depends on the way in which the tool is ground, the rate of feed, and the quality of the material.

Fifth, Sixth, and Seventh Operations on Part B

In the fifth step on part *B*, a final finishing cut is taken across the face of the work by tool *S* on the cross-slide turret; however, it may be possible to eliminate this step. The sixth step consists of finishing and sizing the recess with tool *S*. The cross-slide is first set by a micrometer dial so that the tool will cut to the proper diameter, after which the operator feeds it longitudinally until the desired depth has been reached. The dial permits an accurate setting so that the work can be produced within the required limits of accuracy without difficulty. If concentricity between the small hole and the recess wall is essential, and the diameter of the small hole is held within close limits of accuracy, it is advisable to ream the hole in a seventh step by using a

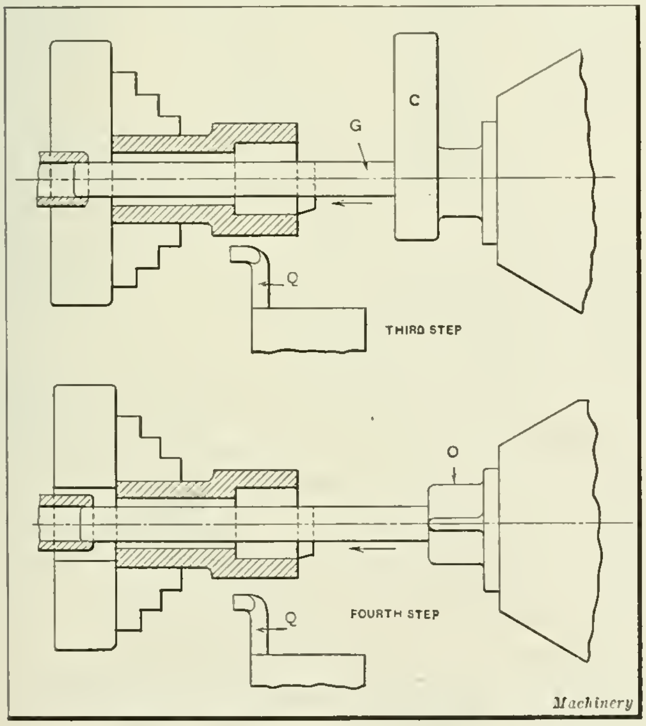


Fig. 10. Rough- and finish-boring the Hole in the Large End of the Billet

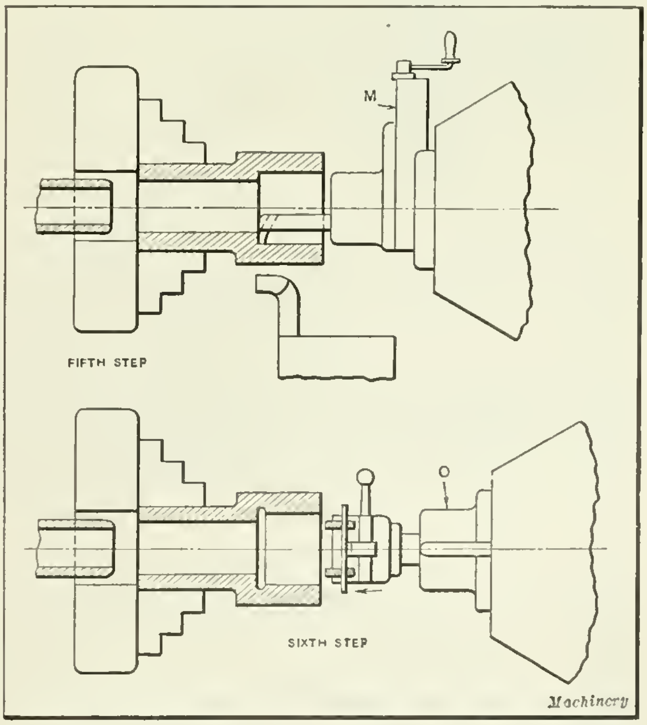


Fig. 11. Using the Slide Tool for cutting the Recess and a Collapsing Tap for the Threads

reamer in holder *O*. It would also be possible to bore the hole once more and obtain very close results.

If it seems desirable to use a reamer, holder *O* should be supplied with a suitable floating holder which will permit the reamer to follow the hole generated by the boring tools in the first steps on this part. When only half a dozen pieces are to be made and no suitable reamer or floating holder is available, it would probably be more economical to finish the hole by boring rather than by reaming. Concentricity of the outside cylindrical surface can best be obtained in an engine lathe with the work mounted on an arbor.

Finishing Steel Casting C

Several additions to the set-up of the hexagon turret tools are necessary to provide for machining casting *C*, Fig. 1, and one of the tools on the cross-slide turret must be replaced. The equipment used for the first two steps is shown in Fig. 6. The work is held by the jaws used for holding the part in the set-up illustrated in Fig. 3, the face of the chuck acting as a stop for the end of the casting. Thus each piece projects the same distance beyond the front of the jaws. Boring-bar *E*, Fig. 6, in facing head *A* is used for boring the hole. In conjunction with this bar, the tool in holder *H* is utilized for turning the rim of the flange, and another tool in the extra holder *T*, on head *A*, bores the inside of the rim.

The cross-slide turret tool *Q* rough-faces the first internal shoulder, the tool being brought against the work, as indicated by the dotted lines and fed radially outward. The flange is then rough-faced by the same tool, its position being determined by the longitudinal stops on the cross-slide. The next step consists of taking finishing cuts on all surfaces rough-machined in the step just completed. These cuts are taken by tools mounted on facing head *B* and by tool *U* on the cross-slide turret, which has been temporarily substituted for tool *R*, Fig. 2. In the third step, which is illustrated in Fig. 7, the second pocket in the work is rough-bored by a tool in boring-bar *G*. The cross-slide remains idle during this step.

Prior to the fourth step, the cutter in boring-bar *G* is adjusted to a simple gage, and then once more employed for boring this pocket. This step could also be performed by using another boring-bar in holder *O*, Fig. 2. The latter method is preferable, as there are always possibilities of error in setting the same boring-bar to cut two different diameters. This is a good example of the facility with which certain work can be machined in small lots on a turret lathe provided with standard equipment. Castings of the type shown are common in general manufacturing work.

Tooling for a Flywheel Pulley

Only two steps are required in machining the flywheel pulley *D*, Fig. 1, the part being held for these steps by chuck jaws which grip the inside of the rim, as shown in Fig. 8. The tool in holder *K* is employed for turning the outside of the pulley rim, and the tool in boring-bar *F* is used for rough-boring the hole. At the same time tool *P* on the cross-slide turret is utilized for facing one side of the rim and one end of the hub.

The second step on this piece consists of finish-turning the pulley rim with the tool in holder *L* mounted in facing head *C*, and finish-boring the hole with the tool in boring-bar *G*. At the same time the cross-slide turret tool *Q* is used to finish-face the rim and hub surfaces that were rough-faced in the preceding step. The machining of the remaining surfaces of this part on which finish is specified can be readily accomplished with the same equipment by substituting a set of soft jaws for those illustrated to hold the

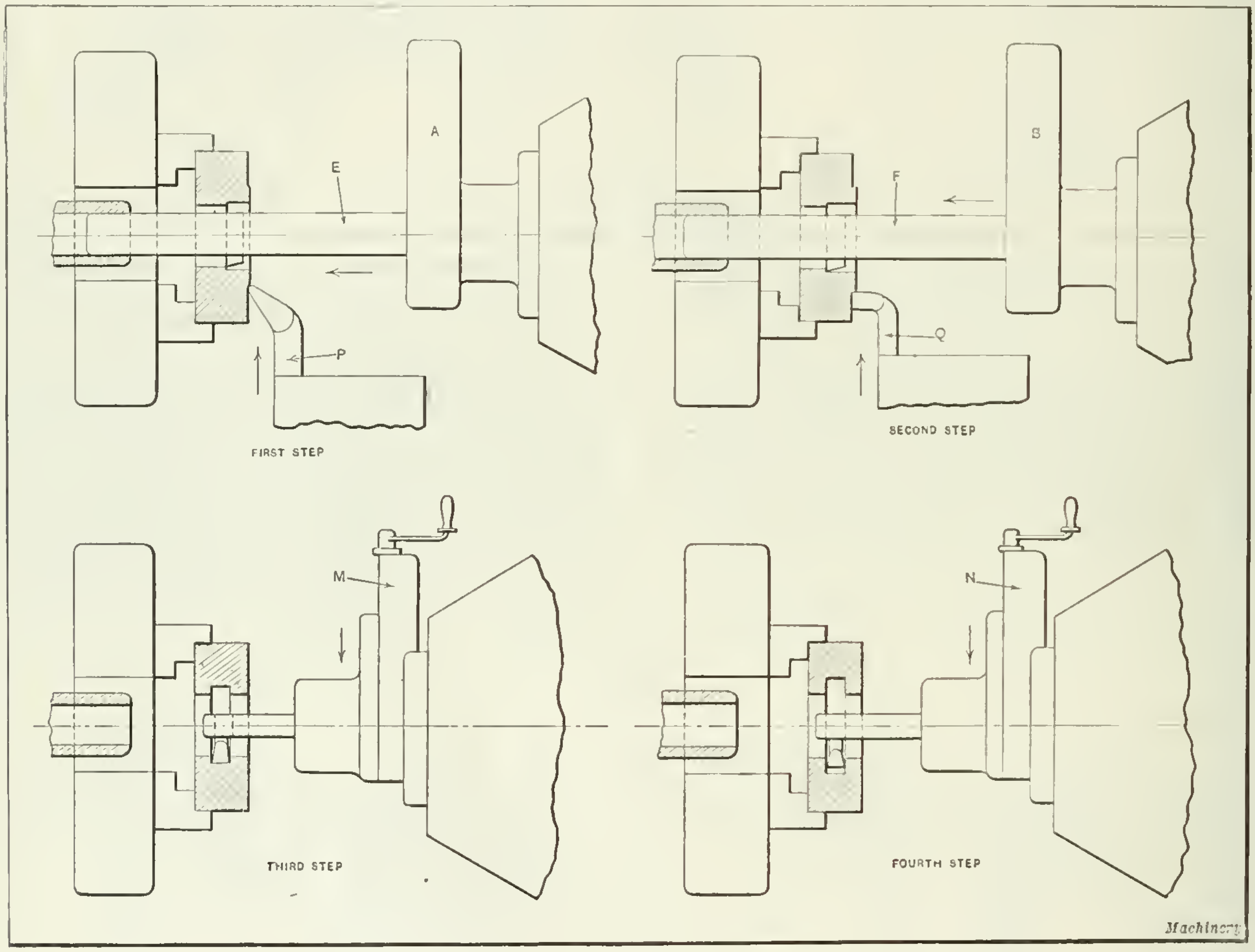


Fig. 12. Succession of Steps employed in machining a Bronze Retaining Collar

work by the finished rim, and employing tools *P* and *Q* successively, for rough- and finish-facing the opposite sides of the rim and the hub.

Finishing a Steel Billet All Over

As previously mentioned, example *E*, Fig. 1, is machined from a solid steel billet. Before bringing this part to the turret lathe, it is preferable to rough-drill the hole through the center. This work, of course, could be done on the turret lathe, but it will be assumed that the hole is produced previously. As shown in Fig. 9, the work is gripped on the shank by standard chuck jaws. In the first step on this part, the cylindrical surface of the large end is rough-turned by the tool in holder *H*, the hole is rough-bored by the tool in boring-bar *E*, and the end of the work is rough-faced by tool *P* on the cross-slide turret, these three tools being employed simultaneously.

The next step on the piece consists of taking finishing cuts over the same surfaces, the tools in facing head *B*, and tool *Q* on the cross-slide turret being used. In the third step, illustrated in Fig. 10, the hole in the large end of the forging is rough-bored by the tool in boring-bar *G*. It is, of course, necessary to provide the bar with a longer tool than has been required up to this time. As the cross-slide is idle during this step, it is moved out of the way so as not to interfere with the movements of the hexagon turret. The finish-boring of this hole is accomplished in the fourth step by another boring-bar in holder *O*. The use of this additional boring-bar enables the necessary setting to be quickly obtained.

The recess at the internal shoulder of the forging is machined in the fifth step by the use of slide tool *M*, as illustrated in Fig. 11. A suitable bar provided with a tool is used on the slide for this purpose. In performing this step, the cutting tool is advanced until its front edge comes in line with the shoulder of the work previously machined. Then the tool is fed down until the proper reading is obtained on the dial of the slide. The final operation on this piece consists of cutting the internal thread, and for this step a collapsing tap is inserted in holder *O*. This arrangement might be inadvisable if chasers and a collapsing tap of the correct size are not found in the tool-crib. It would then be necessary to chase the thread in an engine lathe while the work is mounted on an arbor, or a chasing attachment could be applied to the turret lathe for chasing the thread before the work is removed from the chuck.

Finishing Bronze Collar F

The four steps for finishing the bronze collar *F*, Fig. 1, are illustrated in Fig. 12. This piece is held in the usual manner by chuck jaws which grip the work at points along its periphery. The first step consists of boring the hole with the tool in boring-bar *E*, and rough-facing one side of the work with tool *P* on the cross-slide turret. It would be an easy matter during this step to turn a portion of the periphery with a tool held in a holder inserted in one of the holes of facing head *A*, and it might be advisable to do so in order to remove the scale on this surface and thus permit some of the other machining operations to be more readily performed.

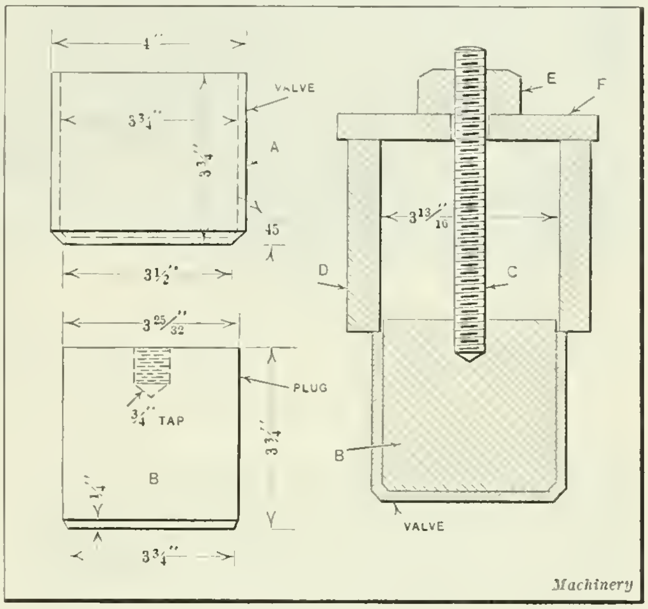
In the second step the hole is finish-bored by the tool in boring-bar *F*, and finish-faced by tool *Q* on the cross-slide turret. The third step consists of cutting the internal recess by means of a suitable cutter on slide tool *M*. This slide is, of course, fed vertically downward, as indicated by the arrow, until the recess has been machined to the desired diameter, as indicated by the dial on the slide. The recess is finished in the fourth step by a similar cutter to that used in the roughing step, mounted on slide tool *N*. The remaining work consists of facing the opposite side, and turning and threading the periphery. This can best be done in an engine lathe, with the work held on an arbor.

SALVAGING AIR COMPRESSOR VALVES

By STANLEY P. GOULD

The salvaging process described in the following was employed recently in restoring a lot of steel air compressor valves to useful service. The compressor valves, one of which is shown at *A* in the illustration, had become worn to such an extent that they had from 1/64 to 1/32 inch play in their bronze cages. The outside diameter of the valves was 4 inches, and the inside diameter 3¾ inches, as shown. Formerly the bronze cages were rebored and new steel valves made to fit the rebored cages, but this involved considerable expense, as the valves were cut from solid bar stock.

With the new method the old valves were first annealed by heating with a gas torch to a red heat, after which they were allowed to cool slowly. A steel plug *B* was then made to the dimensions shown in the illustration. This plug was lubricated with oil and white lead and forced into the open end of the valve by means of a screw press, thus expanding the valve sufficiently to increase its outside diameter 1/32 inch. The plug was then removed from the valve by means of a stud *C* and a sleeve *D* arranged as shown in the view at the right-hand side of the illustration. By tightening the nut *E* against the strap *F*, plug *B* is withdrawn from the valve.



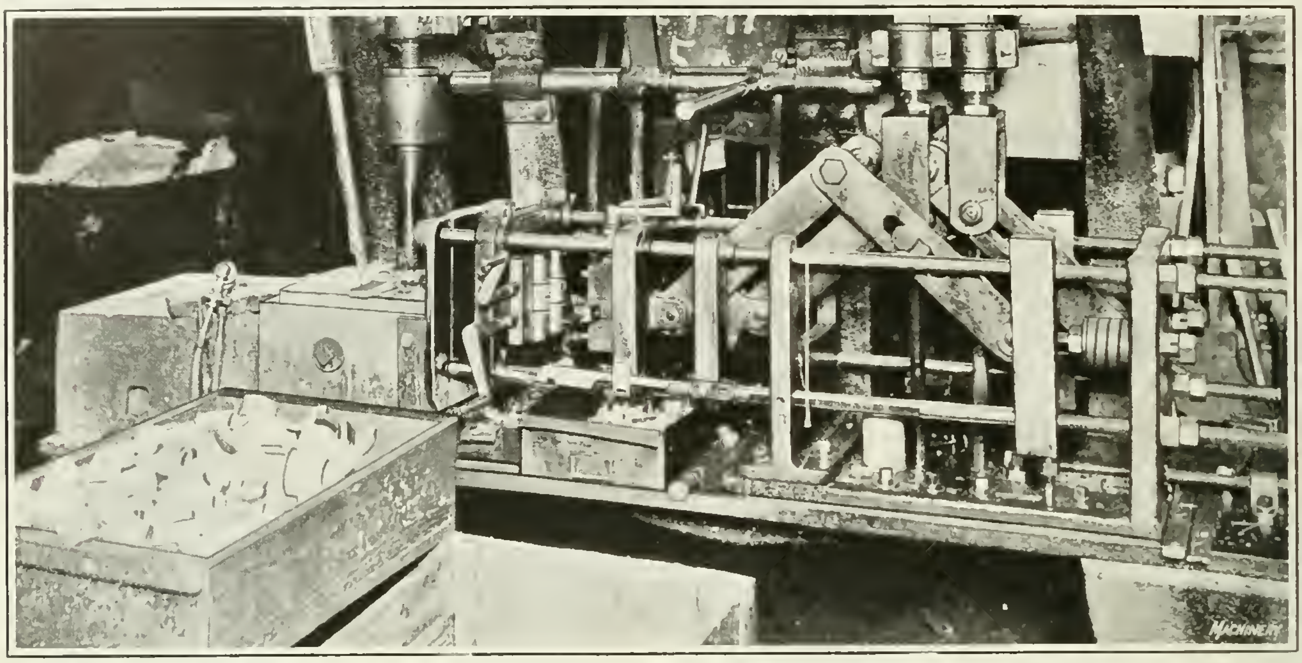
Air Compressor Valve and Expanding Plug

The solid end of the valve was next cleaned and tinned, after which a 1-inch square nut was soldered to the tinned end to enable the valve to be held in a four-jawed lathe chuck. The valve seat was then faced off at an angle of 45 degrees and the outside of the cylindrical part turned. Next the square nut was removed from the end of the valve by heating sufficiently to melt the solder, and the bronze cages were bored to fit the valves. Out of a total of forty-eight valves repaired in this way only four were split in forcing the plug in with the press. The repaired valves are now operating as well as new ones, and the saving in labor and material by making repairs as described was substantial.

* * *

In the first ten months of 1922, the railroads of the United States ordered over 117,000 freight cars. During the same time, 866 locomotives were put in service, and in addition, orders were placed for 1232, making a total of over 2000 locomotives placed in service or ordered. In 1921, the number of freight cars ordered was less than 70,000, and the total number of locomotives placed in service or ordered was 1382.

Dies for Die-castings



Specific Examples of the Design and Construction of Dies for Making Die-castings of the More Intricate Types—Third of a Series of Articles

By A. G. CARMAN, Chief Metallurgist, Franklin Die-Casting Corporation, Syracuse, N. Y.

IN the January installment of this series of articles, methods of designing dies for wheels having raised letters or figures on their periphery and for instrument housings were illustrated and described. The present article will describe dies for aluminum venturi tubes used in gas engine mixing chambers, dies for push-button stem guides and dies for door checks. A later article will deal with the metals used for making die-castings.

Die for Venturi Tubes

The first die to be considered will be that used in producing an aluminum venturi tube. The upper part of the die is shown at the left in Fig. 1, and the lower part at the right in this illustration, with the aluminum casting just below. Cores *A*, *B* and *E* are operated and locked in position by toggle levers, while cores *C* and *D* are operated by rack levers *F* which are actuated by pinions *G*. The four dowel pins shown serve to align the two parts of the die. On the lower plate is an opening *J* through which metal is admitted into the die. A detailed view of the casting is shown in the lower right-hand corner of Fig. 2; this illustration also shows an assembly view of the die for the venturi tube at the left, and views of the various cores in the upper right-hand corner. The heavy dark line in the elevation of the assembled die represents the parting line of the die. In this particular example, the parting line is very irregular, projecting deeply into the upper plate and thereby making it possible to operate cores *C* and *D* through rigid blocks of steel.

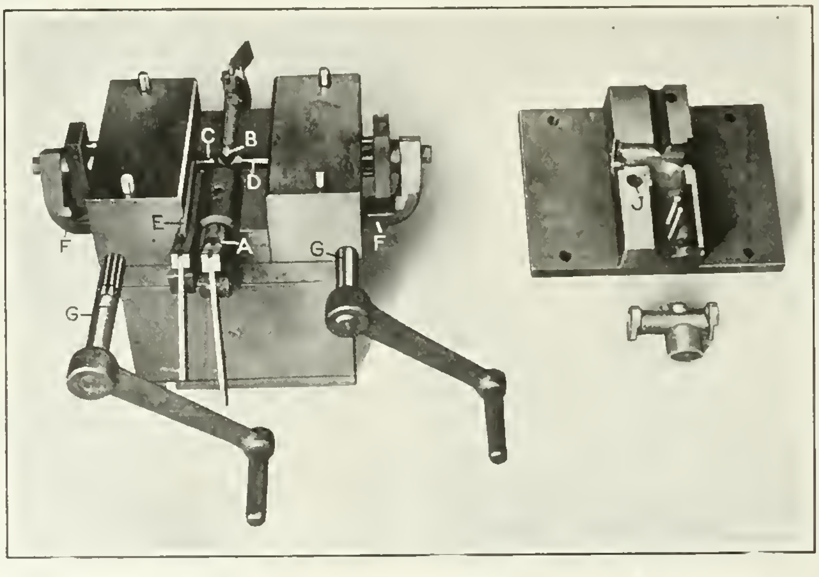


Fig. 1. Die for producing an Aluminum-base Venturi Tube for a Gas Engine Mixing Chamber

The cores *C* and *D* meet when they are locked in place, and form a continuous opening through the casting, tapering in both directions from the center. Each of the rack levers shown at *F* carry, in addition to cores *C* and *D*, two small cores which form the bolt holes in the flanges on the ends of the casting. The casting is removed from the die by two ejector-pins *L*. Care must be taken to see that the ejector-pins are not left projecting into the die after the casting has been removed, for if the cores should be moved back into position before the ejector-pins have been withdrawn, both the ejector-pins and the cores might be damaged.

Plan and elevation views of a die used in producing an

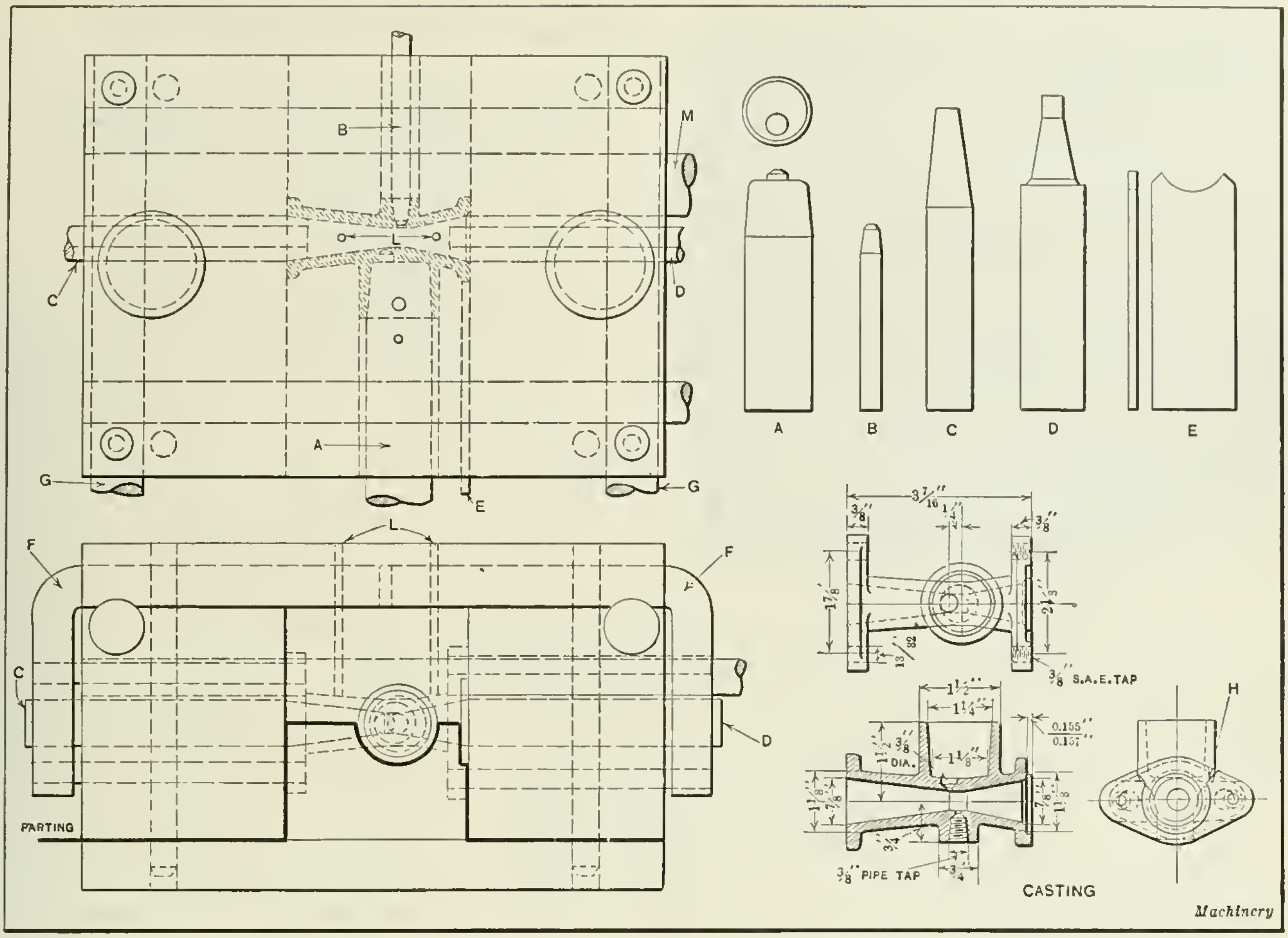


Fig. 2. Detail Views of Cores, Die, and Casting illustrated in Fig. 1

accelerator push-button stem guide for an automobile are shown in Fig. 4, together with a detail view of the aluminum casting. A special feature of this casting is that it has a steel insert 2 9/16 inches long and 3/8 inch in diameter. The portion of the insert that is surrounded by the metal is previously indented in a punch press so as to allow the cast metal to obtain a grip on it, and prevent any possibility of the insert becoming loose. Two castings are produced in this die at the same time. The parting of the die, as indicated by the dark line, follows the shape of the casting, and at the right of the casting, cuts deeply into the upper plate. This construction gives more room in the lower plate to serve as a bearing or sleeve for the two large cores *C* which produce the round central hole and the three countersunk holes in the base of the casting. Both cores *C* are operated by pinion *D* which engages racks on the cores.

Before the die is closed, preparatory to making the casting, the round steel inserts are placed in holes *B* in the upper plate of the die, a portion of the insert equal to the length of the casting boss being allowed to project into the casting depression. It is important that the inserts be of the correct length. If too short, they will not extend all the way through the casting and, on the other hand, if too long, they will prevent the die from closing properly and allow metal to be forced out of the die at the parting line.

The part of cores *C* that produces the long central hole passes through the casting depression and into the upper plate of the die; this makes it necessary to withdraw the core slightly before opening or closing the die so that the cores will not be damaged. In order to support the casting properly while removing the core, the die is so designed that the base of the casting does not rest on the face of the core, but on slotted sections *E* in both halves of the die. Holes through the thin support of the slotted sections receive the central core and the smaller cores which form the three countersunk holes in the base. The provision of blocks *E*, shown in detail in the upper right-hand corner, simplified the machining of the recess for the base of the casting. The ejector-pins are shown at *G*. One pin acts directly on the steel insert and the other two pins act on the lower part of the casting, as shown.

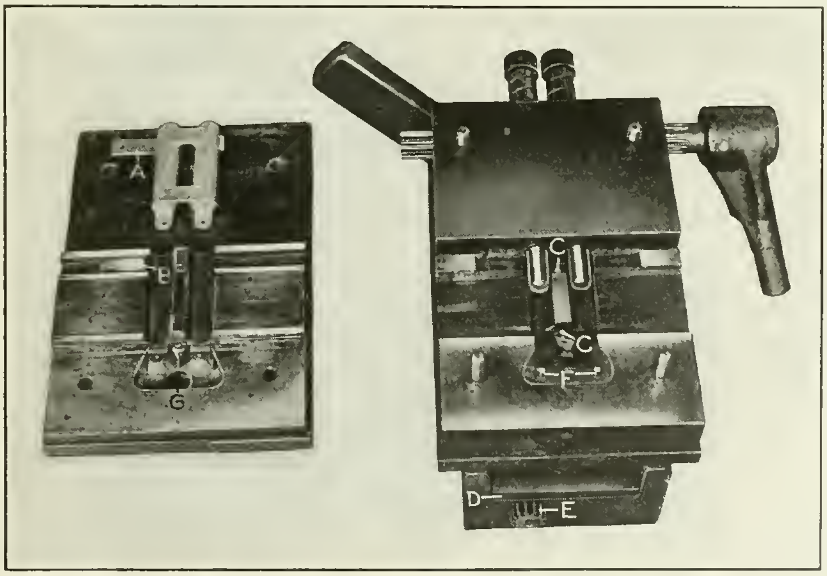


Fig. 3. Die used for casting Aluminum Door Checks

Automobile Door-check Die

A die for making an aluminum door-check for an automobile is shown in Fig. 3. This casting has walls about 1/8 inch thick, and air chambers about 4 inches long for leather plungers. One of the requirements is that the inner walls must not leak under an air pressure of from 30 to 40 pounds per square inch. These castings are made right- and left-hand, the only difference in the two types being in the position of lug *A*. This position is determined by the location in the die of a small steel piece *B* which is a duplicate of lug *A*. Piece *B* may be fastened first in one side of the die and then in the other by means of dowel-pins, for producing the right- and left-hand castings. This change permits both castings to be made in the same die. The metal is introduced through the opening *G*. The two ejector-pins *C* are fastened to the ejector-box *D* which is operated by pinion *E*. Two additional ejector-pins *F* which are also fastened to ejector-box *D*, prevent the metal in the gate from producing a strain on the two slender ears at the end of the castings.

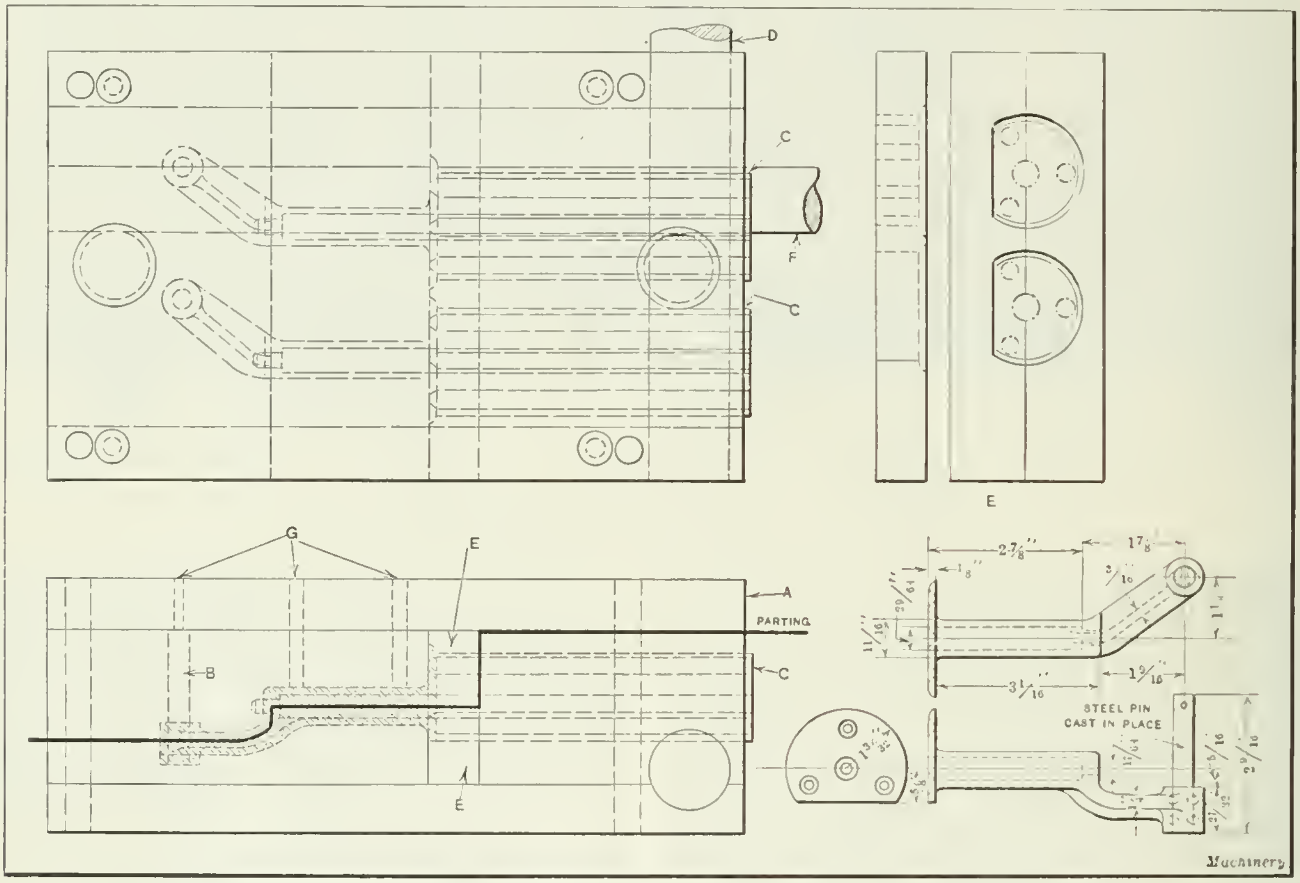


Fig. 4. Detail Views of Die for Push-button Stem Guide, and Aluminum Casting produced in it

* * *

INVESTIGATIONS BY THE BUREAU OF MINES

There has been a great deal of secrecy surrounding the use of titanium as an alloying element for steel. According to the Bureau of Mines, Washington, D. C., carbon-free ferro-titanium has been employed in Europe for making an electric steel containing from 5 to 7 per cent titanium. It has been stated that titanium alloy steels have been used for armor plates, but so far as is known to the Bureau of Mines, no merit has been found in the addition of titanium to steel as an alloying element, and experiments with steels containing from 0.1 to 1 per cent titanium have not proved this alloy steel to have any exceptional qualities. It is believed that a more thorough investigation than any so far carried out is required to determine more clearly the qualities of titanium alloy steels, and the Bureau of Mines assumes that, pending more exact proof to the contrary, these steels are of no unusual value, or at least have no advantages not already provided by other steels. It is possible, however, that some percentages of titanium, either alone or with other metals, might produce valuable qualities in steels for certain purposes, and more complete experiments need to be carried out; titanium increases the hardness of steel, and further experiments with titanium alloy steels should certainly not be discouraged.

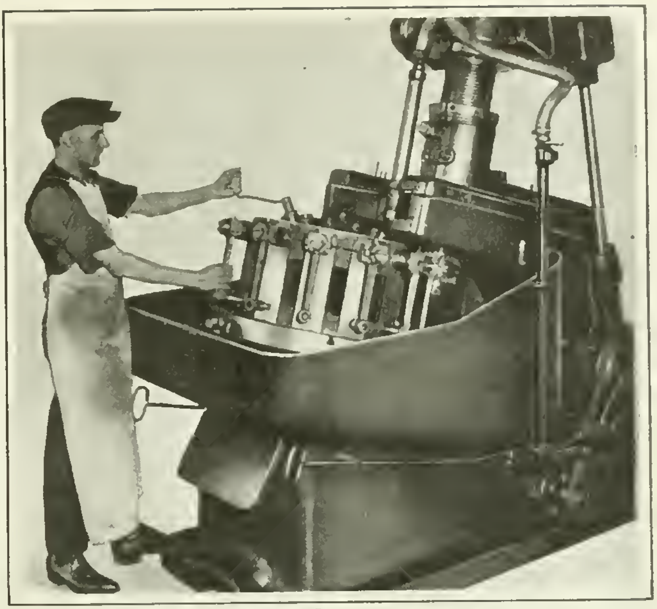
Titanium is used, however, to a considerable extent as a final deoxidizer and denitrogenizer in the making of steel. It has been used for this purpose for a number of years in the production of Bessemer rail steel, and is also used as a scavenging agent for many other kinds of steel, including sheet steel; about 2,500,000 tons of sheet steel are treated with ferro-titanium alloys in the United States annually.

Electric Furnaces for Brass Melting

As a result of a study of brass furnace practice in the United States, the Bureau of Mines declares that if electric furnaces were completely substituted for crucible and oil-fired furnaces in the brass-melting industries, the savings would amount to from $2,000,000 to $3,000,000 a year. The Bureau further estimates that if all the brass made in the country in 1917 and 1918 had been electrically melted, the cost could have been reduced by $10,000,000 each year. One of the great losses in the manufacture of brass in the old type of furnace is stated to be the loss of zinc through vaporization, possibly as much as 6 per cent of the zinc being lost in making brass castings, and as much as 10 per cent in making wrought brass. The investigations of the Bureau of Mines are recorded in considerable detail in Bulletin 202, "Electric Brass Furnace Practice," copies of which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the price of 50 cents.

Milling Automobile Connecting-rods

By CHARLES LITTELMANN
Supervisor of Service, Oesterlein Machine Co., Cincinnati, Ohio



A ONE-PIECE connecting-rod, as distinguished from a two-piece rod, is one in which the connecting-rod and its bearing cap are forged in one piece, and the holes bored or broached, after which the cap is sawed from the rod. The first machining operation on a one-piece rod is usually the straddle-milling of the crankshaft and wrist-pin bosses.

A fixture used in performing this operation on the Ohio tilted rotary milling machine is shown in Fig. 1. This is a three-station fixture with three work-holding divisions. While the work is being machined at one station the operator is loading at another station. It is possible to use a fixture with only two stations for this operation, the third station being provided merely to give the operator more leeway in loading the fixture. The cycle of operations is automatic: The table indexes; then the ram feeds the cutters forward into the work, and drops back rapidly at the end of the cut for the next indexing of the table. The entire time consumed in making the cycle is available for the operator to unload and load the fixture.

Handling the Work on a "Two-story" Fixture

The length of the wrist-pin boss is usually less than the length of the crankshaft bearing. For a rod of this design, the fixture used is essentially a "two-story" fixture, each station of which consists of an indexing plate arranged to hold two rods placed end to end. The arbor carries two sets of cutters, the lower set for straddle-milling the wrist-pin boss, and the upper set for performing a similar operation on the crankshaft boss. In one cycle of operations the opposite bosses of two rough forgings are machined, and when the first station reaches the loading position, the operator indexes the fixture plate so as to bring the opposite bosses into the cutting position. When this station again reaches the loading position both rods are finished and removed.

It will be seen that two bosses, or the equivalent of one rod, are completed at each cycle. These cycles are timed in seconds, and vary with the size of the rods and the hardness of the steel from which they are made. The time required for the cycles varies from 40 seconds, which gives a production of ninety complete rods per hour, to 30 seconds, which gives a production of one hundred and twenty rods per hour. In practice, it was found to be a better division of the operator's time to arrange the two rods in each indexing plate so that one would be receiving the second cut while the other was being milled for the first time. By this arrangement the operator would index the work-holding plate and remove one rod at each cycle, instead of removing two rods every other cycle. For this reason, the clamping of each rod is independent. An automatic trip for the index-plunger makes it unnecessary for the workman to operate the plunger by hand when indexing the work-holding plates.

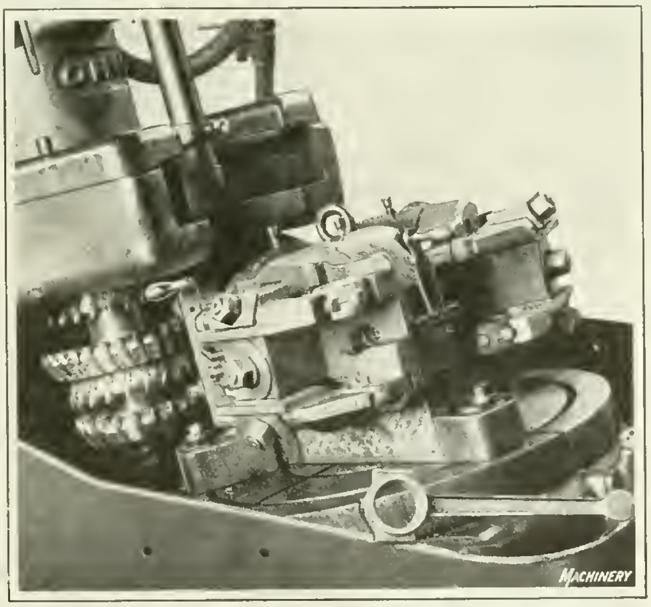


Fig. 1. "Two-story" Milling Fixture of the Indexing Type for holding Connecting-rods

Power Requirements

The power used per 40-second cycle is shown graphically by the curve in Fig. 2. This curve was recorded on the tape of an Esterline graphic wattmeter. The chart shows the wattmeter record during four cycles of the machine. In the operation of the meter, the recording tape feeds past the swinging recording pin in the direction of the arrow, so that the sequence of events is read from right to left.

As previously explained, the rods are clamped in a two-story fixture, and when the cut is taken a crankshaft boss is located on the upper story and a wrist-pin boss on the lower story. When the advancing cutters meet the crankshaft boss, the peak *A* is registered by the wattmeter pointer. The relation of bosses and cutters at different stages in the cycle is shown in Fig. 3. The cutters meet a comparatively broad cutting surface at *A*, and the power consumption mounts sharply as shown by the curve at *A*, Fig. 2.

As the cutters advance, they pass off the wide cut and are then cutting only on two narrow areas, as shown at *B*, Fig. 3. The result is a decrease in power to the point *B* on the curve, Fig. 2. As the cutters continue to feed in, the lower set of cutters begins to mill the wrist-pin boss, as indicated at *C*, Fig. 2 This load is in addition to the light load indicated at *B*. These cuts result in a jump in the power curve to the point *C*, and as the feed advances this power curve gradually rises until it reaches the peak *D*, at which time the lower cutters are still at work on the wrist-pin boss

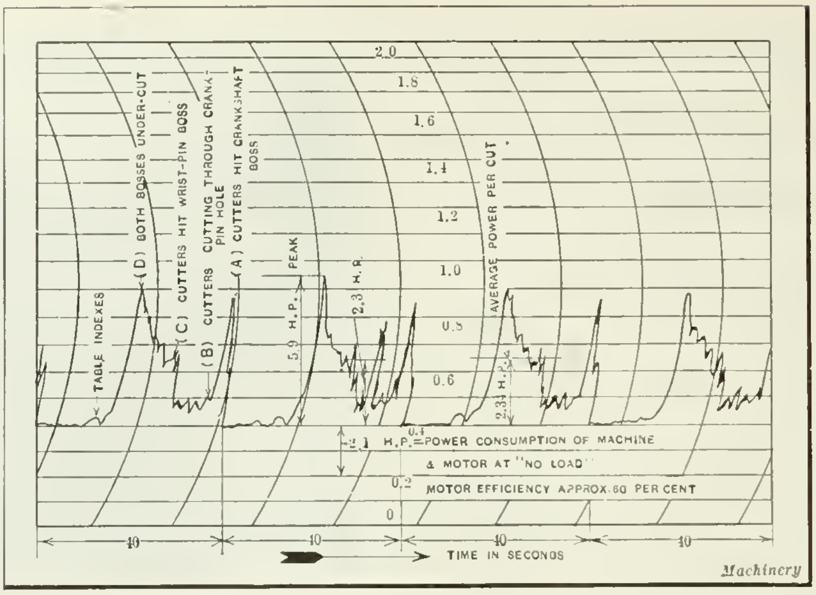


Fig. 2. Section of a Wattmeter Recording Tape, showing Consumption of Power in milling Crankshaft and Wrist-pin Bosses

(see diagram *D*. Fig. 3), and the upper cutters have met the broad cut on the opposite side of the crankshaft boss. It will be noted that peak *D* is higher than peak *A*, the difference in height representing the power required for the wrist-pin boss and the slightly broader cut on the crankshaft boss.

Each horizontal line on the curve represents 0.8 kilowatt, or 800 watts. An eight-to-one step-down transformer was used in the motor circuit of the meter, so that one-eighth of the supplied current flowed through the wattmeter. For example, the peak *D* extends from the 0.4 kilowatt line to the 0.9 kilowatt line. The current flowing through the instrument was equal to the difference between these amounts, or 0.5 kilowatt. Eight times this current flowed through the motor, which was equivalent to 8 × 0.5 = 4 kilowatts, or 4000 watts. The horsepower consumption at peak *D* is therefore 4000 ÷ 746 = 5.4 horsepower. The curves vary somewhat with the hardness of the stock from which the connecting-rod forgings are made.

When the curve shown was traced, the motor carried an additional load, so that the base line or "no load" line is at the 0.2 kilowatt line on the chart instead of at the zero line. The base line was determined by disconnecting the milling machine and recording only this additional load. The distance between the 0.2 and the 0.4 line represents the power consumption of the motor and the milling machine when the machine is running idle. This idle load is 1600 watts (2.1 horsepower), and as the motor efficiency is 60 per cent when carrying this load, the actual power consumption of the milling machine alone is 960 watts or slightly less than 1.3 horsepower.

Arrangement when Both Bosses are of Equal Length

When the crankshaft and wrist-pin bearings of a connecting-rod are of equal length, a simpler arrangement of the connecting-rods may be employed than is possible with a two-story fixture, as shown in Fig. 4. This illustration is a plan view of the fixture used, and shows the arrangement of the rods in pairs and their relation to the cutters during the milling operation. The cutters feed into the four bosses—two crankshaft and two wrist-pin bosses—the equivalent of two connecting-rods being thus completed at each cycle of the machine. This method gives a production of from 100 to 150 complete rods per hour. Only one set of cutters is required, since all bosses are of equal length and parallel. Carefully designed clamps are used for holding the connecting-rods so as to avoid clamping strains. With this method of milling the rods, the bosses may be held to tolerances of from 0.001 to 0.002 inch on the width and to within 0.005 inch of parallel.

Milling Bolt-hole Bosses and Cutting off Caps

After the rods have been broached and drilled, the bolt bosses are milled and the cap sawed from the rod, the fixture shown on the machine in the heading illustration being used for this purpose. In this case, a twelve-station fixture is shown, although fixtures that have as few as four stations may be used. The rods are placed on locating pins and are each held in place by a screw and horseshoe washer. The cutter-arbor carries two half side-mills and a saw located between them. The cutters are fed between two adjacent rods, milling two bolt bosses above and below, as well as cutting the adjacent sides of two caps at each cycle. The table indexes one-twelfth of a revolution, and during the next cycle the other side of one rod, and the first side of the adjoining rod are machined. The equivalent operations for one rod are therefore completed at each cycle of the machine. The production varies between 90 and 180 rods per hour, depending upon the width of the crankshaft bearing and the material from which it is made.

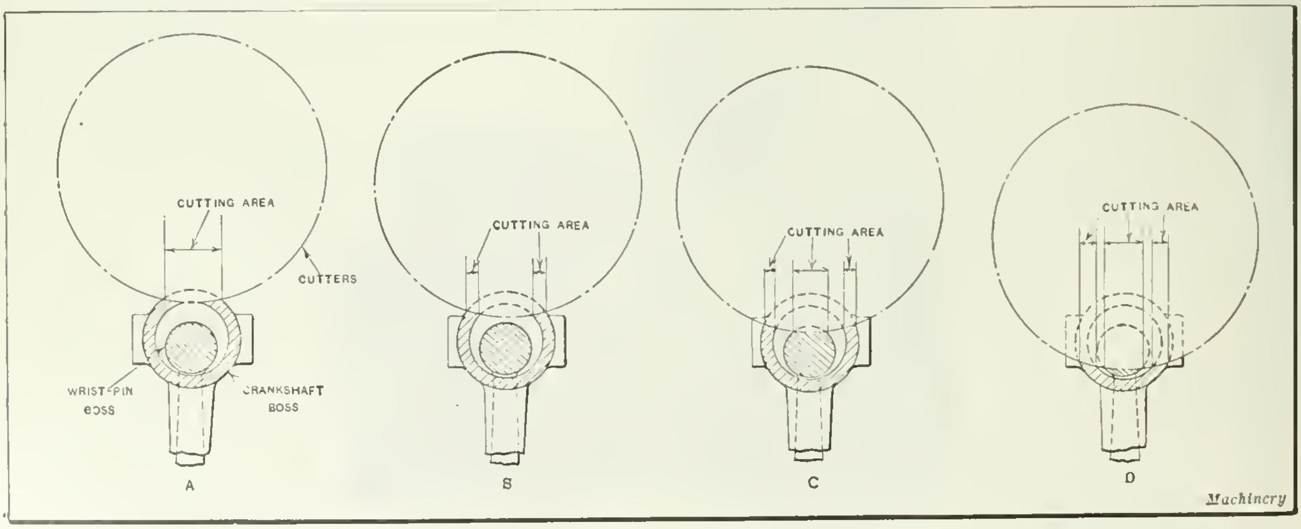


Fig. 3. Diagrams showing the Amount of Metal removed at Different Stages in milling One Crankshaft and One Wrist-pin Boss

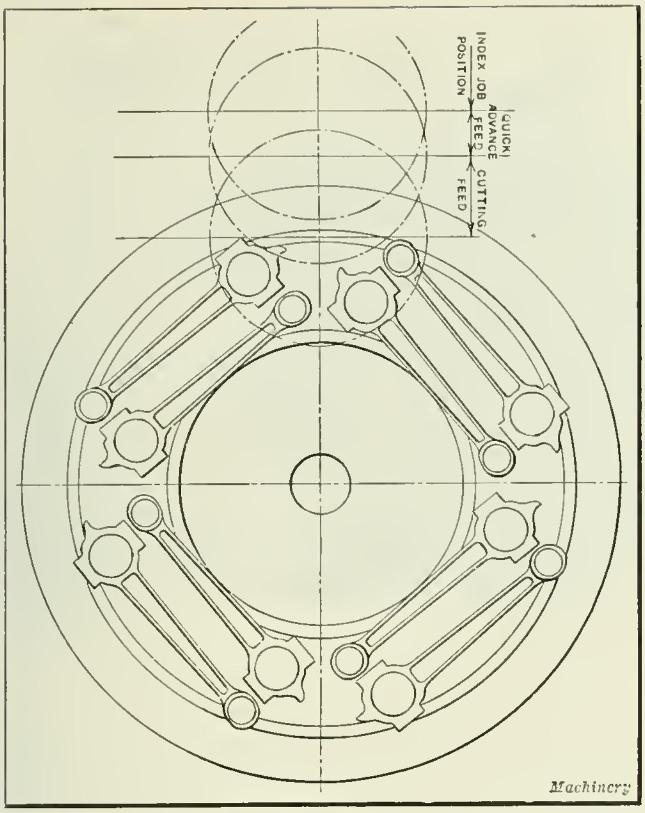


Fig. 4. Arrangement of Connecting-rods on a Station Milling Fixture when the Bosses at Opposite Ends are of the Same Width

TERMS OF PAYMENT FOR FOREIGN SALES

In the summary of an article on terms of payment for exported machinery, prepared by W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce at Washington, it is stated that as far as industrial machinery is concerned, manufacturers should not take too seriously the reports coming from foreign countries intimating that more liberal terms should be granted in connection with export business. Experience indicates that neither European nor American manufacturers in this field grant exceptional terms in connection with the selling of machine tool equipment. This information, coming from the Department of Commerce, is of considerable value to American manufacturers, who have been told that in order to compete in Europe and other foreign countries they would have to grant more liberal terms of payment. Generally speaking, if the banks with whom the foreign buyer does business does not care to extend credit to him and thereby finance his purchases, there is no reason why the American manufacturer should act as banker. He has no facilities for knowing whether the risk is good or not, whereas the local bank generally does know. If the risk is not good enough for the customer's own bank, it is hardly good enough for an American manufacturer thousands of miles away.

* * *

Seventy-five per cent of the centrifugal pumps used in South Africa are of American manufacture. The duty on pumps is 3 per cent ad valorem, except on those imported from other parts of the British Empire, which are duty free; but the duty is so low that it does not offer a serious handicap to American manufacturers. There is an increase in the demand for wind mills in South Africa, which may offer an opportunity for American manufacturers in that field. Large pumps, such as are used in the mining industries, are mainly imported from England and Switzerland. Of the pumps imported for farm use, fully 90 per cent come from the United States.

FORMULAS FOR CONE PULLEY DESIGN

By LAURENCE T. FLEMING

In spite of the increase in multi-motored machine tools and the more common use of positive drives, it is hardly probable that belt-driven cone pulleys can be dispensed with for many years to come, particularly for feed drive purposes. The following formulas for determining directly the diameters of the steps of cone pulleys having any desired speed ratios, when the distance between centers and the diameters of any one pair of steps are known, may, therefore, be of interest to machine tool designers. In the formulas,

D = diameter of larger pulley plus thickness of belt, in inches;
d = diameter of smaller pulley plus thickness of belt, in inches;
C = distance between centers, in inches;
L = length of belt, in inches;
$m = \frac{D}{d}$ = speed ratio of pulleys.

By making use of the approximation that the sines of small angles vary directly as the angles, and by neglecting higher powers of the sine, which are so small in amount that they do not materially affect the result, the exact formula for the length of a straight belt may be reduced to the following form:

$$L = \pi \times \frac{D + d}{2} + 2C + \frac{(D - d)^2}{4C} \qquad (1)$$

By substitution in Formula (1) we obtain Formula (2), which may be written,

$$d = \frac{\sqrt{[\pi C\,(m + 1)]^2 + (4\,CL - 8\,C^2)\,(m - 1)^2}}{(m - 1)^2} - \frac{\pi C\,(m + 1)}{(m - 1)^2} \qquad (2)$$

It will be noted that Formula (2) requires no intermediate steps; all "cutting and trying" and laying out on the drafting board is eliminated If the distance between centers and the diameters of any one pair of steps is known, L can be determined by the use of Formula (1). The diameter d of the smaller of any other pair of steps having the same center distance C and any desired speed ratio m with the same belt length L, can then be determined by Formula (2). The diameter D of the larger pulley is found by multiplying the diameter d thus determined by m. For the special case where the diameter of the driving pulley is to be the same as that of the driven pulley we may use the formula

$$D = d = \frac{L - 2C}{\pi} \qquad (3)$$

Within the limits of usual practice, these formulas will give very accurate results. The length of a crossed belt may be obtained by the formula

$$L = \pi \times \frac{(D + d)}{2} + 2C + \frac{(D + d)^2}{4C} \qquad (4)$$

and the pulley diameters may be determined from the formula

$$d = \frac{D_1 + d_1}{m + 1} \qquad (5)$$

in which D_1 and d_1 are the known diameters and d the diameter required for the smaller of another pair of pulleys, the speed ratio of which is m.

* * *

The present record production of Ford cars is 5380 in a single day. It is expected that this record will be surpassed during the spring.

Punching Rotor and Stator Laminations

A Description of Three Piercing and Blanking Dies that are Used in Sequence in the Manufacture of Laminations for Small Electric Motors

By CHARLES O. HERB

ECONOMY in punch press work demands that the scrap be reduced to a minimum. There is perhaps no better example of the maximum utilization of stock than in the practice commonly followed in punching rotor and stator laminations for induction motors. It is customary to punch both laminations from one strip, those for the rotor being punched along the center line of the strip at a center-to-center distance slightly greater than the outside diameter of the stator laminations, and the latter being punched around those for the rotor. By this procedure the only scrap produced is the small amount blanked from around the stator laminations.

Sometimes the holes and slots are punched before separating the laminations from each other and from the strip, while in other instances they are punched afterward. The rotor and stator laminations for small motors of ⅛, 1/6, and ¼ horsepower capacity, made by the Gillespie Eden Corporation, Paterson, N. J., for driving the washing machines of its manufacture, are produced by the first of these two methods. The construction of the dies used will be described in this article. Each of these dies averages about 40,000 punchings between regrindings.

Slitting the Stock and Punching the Rotor Laminations

Electric sheet steel stock, 0.022 inch thick, which comes to the plant in sheets 34 inches in width and from 5 to 8 feet in length, is used for the laminations. These sheets are run through a gang shear, which cuts them into five strips 6⅝ inches wide. The strips are then brought to a row of three power presses, two of which are equipped with dies for piercing the various holes and slots, while the third is supplied with blanking equipment. The sequence of operations is illustrated diagrammatically in Fig. 1. It will be obvious that as the stock is fed from right to left the rotor holes are punched by the first machine, the stator holes and slots by the second machine, and the parts are separated by blanking in the third machine. The diameter of the rotor laminations is 3½ inches, and that of the stator laminations 6⅜ inches.

Fig. 2 shows the press and die employed for punching the rotor holes. This press is equipped with an automatic feed, which has a finger that engages one of the punched holes and, through a bellcrank lever, pulls the strip of stock to the left between the strokes of the press, to bring it into position for each successive stroke. A rotor die that differs somewhat in construction from that illustrated in Fig. 2 is shown in Fig. 4. It will be seen that the punches for producing the holes are held in a block *A*, which is attached to the punch-holder by means of fillister-head machine screws. The holes are pierced as the punches enter the holes of die *B*, which is a press fit in ring *C*. Stripper plate *D* is located above the die-block the desired amount by means of blocks *E*. The production on this machine is 1900 laminations per hour. The working members of this punch and die and of all others used in the plant of the Gillespie Eden Corporation are made from "Mangano" steel, manufactured by the Latrobe Electric Steel Co., which is an oil-hardening, non-shrinking alloy steel.

Die for the Stator Laminations

The press in which the next operation is performed is so located that its operator can conveniently reach the strips

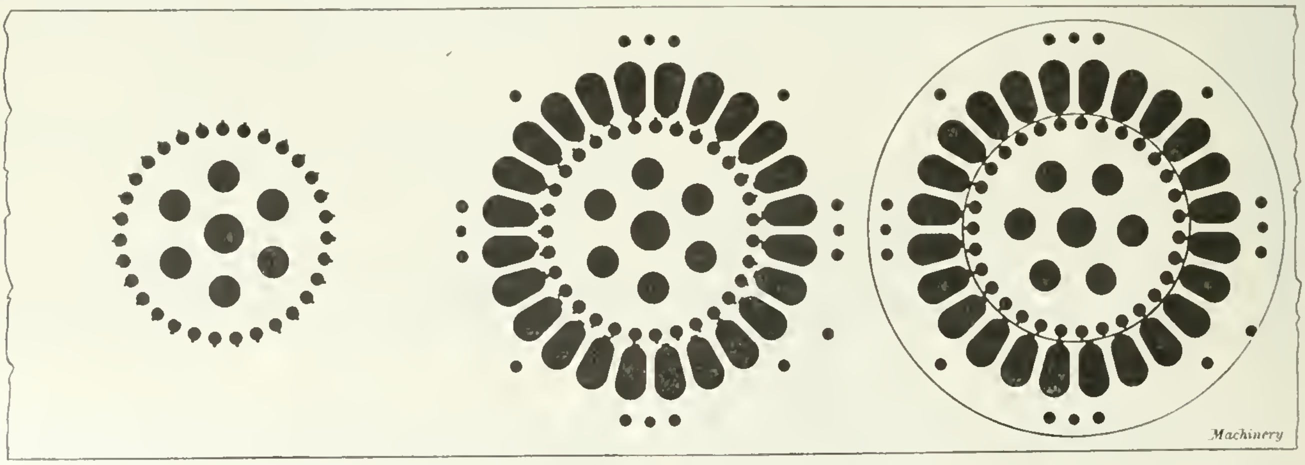


Fig. 1. Diagrammatic Views of the Sequence of Operations as the Strip Stock is fed from Right to Left through Three Power Presses

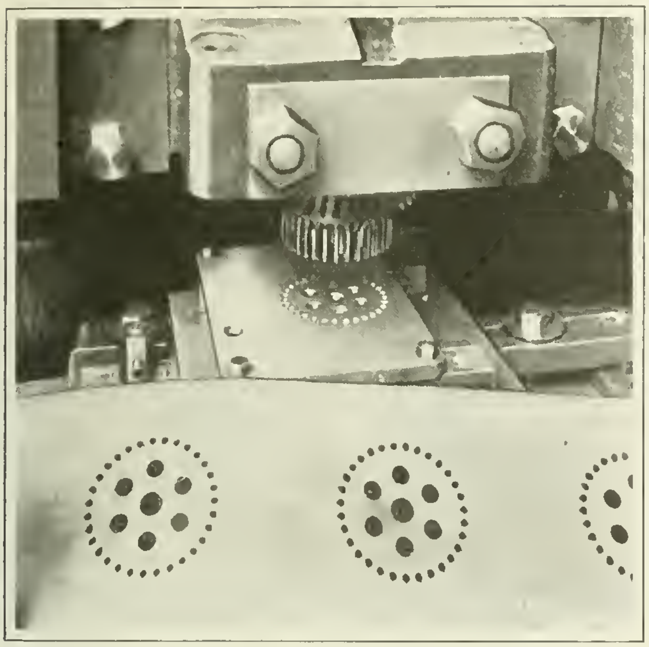


Fig. 2. Press equipped with Die for piercing the Rotor Holes

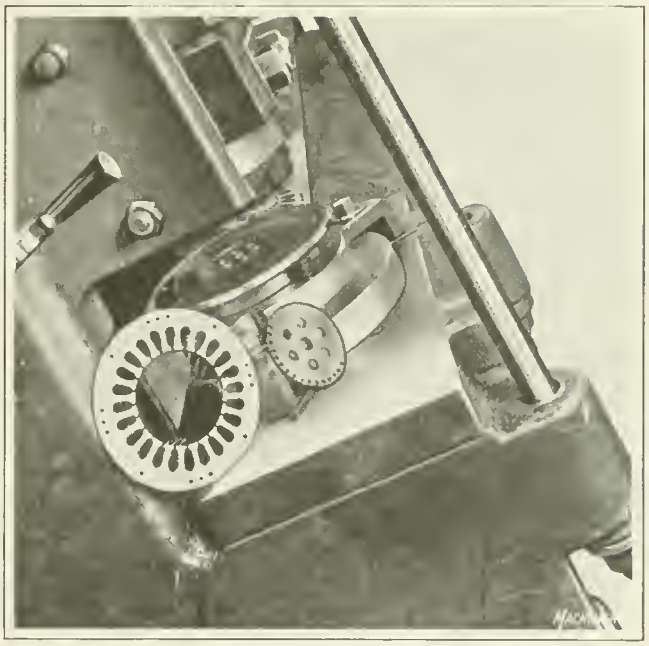


Fig. 3. Inclinable Press equipped with Blanking Die

of stock as they come from the rotor punching machine. In the second operation, as will be seen by referring to the central diagram in Fig. 1, twenty-four elongated holes, or slots, are punched immediately around the thirty-one outer holes of the rotor, and there are seventeen small-diameter holes located outside the ring of slots.

The heading illustration shows the method of feeding the stock between the stripper plate and the die for the second operation, in which the stator slots and holes are pierced. As the punch descends, a pilot at the center enters the hole pierced at the center of the strip by the rotor press, and aligns the strip properly for this operation. A close-up view of this set of dies is shown in Fig. 6, and an assembly view in Fig. 5. One of the interesting features of this die is that the row of punches *A*, Fig. 5, for the slots, are integral with block *B*. The smaller-diameter punches are inserted pins held in a ring *F* in which block *B* is a press fit.

An advantage claimed for this construction is that a larger number of regrindings can be obtained than with a sectional punch. The practice has been followed for a number of years by this company with entire satisfaction. The punches are hardened by dipping to a depth of 3/4 inch in a lead pot, and quenching in oil. This procedure hardens the point and leaves the remainder of the punch soft, so that in case a punch breaks off it may be readily milled out and a new one substituted. The punch and die members are made to size and then hardened, there being practically no shrinkage in hardening.

The pilot that aligns the strip on the downward stroke of the press ram is indicated at *C*. The punch-holder is held in alignment with the die by two guide posts 1 3/8 inches in diameter. Pilot *C* is a press fit in block *B*, and stripper plate *D* is supported on the die-block by four posts which are screwed into the block. Die *E* is machined from one solid piece, and is hardened all the way through. Approximately 1500 punchings are made per hour with this equipment.

Blanking the Laminations from the Strip

The separation of the two laminations from each other and from the strip stock is accomplished by means of the inclined power press illustrated in Fig. 3. Two laminations, after being separated, are shown on the die bolster. The

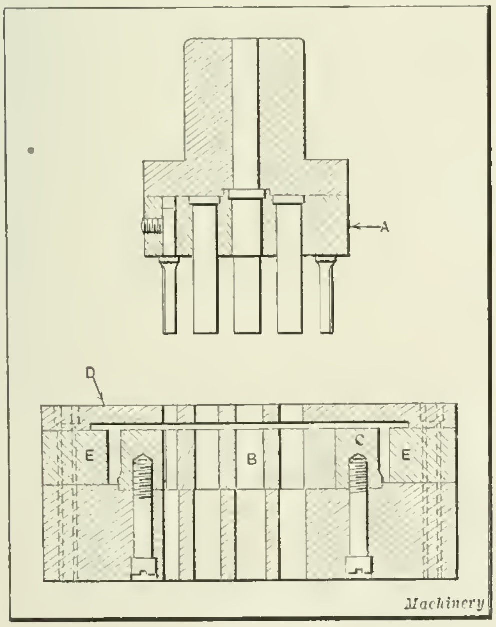


Fig 4. Construction of Die for punching the Rotor Holes

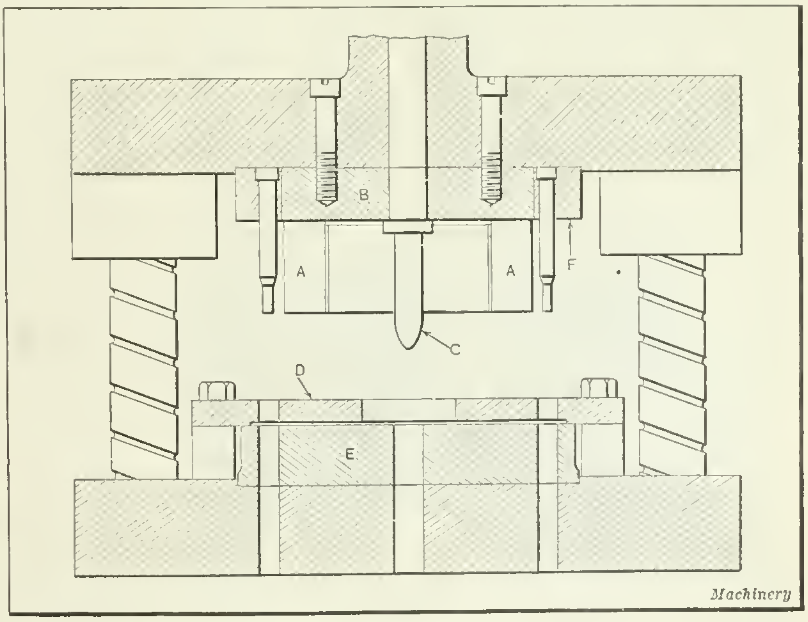


Fig. 5. Stator Die in which All the Punches for the Slots are Integral with a Block and the Die Member is made of a Solid Piece of Steel

construction of the die with which this press is equipped will be more readily understood from the sectional view in Fig. 7. The strip is also aligned for this operation by a pilot entering the central hole, on the downward stroke of the ram. The rotor lamination is blanked as the face of punch *B* passes the inner cutting edge of die *C*, and the stator lamination is blanked simultaneously, as the face of ring *D* passes the outer cutting edge of die *C*. Stripper ring *E* which is acted upon by eight compression coil springs, holds the stator lamination firmly against the face of die *C* during the blanking, and at the same time stripper ring *F* holds the stock that surrounds the stator lamination firmly against punch ring *D*. Stripper ring *F* is supported by four coil springs and is attached to the die-block *G* by means of fillister-head machine screws that pass through the center of the springs.

As the rotor laminations are blanked they drop through the die and die-block and are automatically stacked on a round rod which is replaced from time to time as it becomes filled. Similarly the stator laminations slide through the inclined frame of the press after they have been separated from the strip and are automatically stacked on a rod at the back of the machine. By stacking the laminations in this manner, they may be conveniently handled in subsequent steps. This blanking press is operated at about 1300 strokes per hour. The laminations as they come from this operation, are clean cut without burrs either around the edge or around the pierced holes, and may be assembled without filing.

Assembling the Laminations

As the rods of stacked laminations accumulate, they are immersed in a hot soda solution to clean them from oil and dirt, after which the stacks are hung up to dry. As previously mentioned, the rotor and stator of all motors made by this company are made up of laminations of the same dimensions. However, a different number of laminations is supplied for the different sized motors. For instance, the rotor of a 1/6-horsepower motor is built up of more laminations than the rotor of a 1/8-horsepower motor. The number of laminations to be used in both the rotor and stator of a given sized motor is determined by weight, a small accurate scale being used for weighing the laminations.

The rotor laminations are assembled by means of copper bars inserted through the holes around the center of the laminations and through a ring placed on each end. The bars are riveted under a hydraulic press, the lower die of which has depressions to accommodate the round head on the bars. This method results in a compact assembly. The stator laminations are assembled in a similar manner by inserting pins through the holes that surround the slots, but no end rings are used. The assembled rotor is next subjected to a hot solder bath, and then dipped in a flux to neutralize acids. The result is a solid joint between the end rings and the laminations. The outside of the rotor is finally ground to size, while the stator is ground both on the inside and the outside.

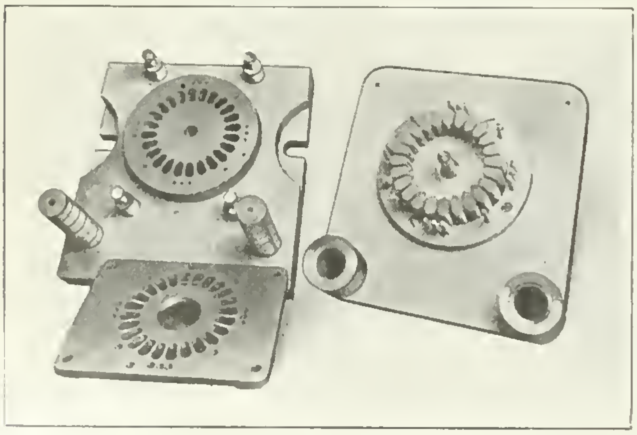


Fig. 6. Punch, Stripper Plate, and Die used for punching the Holes in the Stator Laminations

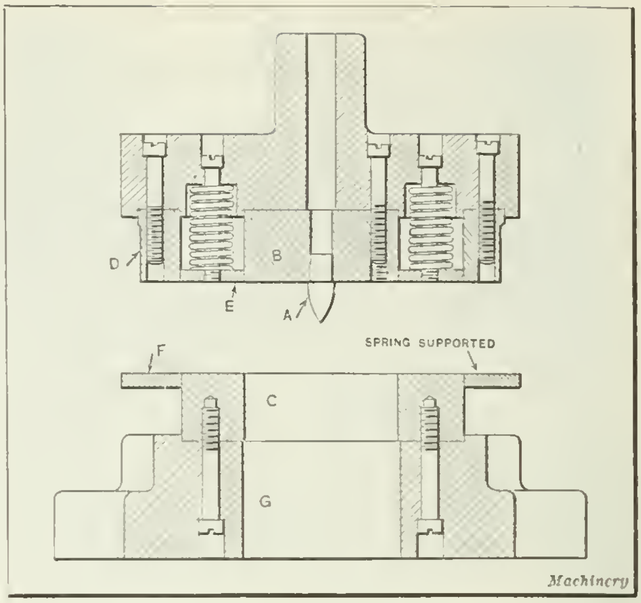


Fig. 7. Blanking Die which separates the Rotor and Stator Laminations from Each Other and from the Strip of Stock

* * *

STANDARDIZATION DURING 1922

The year 1922 saw a greater activity in industrial standardization than any former year. One of the important accomplishments was the organization of the Federal Specifications Board—which develops and approves the specifications under which all government purchases are made—and the development of a plan of cooperation between this board and the American Engineering Standards Committee with headquarters at 29 W. 39th St., New York City. The organization of Secretary Hoover's Division of Simplified Practice, and its entrance into the industrial field, has had a highly stimulating effect on the industrial standardization movement.

Great advances have also been made by various industries along standardization lines. More than 120 different standardization undertakings are now under way, 43 of them having been initiated within the last year in cooperation with the American Engineering Standards Committee. Of the twenty-eight industrial standards developed and approved by the committee since its organization in 1918, thirteen were approved within the past year. The efforts to develop national safety codes have begun to bear fruit. Six of these safety codes have been approved during the year, covering among other subjects abrasive wheels, foundry practice, power presses, electrical safety, and the protection of heads and eyes of industrial workers.

The last year also saw important developments in international standards. There are now national standardization bodies in fifteen foreign countries, and plans are under way for the development of standardization work in each of the South American republics. The most recent of the national standardization bodies is the Australian Engineering Standards Association, which held its first meeting during the month of November.

One of the most encouraging developments of the year has been the interest in standardization shown by many trade associations in the United States. These associations have a great opportunity for developing industrial standards and for putting them into effect. Standardization is a legitimate and constructive activity of trade associations, and is one of the fields in which such associations can perform some of their most valuable work.

The Work of the Bureau of Standards

WHAT does the Bureau of Standards do? What facilities has it for carrying out industrial and scientific investigations? What is the scope of the work undertaken, and what kind of problems is it prepared to solve? These are questions that arise in the minds of manufacturers and engineers when the Bureau of Standards is mentioned. The work of the bureau is so diversified that it is quite difficult to obtain a comprehensive idea of its manifold activities, except by a visit to its laboratories in Washington, but a brief review will indicate in a general way the scope of its activities and the character of its work.

Standards of Weights and Measures

Originally the Bureau of Standards was mainly a government agency that preserved for comparison and duplication the standards of length and weight (mass). This function, of course, the bureau still retains, in addition to its many other activities. In what is known as the "standard vault" are preserved the national standards of length and weight. Here is a standard meter made in 1797, and a yard made about 1830, as well as standard weights dating back to the early part of the past century. In addition, there are many standards made at a later date.

The length and weight comparators are kept in a "constant temperature room," and are used for fundamental comparisons of length and mass under conditions controlled so that the highest precision can be obtained. The standards with which comparisons are made can be kept at a constant temperature within 0.1 degree F. A comparator is also available for standardizing precision steel tapes, such as are used in very accurate surveys. The room in which this work is done can be kept at any temperature from 32 to 110 degrees F. The bureau also cooperates with the state and local authorities for the inspection of trade weights and measures, by annual conferences with the officials engaged in such work, by the distribution of handbooks relating to the technical details of weight and measure inspection work, and by consultation and correspondence.

Laboratory for Accurate Determination of Weights or Mass

In the laboratory for accurately checking weights, there are a number of balances and sets of precision weights that are used for certifying weights in sets of high precision used in scientific work and in the industries. In this laboratory there are scales that are accurate to within 1/100,000 of a grain, while other scales available in the laboratory are accurate to 1/10,000 of a grain. The ultimate reference standards that are used are kept in a vault and are brought out only at intervals of many years. The secondary standards are the basis of the manufacture of all weights and balances used in trade and in the industries in which weighing is a necessary operation.

Precision Gage-blocks, Screw Threads, and Graduations

The Bureau of Standards developed in this country the original methods for producing, heat-treating, and standardizing precision gage-blocks. These gages are accurate within five-millionths of an inch. Some of the gages, under favorable conditions, are made accurate within one-millionth of an inch. The knowledge and experience gained by the Bureau of Standards in this work is now available to all manufacturers of gages.

In the laboratory for producing master screws of the highest precision, the bureau has developed machinery and methods whereby master screws accurate to within 1/25,000 of an inch can be made. The accuracy of ruled scales has also been developed to a high degree of precision, and the bureau is able to graduate scales on glass with 100,000 graduations to the inch.

Absolute Standards of Length

Since possibly all metals change in the course of time, the standards of length have been actually measured in terms of wave length of cadmium light rather than by the length of a metal bar. The bureau is now able to produce ruled standards of length, determined directly from the wave lengths of light. The highest precision so far attained is within 1/100,000 of an inch for each ruled division. This work is being performed for and at the request of the gage-making industry. Wave lengths of light are measurable to within one two-hundred-and-fifty-billionths of an inch.

Industrial Research

In addition to the scientific work done by the bureau, the work also covers original investigations pertaining to a great number of industrial processes. It is provided with a ten-million pound testing machine for testing the strength of materials. This is the largest testing machine in the world. At present it is used for testing the members of the At the present it is used for testing the members of the Delaware River Bridge connecting Philadelphia and Camden.

In the rubber laboratory the bureau is investigating the power losses that are due to the use of different types of automobile tires. This loss is high, and the bureau has developed types in which these losses are minimized. The preventable waste in this field would save many thousands of dollars worth of gasoline a day. The bureau is also testing to destruction many kinds of tires, to find the cause of failure. In the paper laboratory there are miniature experimental paper making machines, capable of producing paper from different kinds of fiber, and experiments that are of value to the paper industry are undertaken there. In the textile laboratory there is a complete experimental cotton mill, which duplicates the process from carding to weaving, and in which original investigations are made relating to different textile processes. In another laboratory investigations are made covering the processes used in producing pottery, brick, refractory materials, and optical and other glass.

The automotive power plant laboratory is unusually complete, and the bureau has designed, constructed, and put into use an equipment mounted on an automobile which records automatically all the factors influencing the effect of the design of an automobile. The resulting data will be free to the entire automobile industry.

In the radio field, the work in progress includes the standardization of radio measuring instruments. The bureau first developed the direction finder, the radio compass, and the radio beacon. The recent work on short wave lengths with reflectors that throw out the radio energy in a given direction only is of unusual interest. The possibilities of the radio are only beginning to be realized.

These are only a few examples of the type of work that is done by the Bureau of Standards, and manufacturers who find themselves confronted with problems that require scientific investigations should take advantage of the facilities of the bureau and should present and talk over their problems with its scientists and engineers. The Bureau of Standards has been designated by Mr. Hoover as the largest and most complete industrial laboratory in the world.

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MACHINE TOOL STATISTICS

As the accuracy of the machine tool statistics published in January MACHINERY has been questioned, they have been rechecked by the Census Bureau and found to conform to the returns made by the machine tool manufacturers.

* * *

STANDARDIZATION ADVANCES

The American Engineering Standards Committee in its annual report says that one of the most encouraging developments of the year has been the interest in standardization shown by many trade associations. The standardization of industrial products offers unusual opportunities to manufacturers' associations, and their activities in that work will result in important economies, not only in the industries they represent, but for their customers and the public generally. The National Machine Tool Builders' Association has already taken up the standardization problem, but more active cooperation of manufacturers of machine tools among themselves and also with their customers, is urgently needed. Other associations of engineers and manufacturers are working steadily toward standardization, and it is quite possible that some standards will be adopted and accepted by engineers in general that will not be satisfactory to machine tool builders, unless they take an active part in this work. Such standards may cause considerable trouble if adopted by large engineering societies, and the only certain way to prevent this is for our machine tool builders to help in guiding the movement of standardization so that there will be no lack of harmony between the various industries.

* * *

RED TAPE IN LARGE PLANTS

Frequently the large shop is at a disadvantage compared with the small one because of the elaborate organization required to keep things running smoothly when there are several different departments. Most large plants have a special department for making repairs of machines or equipment—apparently an economical method, but having both advantages and disadvantages. One disadvantage is that when an important machine breaks down and production is held up, it may not always be possible for the repair department to handle the work immediately, and several hours, or even days, may pass before the needed repairs are begun. Written orders may also have to be prepared and approved by several different men. The system of the large plant naturally tends to develop red tape, which increases the difficulty of getting emergency work done promptly. System is necessary; the problem is how to prevent too much of it.

No general rule would be applicable in all cases, but a simple remedy is to modify the system so that an emergency can be met immediately. We have in mind an instance when the superintendent of a manufacturing department in a large plant telephoned a shop a hundred miles away to rush some needed repair parts by motor truck. The parts arrived the next morning and before noon the repaired machine was again in operation; but, as required by the system, the manufacturer who delivered the parts received the customary request to bid on them the day after they had been installed, and the formal order for them about a week later.

FEW DESIGNERS ARE WRITERS

Why do engineering journals receive more articles for publication from the men engaged in production work than from those who design the machines, tools and methods for the production? Comparatively few machine designers record the results of their experience and training in writing, although they should be unusually well qualified to do so. Their work frequently brings them in contact with new developments, new mechanisms and new methods for doing work. An important part of their business is to keep in touch with what is done in other shops; but how can this interchange of ideas be effected unless machine designers record their knowledge and experience more frequently in the technical press?

The designer should be especially qualified to contribute to engineering journals, because he is able to make clear and accurate drawings—something that the shop man cannot always do. The designer is accustomed to explain orally the workings of mechanisms and the reasons for his designs, and it should be comparatively easy for him to put these explanations in writing. His experience should enable him to separate the commonplace from that which is new, interesting and ingenious; and in consequence to prepare material for publication that would be of great value. Why is it, then, that technical journals receive comparatively few articles from this class of men and so many from shop men?

* * *

SIMPLICITY IN MACHINE DESIGN

Machine designers are realizing more than ever that simplicity in design is good practice, since a complicated mechanism is more costly and more likely to give trouble than a simple one.

Almost any mechanical action or result can be obtained, provided there are no restrictions to the number of parts used and to the manufacturing cost; but in the machine-building industries it is evident that the best designs are those that pass the commercial as well as the purely mechanical test. A machine may function as intended, but unless it will sell for more than cost it is a commercial failure.

The degree to which a mechanism can be simplified usually depends chiefly upon the principle underlying the design. By way of illustration: A certain type of machine now on the market requires an automatic feeding mechanism which must be so designed that it will transfer drawn shells from a magazine or main source of supply and present them to the operating tools. These shells have one closed end, and the feeding mechanism must be so arranged that each shell is automatically presented to the tools with the open end up to prevent tool breakage. One design of this feeding mechanism is complicated and costly, but it evidently has been simplified as far as the principle employed will permit. Another feeding mechanism serving the same purpose, much simpler and more compact in design, is mechanically superior to the first because the basic operating principle is simple.

Usually there are several ways of accomplishing a given result mechanically, and after devising one method it is advisable to try out others until the simplest possible one is found. Many designs in operation are unnecessarily complicated because the first principle that met the operating requirements was adopted without studying others.

Fair Play for Railway Shop Executives

FOR years the railroads have been easy and inviting targets for writers in the daily press and the popular magazines—easy, because we all have our grievances against the roads at one time or another; inviting, because criticism of railroads and railroad managements is popular with most readers, often for good reasons.

In the field of trade and technical journalism the railroads are not spared either, but generally speaking, the technical journal stands on different ground and is primarily interested in efficiency and not in winning applause. The industrial journals are constructive, and necessarily so. Still it is true that in the industrial journals, criticism is sometimes directed against the railroad shop because of antiquated methods and equipment, without adequate effort to place the blame where it really belongs.

This is not a plea for the railroad shop, but an appeal for fair play for the railway mechanical department. It is true that the average railroad shop is no model of productive efficiency, compared with first-rate manufacturing plants. But the comparison should be on a fair basis. To begin with, nearly all railroad shops are repair shops. Hence, repair methods rather than production methods must be employed, and relative efficiency should be measured by that yardstick. It will have to be admitted, nevertheless, that even if the railroad repair shop is compared only with the average repair shop in other fields, there has been, and is, a good deal of inefficiency. The superficial observer too often puts the blame upon the mechanical management, which is erroneous and unfair. But who is responsible? That is the question.

The men directly responsible for efficiency and output of railroad shops seldom or never have adequate authority to run the shops in accordance with their own ideas of efficiency. They have no power to purchase even the most ordinary supplies and tools. They receive little or no encouragement in their efforts to put the shops on an efficient commercial basis. This lays them open to attacks from all sides, on the basis of an inefficiency that they are powerless to remedy.

As a matter of fact, the men in charge of railway mechanical departments average up with capable executives in other industries. They would like to make as good a showing of shop efficiency as any other executive, and would if they had the equipment and authority. The examples of modern practice copiously spread before them every day by periodicals like MACHINERY spur them on—but in vain. Efficiency is largely a matter of tools, and they are denied the tools of efficiency. The result is that they get discouraged, and chafe under conditions and rules and limitations that kill initiative. It is not their fault if the average railroad shop falls behind in the procession. They do the best they can with the tools they have.

A great deal of credit is due these men for the skill, resourcefulness and ingenuity they so often display in getting results with antiquated equipment. They do remarkably well in keeping rolling stock in working condition, handicapped as they are and have been for years and years. For it is not only adequate machine tool equipment they lack, but also the most ordinary types of small tools.

A well-known salesman of a leading line of machine tools, with a broad acquaintance in the railroad field, writes us:

"The question so often asked 'What is wrong with the railroad shops?' can be answered in three words—*the general management.* The trouble is not with the shop management. Let me quote a few examples. One master mechanic told me he was unable to get the purchasing department to buy a 1-inch twist drill badly needed—to say nothing of all the other things he needed and could not get—so he made a drill in his own shop! The same railroad, in the interest of economy, laid off most of its track-walkers. This was followed in about a week by a wreck due to a broken rail, which presumably might have been discovered by one of the track-walkers if he had been kept on the job. The wreck cost a good deal more than all the twist drills and all the track-walkers would have cost for a very long time.

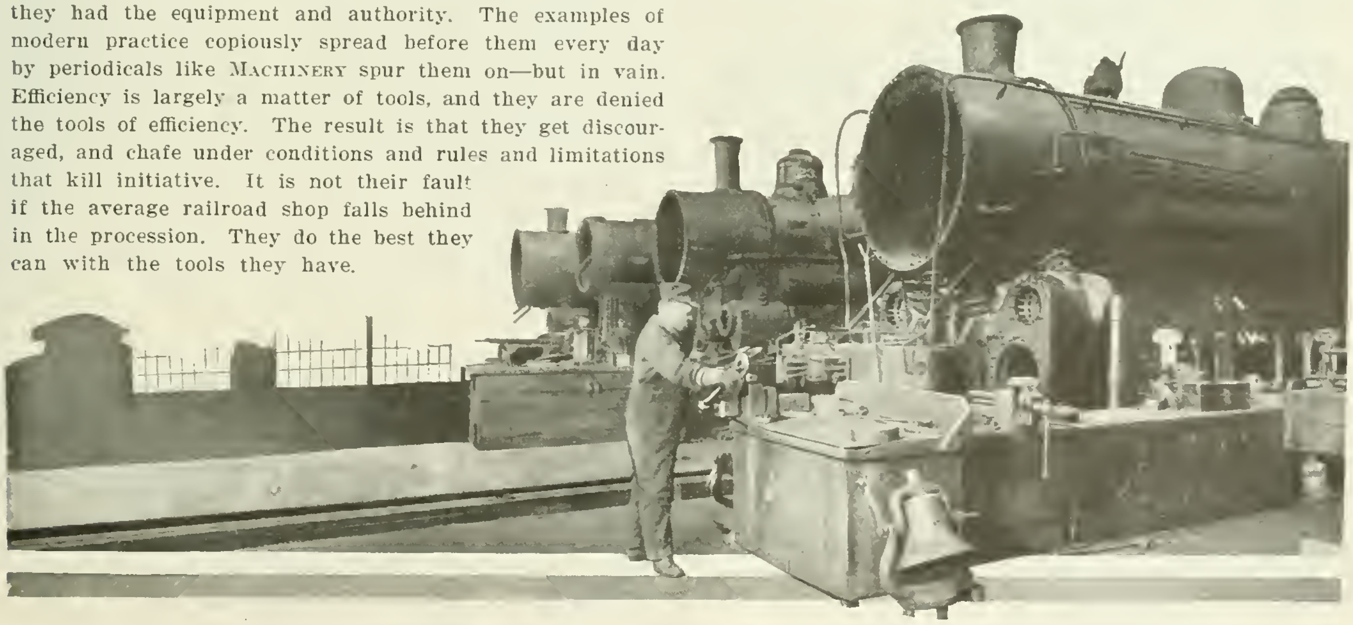
"Another master mechanic was unable to get a 1¼-inch steel bar, and had to get along with an old axle much too large in diameter, which he took out of the scrap pile and turned down.

"The worst of it all is that it is simply mistaken and costly economy. How much did it cost to make that 1-inch twist drill in the shop or to turn down the old axle?"

The whole thing is summed up in a terse statement by one mechanical executive. He said, "If we had to sell what we make, we would go broke in a week."

Superintendents of motor power, railway master mechanics and shop foremen will show real results when they are given a chance. In the comparatively few instances where capable and progressive railroad managements look after the shop as well as the traffic end, the railroad shop has developed high efficiency.

The railroad shop, operating with antiquated equipment, is a costly department. If we are to have better railroad shops, this truth must be brought home to the men who control the finances. Put the blame where it belongs.



The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, January 16, 1923

THE best that can be said of the machine tool industry is that the new year undoubtedly opens with much better prospects. Manufacturers as a whole confine their purchases pretty much to new types of tools and machinery which promise immediate economies in production costs. Of late the willingness to buy on the strength of performance has become distinctly pronounced, and each week sees an improvement in the prospects of new business.

The Automobile Industry

It is expected that automobile manufacturers will be taking a fair amount of new equipment as production schemes, during the next month or two, are put into effect. For reasons of economy, automobile manufacturers, in common with many others, stopped buying machine tools long before actual requirements were satisfied, but times are now considered more propitious, and with a good season for the industry fairly well assured, buyers are entering the market with greater freedom. It is evident that automobile manufacturers are intent upon cutting production costs to the minimum. The productive capacity of existing equipment is being carefully investigated—in a number of cases it is found to be hopelessly inadequate—and where conditions warrant replacement with new and better machine tools, these are being immediately ordered. As a rule, simple machines with a proved capacity for continued heavy duty and rapid production are mostly in favor.

In lathe manufacture the biggest volume of trade is undoubtedly in machines with beds up to 20 or 30 feet in length, the standard lengths still being, apparently, largely supplied from munition surpluses.

The Dickinson Machine Tool Co., Keighley, is going out of business, and its works and equipment are to be sold by auction. One of the oldest machine tool shops in Yorkshire, it was founded about the middle of the last century, and has always had a good reputation, particularly amongst textile engineers. Latterly the works were laid out especially for the production of horizontal boring machines, of which large numbers have been turned out during the last few years.

The Second-hand Market

The second-hand machine tool market is relatively brisk, and reconditioned machines of reputable make are selling readily at comparatively high prices. A fair amount of surplus munitions equipment has recently been thrown on the market, or is announced for sale by auction in the near future. For some months past these sales have been conspicuously absent, and although the knowledge that further sales are about to take place may be somewhat disconcerting, they denote at least one thing, which is that machine tools are now considered to be a much more marketable commodity than they have been for the last six months.

Iron and Steel Industry

There is a better feeling in the iron and steel industries. The production of pig iron is steadily increasing, and in November amounted to 493,900 tons, which was the highest monthly total attained since January, 1921. The furnaces in blast now number 162, compared with 77 at the beginning of last year. Steel production in November amounted to 600,800 tons—the highest since December, 1920.

The Railway Field

In the railway field there is a considerable amount of work on arrears of maintenance programs alone, and the payment of the second instalment of £30,000,000 by the Government to the railway companies is expected to give a stimulus to the engineering and other trades. Substantial orders have been received on account of the Indian railways, and tentative orders have been forthcoming for other systems abroad. It is understood that orders already placed for India represent but the initial stages of important plans for railway development and that further large orders are likely to follow. Extensions of the Australian lines are being proceeded with, and many more cars will be required by South America. The railway electrification schemes in hand, both at home and abroad, are also expected to result in valuable orders for rolling stock. Shipbuilding prospects are much brighter than they were a year ago.

New Machine Tools

A new design of all-geared manufacturing lathe has been put on the market by Charles Dale, Keighley. The machine has been designed specifically for a high rate of output. The single pulley drive is coupled to the transmission by a cone friction clutch, the control lever for which is carried in a convenient position on the saddle. This lever, in addition to engaging or disengaging the clutch, also operates a spindle brake so that the work can be brought to rest as soon as the clutch has been disengaged. There are twelve spindle speeds operated by three convenient levers on the front of the headstock.

At the Chiswick Works of the London General Omnibus Co., Ltd., where London's motor buses are systematically overhauled periodically, several interesting special machines have been installed. One of these supplied by John Holroyd & Co., Ltd., is for boring, reaming and running in crankshaft main bearings. There are two spindle heads arranged at opposite ends of the machine bed, which carries a turntable indexing to four positions at 90 degrees to one another. The turntable carries four crankcases. One spindle head drives a boring tool or reamer, as the case may be, and the other supplies the drive for running in the crankshafts after the bearings have been machined. When working continuously one crankcase is completed every twenty minutes.

The range of horizontal boring, drilling and tapping machines manufactured by George Richards & Co., Ltd., Manchester, has been increased by a series of machines of the sliding spindle type, fitted with an automatic facing head.

A new tube-mandrel grinding machine has been produced by the Churchill Machine Tool Co., Ltd., Manchester. This is an adaptation of the company's standard model B plain grinder, and is intended for the rapid handling of round-nosed mandrels, such as are used in tube rolling.

* * *

Of the automobiles built in 1922, Ford produced in the United States 1,233,000 cars, and adding the Canadian and foreign production, the total reached 1,352,000 for the year. The output of Ford tractors was 63,000. The automobile industry as a whole produced approximately 2,500,000 cars and trucks, of which the trucks represented somewhat less than 10 per cent. The outlook for the automobile industry for the coming year is exceptionally bright, and many orders are reported as a result of the automobile show.

Grinding a Cam Slot in a Reference Gage

By W. H. KEEFE

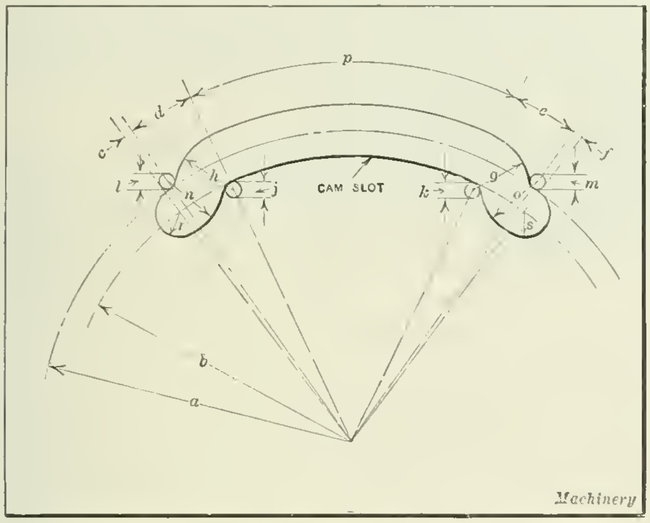


Fig. 1. Outline of Cam Slot in Reference Gage

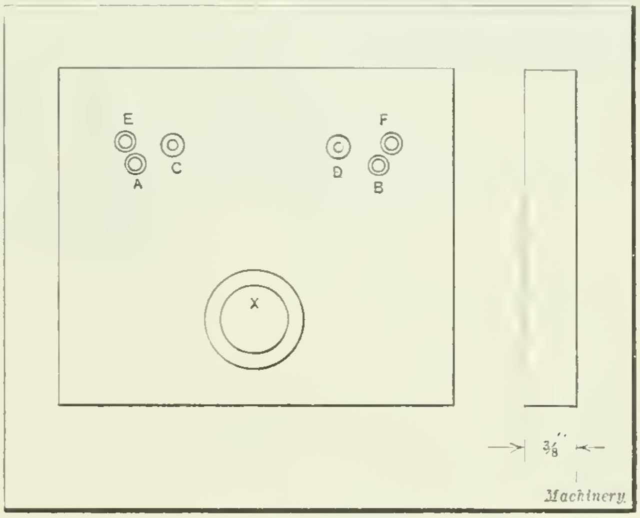


Fig. 2. Master Plate used in grinding Cam Slot

INTERESTING grinding problems are often encountered in the production of cams, profile gages, and similar parts requiring accurate profiles. The cam slot shown diagrammatically in Fig. 1 presents a problem in grinding that is typical of this class of work. The methods and equipment here described, which were employed by the writer in grinding the cam slot, may also be used for a variety of similar work. The description should, therefore, be of general interest to toolmakers and machinists. Referring to the diagram, Fig. 1, it will be noted that reference letters are inserted in place of actual dimensions. On checking up the finished cam slot with precision gages, all the dimensions represented by the letters were found to be correct within the allowable tolerance of 0.0002 inch, and no error could be detected in the angular measurements.

Equipping Bench Lathes for Grinding Operations

The first step in producing the cam-slot gage was to equip a Pratt & Whitney bench lathe of 7-inch swing with bolster blocks to obtain the required swing of 13 inches. The bolster blocks were made of cast iron and were of simple design. A piece of boiler plate, ¾ inch thick and of sufficient size to make a round plate 12 inches in diameter, was drilled and tapped for clamping screws. This plate was then fastened to the faceplate of a 14-inch engine lathe by passing screws through the slots in the faceplate, and tightening them in the threaded holes of the boiler plate. The prick-punched center of the boiler plate was trued up by the use of an indicator. After rough-boring the central hole to within 1/16 inch of size, the plate was faced off.

The work was next reversed on the faceplate, after which the other side was faced and the outside edge finish-turned to a diameter of 12 inches. The central hole was then finish-bored and threaded to fit a collet stem of standard size, which was made up for use with the special faceplate. A faceplate made in this way will be found very accurate and suitable for various kinds of work. The spindle head of the bench lathe was mounted on one of the bolster blocks attached to the lathe bed, while the cross-slide was mounted on the other bolster block. As there was no occasion to use the tailstock, this part was not taken into consideration.

A Pratt & Whitney slide grinder—or internal slide grinder as it is sometimes called—was used for the grinding operation. The speed of the lathe spindle was reduced and that of the grinder increased by the use of special pulleys. As the narrow slot to be ground necessitated the use of a small-diameter wheel, a speed of approximately 12,000 revolutions per minute was required for the grinder spindle, to obtain the desired results. Hence it was necessary to exercise considerable care in order to prevent the grinding wheel spindle bearings from cutting or becoming abraded. The best results were obtained by running the grinder

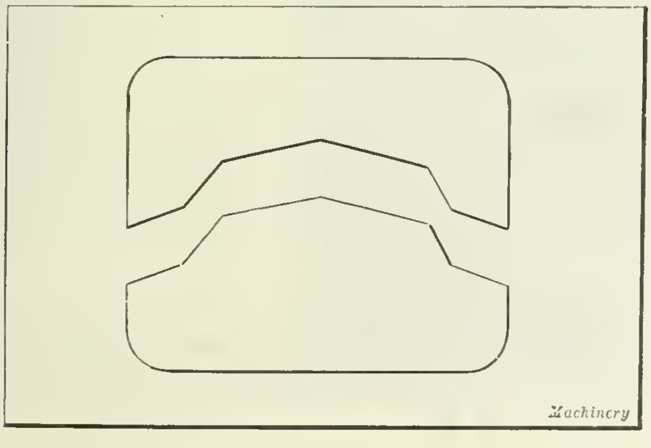


Fig. 3. Diagram showing Two-piece Construction of Gage

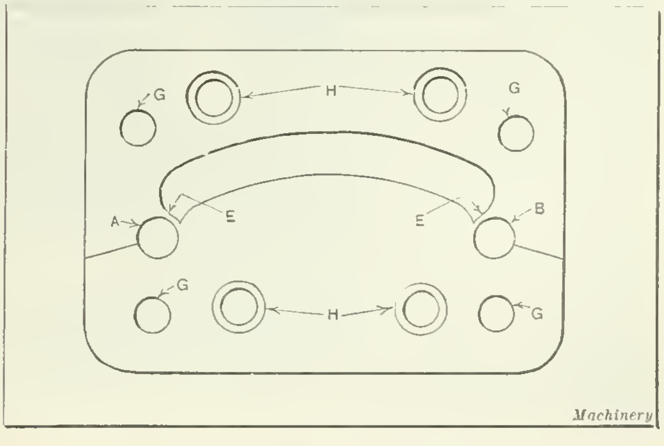


Fig. 4. Roughed out Gage Blank

spindle dry and occasionally rubbing the fingers over it to provide a thin lubricating film.

As the only grinding wheels obtainable of the required size were of too fine a grain for the purpose, it was necessary to make up special wheels. These were made from small square blocks, cut from a larger wheel with a hacksaw. Holes were drilled in the center of each of the blocks of the correct size to fit the internal grinding spindle. Small, thin brass or copper washers were placed on each side of the small wheels or blocks to insure a good grip of the screw and to prevent crumbling. About an 80 K wheel was found to give good results. The harder and finer grain wheels proved unsuitable, mainly for the reason that they were subject to excessive glazing. When used by a careful workman a bench lathe equipped as described is capable of handling a great variety of grinding work.

Master Plate for Gage

A master plate, such as shown in Fig. 2, was next made up. The holes *A*, *B*, *C*, *D*, *E*, and *F* in this plate represent the centers of the radii that determine the outline of the cam slot, as shown in Fig. 1. As the accuracy of the finished gage depends on the location of these holes, extreme care was taken in the laying out and boring operations. Each hole was provided with a hardened, ground, and lapped bushing, having a central hole 0.125 inch in diameter. After inserting the bushings in the master plate, the latter was given a final inspection.

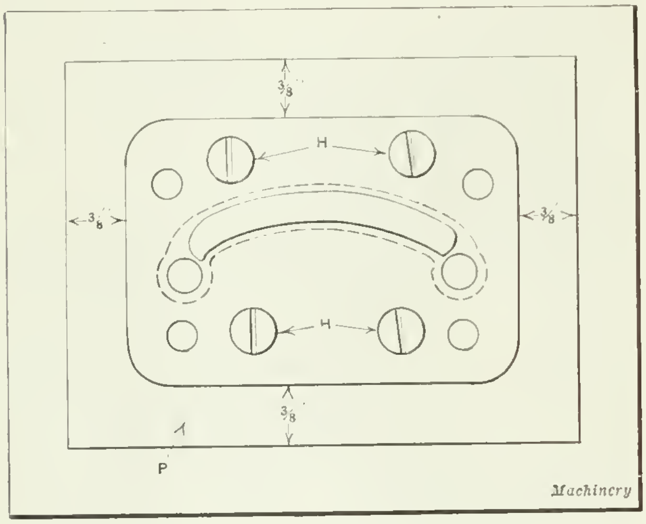


Fig. 5. Gage Blank mounted on Plate Ready for Grinding Operation

Grinding the Gage Slot

The gage itself was made in two pieces, as shown in Fig. 3. The cam slot outlined was laid out or scribed with a height gage and dividers, after which the slot was roughed out, leaving webs *E* at each end, as shown in Fig. 4. The dowel-pin holes shown at *G* were drilled, and the fastening screw holes *H* counterbored, after which the gage was heat-treated to obtain a glass-hard surface. The dowel-pin holes were then lapped, and the edges of the plate ground so as to form a good fit at points *J*, Fig. 6. A 3/8-inch plate *P*, Fig. 5, 3/4 inch longer and 3/4 inch wider than the gage blank, was next procured. The gage blank was assembled on this plate, and secured by screws inserted in the counterbored holes *H*. Before fastening the blank to the plate, the outline of the slot was scribed on the plate, and this section cut away to permit the grinding wheel to pass through the work.

The plate with the work doweled in place was next attached to the faceplate of the bench lathe, the hole corresponding to bushing *A*, Fig. 2, being accurately centered. After grinding the hole thus centered, the master plate shown in Fig. 2 was placed on the work, a stepped plug having steps of 1/8 and 1/4 inch being used to bring the hole in the bushing *A* into alignment with the hole just ground. The master plate was then pivoted on the stepped plug, or swung around until the roughed out hole in the work at *B*, Fig. 4, was in line with the bushing *B*, Fig. 2, of the plate. When the correct position was obtained, the master plate was clamped to the work, the hole ground, and another stepped plug inserted in bushing *B*. This plug was then employed in locating the work on the faceplate preparatory to finish-grinding the section of the cam slot formed by the hole *B*, Fig. 4. The master plate and the stepped plug were used to check up the chordal distance between the centers of holes *A* and *B*.

The next operation was grinding that part of the cam slot profile determined by the radius located by bushing *C*, Fig. 2. The method of locating and grinding this surface, as well as the corresponding one located by bushing *D*, was identical with that employed in the case of holes *A* and *B*, except that the lower member of the gage was removed for the grinding operation. The sections of the slot profile which have 0.2700 inch radii *h* and *g*, Fig. 1, were checked up by the use of a stepped plug having 1/8 inch and 0.540 inch diameter steps.

The section of the cam slot determined by the radii located by bushings *E* and *F*, Fig. 2, were next ground Only two settings of the work on the faceplate were required for these grinding operations, as the sections ground on the upper and lower members of the gage were located by radii having common centers. In these grinding operations it was necessary to grind away the webs indicated at *E*, Fig. 4. This was readily accomplished by keeping the wheel in good condition by frequent dressings with a diamond or a piece of carborundum and making no attempt to crowd the wheel.

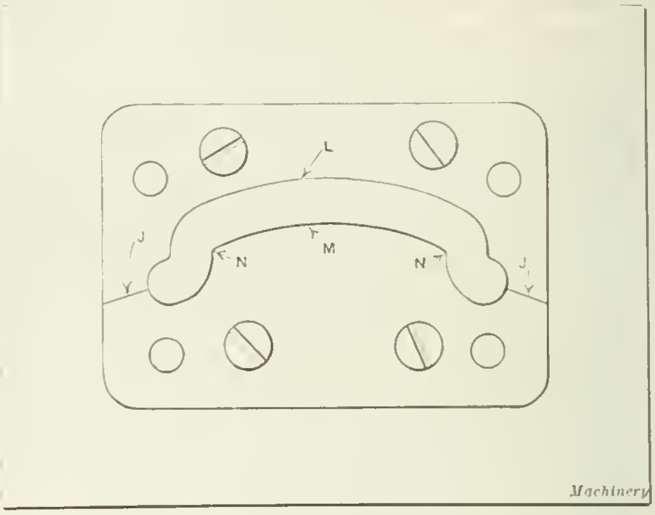
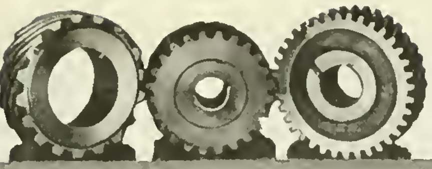


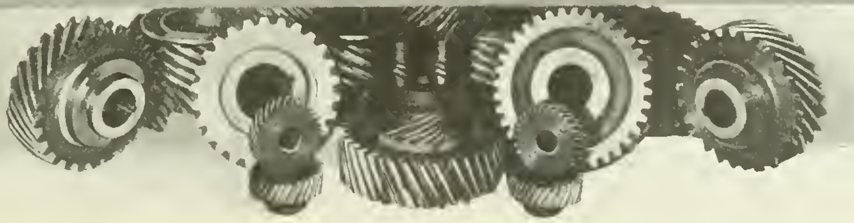
Fig. 6. Completed Reference Gage for Cam Slot

In grinding the top and bottom surfaces *L* and *M* of the cam slot (see Fig. 6), bushing *X* of the master plate, shown in Fig. 2, was made to serve as a pivot bearing, so that the work could be swung through the required arc. In the final grinding operations, the work was relocated on centers corresponding to bushings *C* and *D* and the corners of the lower part of the slot, at *N*, Fig. 6, were ground to the required radius. After this was done, a piece of cold-rolled steel 1/4 inch in diameter, held in a drill chuck, was used as a lap in finishing the slot to a perfect plug fit at every point.

While a gage of the type referred to could be made in various ways, the method here described has been thoroughly tried out and has proved satisfactory. This gage is in use at the present time in the plant of a manufacturer in the Middle West who demands the best in machinery and tools.



Methods of Generating Helical Gears



Cutting Teeth of Helical Gears on Hobbing Machines and Gear Shapers

By FRANKLIN D. JONES

GEARING commonly known as helical or spiral gearing is usually cut by some generating method, although milling machines are sometimes used, especially when such gears are not required in quantity. Large helical gears particularly in the herringbone form, may also be cut on planers of the form-copying type and by the end-milling process. The most common generating method employed is that of hobbing, but the shaping or planing processes are also used in many shops. Before dealing with these generating methods, the terms used to designate helical gearing will be considered to avoid misunderstanding, since different names are often applied to the same general classes of gearing.

In the first place, helical gears are commonly known as spiral gears, although the teeth are helicoidal like a screw thread and not of spiral form; the name helical, however, is being used increasingly. Helical gears are applied in different ways, and various terms are used to designate them. For instance when helical gearing is used to connect parallel shafts, the term "twisted spur gear" is sometimes used, because the gearing in this case serves the same general purpose as ordinary straight-tooth spur gearing. This relates to the use of single helical and not the double-helical or herringbone gearing. When helical gearing is used to connect shafts located at an angle, the term "helical" or "spiral" is commonly applied, both terms being extensively used. Both of these general classes of gearing have helicoidal teeth, and the principles underlying the methods of cutting them are similar, but the tooth action (when the gears are running together) is quite different, and so also are the functions of the gearing. Thus, twisted spur gears are used to connect parallel shafts in order to secure a smoother action than can be obtained with ordinary spur gears. On the other hand, helical gearing is frequently used as a convenient means of transmitting motion between shafts that are located at an angle and not in the same plane. The foregoing applications of the terms given do not represent standard usage, as there is no standardization of these terms. By way of illustration, some treatises on gearing designate gears for parallel shafts as helical gears instead of twisted spur gears, and those for shafts at an angle as spiral gears. When parallel shafts are connected by gearing having both right- and left-hand helical teeth, the terms "herringbone" or "double-helical" gears are commonly used, the former being more common.

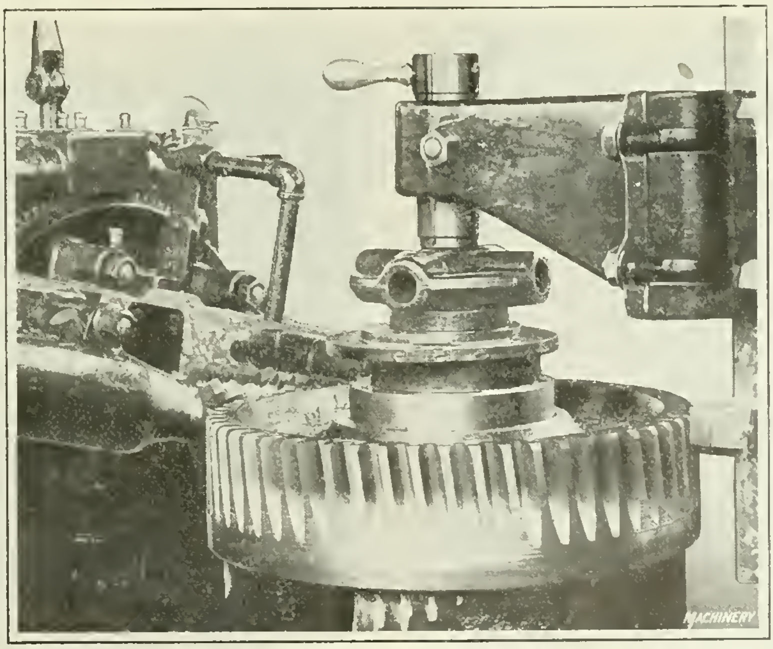


Fig. 1. Cutting a Helical Gear on a Hobbing Machine

Cutting Helical Gears by the Hobbing Process

Gear-hobbing machines are very efficient for cutting helical gears, and are widely used for this class of work as well as for spur gears. Many machines are used for cutting both spur and helical gears. The general method of cutting helical gears by hobbing is practically the same as cutting spur gears, after the machine is properly geared and adjusted. The angular position of the hob must be determined with reference to the helix angles of both the hob and the gear to be cut, and the machine must be geared to generate helical teeth having the required helix angle with relation to the axis. When the machine is at work, the hob has a feeding movement parallel to the axis of the gear, and, ordinarily, all the teeth are finished during one passage of the hob.

The principle governing the generation of helical gears by hobbing is illustrated by the action of a helical pinion meshing with a rack, as embodied in the well-known Sellers planer drive. When a

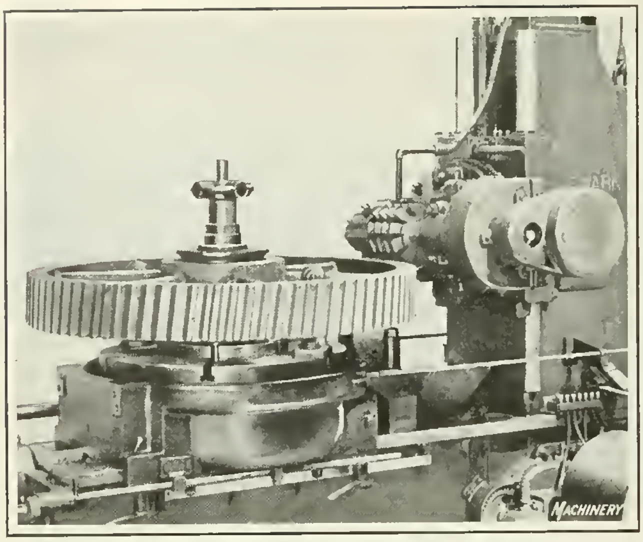


Fig. 2. Cutting a Right-hand Gear with a Right-hand Hob—Number of Teeth 83, Angle 7 Degrees

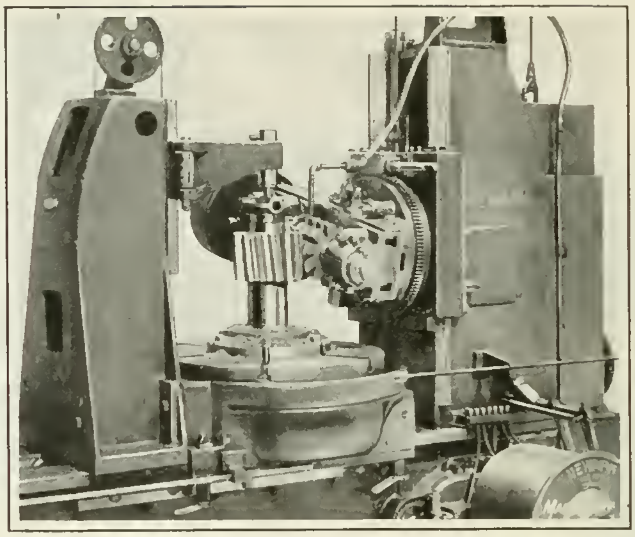


Fig. 3. Cutting a Left-hand Pinion with a Right-hand Hob—Number of Teeth 14, Angle 7 Degrees

helical gear is to be cut with a hob, the latter is set at such an angle that its teeth, as they come around to the cutting position, coincide with the teeth of an imaginary rack in mesh with the revolving gear. Fig. 1 shows the cutting of a helical gear by hobbing. The hob, set at the proper angle, begins cutting at the top of the blank, and the slide carrying it feeds downward, parallel to the axis of the gear being cut, thus forming all the teeth at one passage of the hob. Fig. 4 shows a machine cutting two pinions at the same time. Both of these views are from the plant of the R. D. Nuttall Co., Pittsburg, Pa.

In cutting a spur gear with a single-threaded hob, the number of revolutions of the hob for each revolution of the gear equals the number of teeth in the gear, but in cutting helical gears, the ratio of the change-gears on the machine is affected not only by the number of teeth in the gear to be cut, but also by the lead of the teeth, the relation between the hand of the hob and the gear, and the rate of the hob feeding movement. The formation of helical teeth, as the hob feeds across the gear blank, is accomplished by accelerating or retarding the motion of the work-table. The principle will be made clear by comparing the hobbing of spur and helical gears.

Suppose, for example, that a single-thread hob were used for cutting a forty-eight-tooth spur gear; in this case the work-table would make just one revolution to forty-eight revolutions of the hob. Now, assume that a left-hand spiral gear with forty-eight teeth is to be cut with a left-hand hob; then it would be necessary for the table to revolve somewhat faster than for a spur gear with the same number of teeth. It is this acceleration or increase of rotary motion of the table, as compared with the rotation for cutting a spur gear, that causes the hob, as it feeds across the blank, to develop helical teeth.

In some cases, however, the motion is retarded instead of being accelerated, since this depends upon the kind of hob used. In cutting a left-hand gear with a left-hand hob, or a right-hand gear with a right-hand hob, the table revolves at a faster rate than it would in cutting a spur gear having the same number of teeth. On the contrary, in cutting a gear of opposite hand, the rotation is retarded in order to secure the same effect in generating the helical teeth The plan is to gear the machine so that the table will either gain or lose one complete turn during the time required for the hob to feed a distance equal to the lead of the gear being cut. In actual practice, of course, the total feeding movement is usually only a small part of the lead, since the latter represents the distance that a tooth would advance if it made a complete turn about the gear. [For information on the calculating of change-gears for hobbing helical gears, see Machinery's Encyclopedia, Vol. III, pages 363 to 367, inclusive].

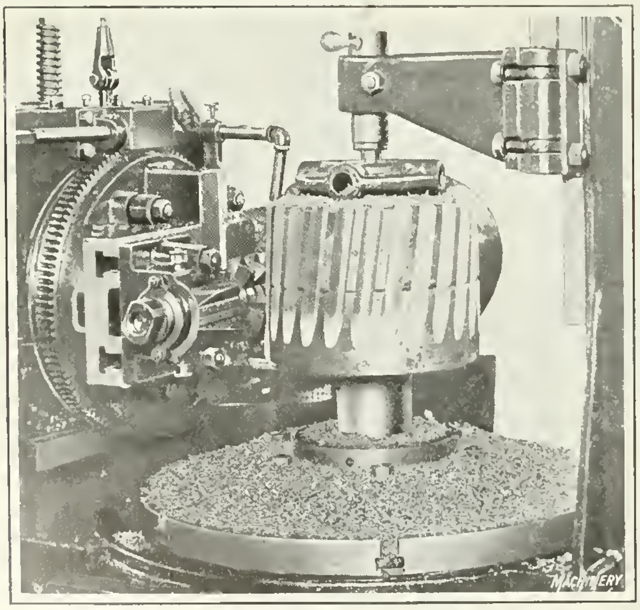


Fig. 4. Cutting Two Helical Pinions at the Same Time

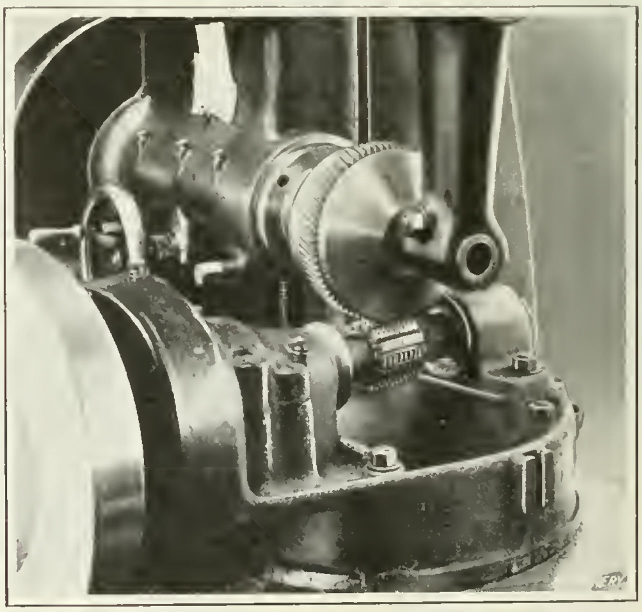


Fig. 5. Cutting Timing Gears on a Horizontal Hobbing Machine

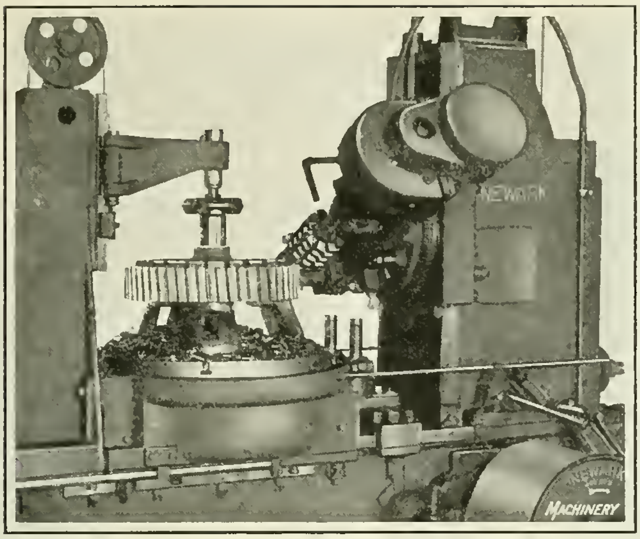


Fig. 6. Machine arranged for cutting Helical Ring Gears

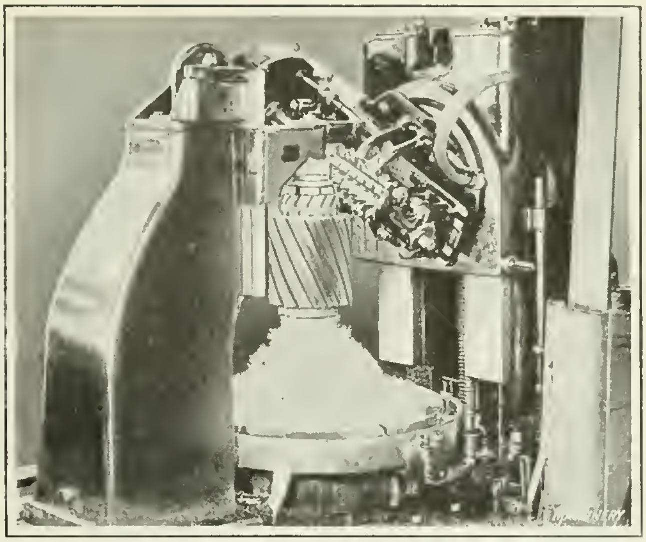


Fig. 7. Cutting Helical Gears made of Chrome-nickel Steel

Angular Position of Hob for Cutting Helical Gears

The angle at which the hob is set for cutting helical gears depends upon the helix angle of the gear and the angle of the hob itself. When a right-hand hob is used for a right-hand gear, or a left-hand hob for a left-hand gear, the hob spindle is inclined from the horizontal position an amount equal to the *difference* between the angles of the gear and hob. The helix angle of the gear is measured from the axis, and the helix angle of the hob (which should be stamped on it to avoid measurement and calculations) is measured from a plane perpendicular to the hob axis and is often referred to as the "end angle." When a right-hand hob is used for a left-hand gear or vice versa, the hob spindle is inclined an amount equal to the *sum* of the gear and hob angles.

When a hob has the same angle as the gear to be cut, and the hob and gear are of the same hand, the hob spindle is set in the horizontal position. This agrees with the rule just given, since the result of subtracting one angle from the other equals zero.

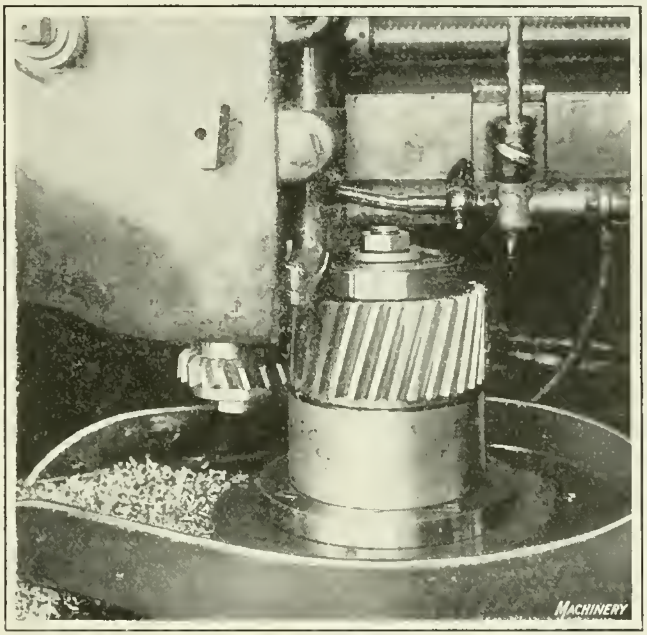


Fig. 8. Helical Gear Shaper of Vertical Design

Selection of Hobs for Cutting Helical Gears

Hobs for helical gears are selected according to the normal diametral pitch instead of the "real" diametral pitch. The latter is the quotient obtained by dividing

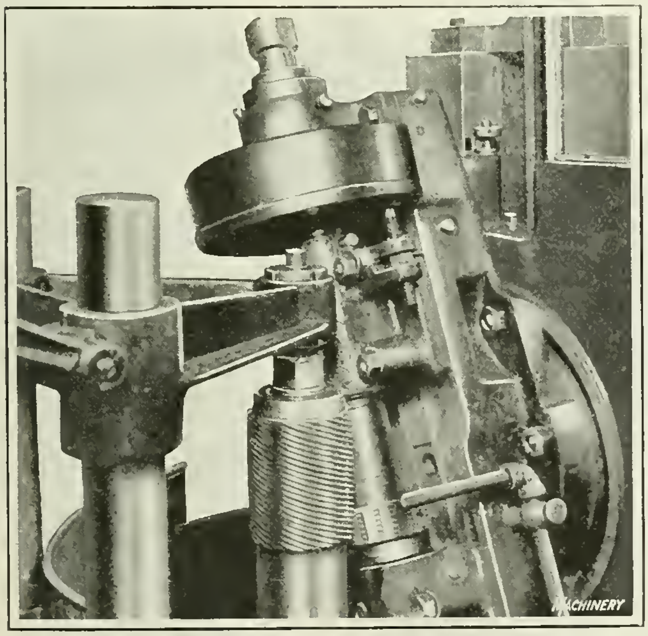


Fig. 9. Cutting Gears having a Large Helix Angle

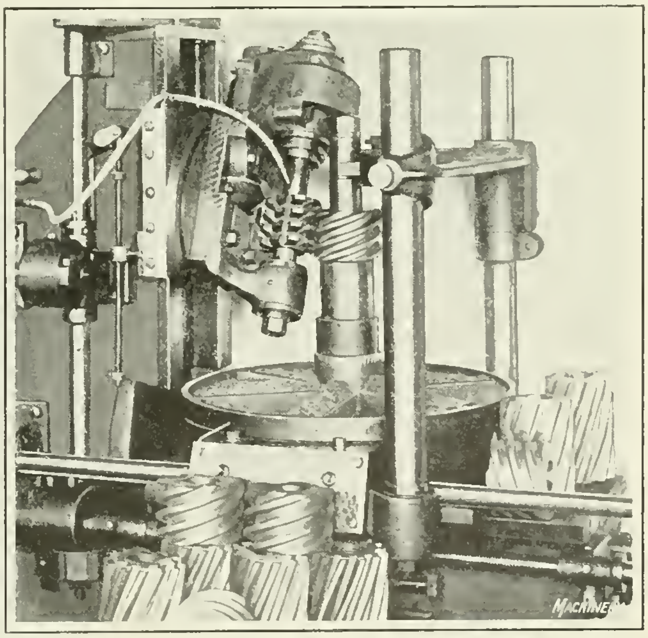


Fig. 10. Hobbing Gears of 70-degree Helix Angle

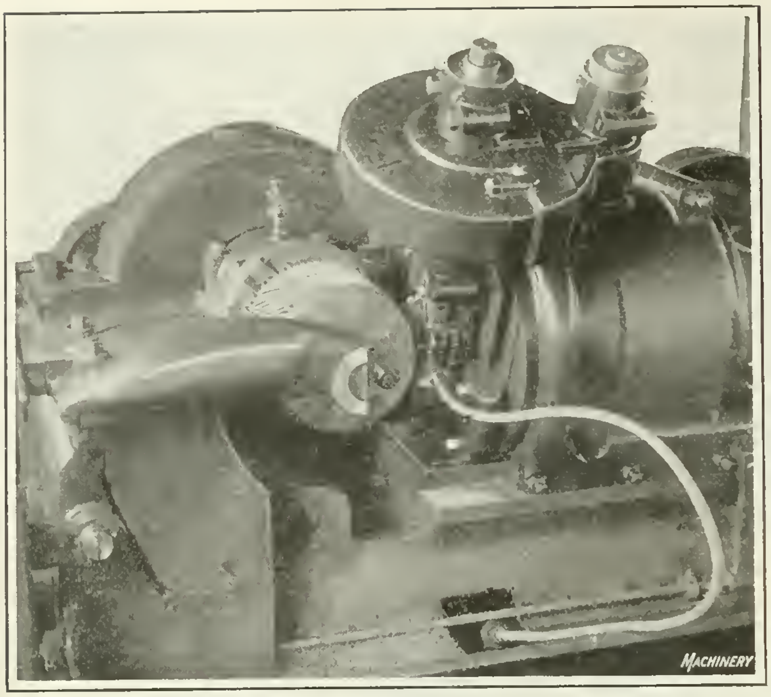


Fig. 11. Horizontal Type of Machine cutting Two Helical Gears simultaneously

the number of teeth by the pitch diameter, as for spur gears. The normal diametral pitch is found by dividing the real diametral pitch by the cosine of the helix angle of the gear.

Whether the hob should be right-hand or left-hand depends upon the gear. As a general rule, it is advisable to use right-hand hobs for right-hand gears, and left-hand hobs for left-hand gears, particularly when the gear is to have teeth of large helix angle. The reason that the hob and gear should be of the same hand for large helix angles, is that the hob has a better cutting action relative to the work, the direction of cut being against the rotation of the gear blank. When the helix angles are not large, a hob may be used interchangeably for either right- or left-hand gears.

Examples of Helical Gear-cutting by the Hobbing Process

The application of gear-hobbing machines to the cutting of helical gears varying considerably in regard to size, pitch, and angle of teeth, will be illustrated by a number of specific examples from practice. Fig. 2 shows a machine set up for cutting a cast-iron helical or twisted spur gear to be used for connecting parallel shafts. This gear has 83 teeth (47.78 inches pitch diameter) of 1¾ normal diametral pitch, a face width of 7 inches, and a helix angle of 7 degrees. This is an example of cutting a right-hand gear with a right-hand hob.

The normal diametral pitch or the pitch of the hob is determined as follows: The real diametral pitch equals 83 ÷ 47.78 = 1.737. The cosine of the helix angle of the gear (7 degrees) is 0.99255; hence the normal diametral pitch equals 1.737 ÷ 0.99255 = 1.75. Therefore, a hob of 1¾ diametral pitch should be used. This hob is the same as would be used for spur gears of 1¾ diametral pitch, and it will cut any spur or helical gear of that pitch regardless of the number of teeth, provided 1¾ is the diametral pitch of the spur gear and the normal diametral pitch of the helical gear.

The gear shown in Fig. 2 is mounted between stepped flanges on the work-arbor, and there are two drivers bolted to the work-table to prevent any movement of the gear relative to the table as it revolves. The outside supporting column has been removed from the machine for this operation, and the thrust of the cut is taken by two rim rests located below the gear rim on the cutting side. This gear is finished at a single passage of the hob.

The machine steel pinion shown on the machine in Fig. 3 runs with the 83-tooth gear just referred to. This pinion has a pitch diameter of 8.06 inches, and 14 teeth with an angle of 7 degrees. This is an example of cutting a left-hand pinion with a right-hand hob. It will be noted that the hob inclines more than when cutting the mating gear. This is because the pinion and hob are of opposite hand, and consequently the inclination must equal the sum of the gear and hob angles. The diameter of the pinion is too small to permit using a rim rest to take the thrust of the cut, so the upper end of the work-arbor is supported by the column and arm, as shown. The same gearing is used for controlling the lead or angle as is employed for cutting the mating gear, the only change necessary being in the "dividing" gears for the number of teeth.

The helical ring gear illustrated in Fig. 6 is made of bronze, and has 54 teeth of 2½ normal diametral pitch, with a helix angle (measured from the axis) of 5 degrees 45 minutes. The left-hand gear shown on the machine (as well as right-hand gears) is cut with a right-hand hob. The gear rests upon three supports bolted to the work-table, and is held in a central position and clamped, to prevent slipping, by a cast-iron plate located on top of the gear. The three examples referred to represent work done on hobbing machines made by the Newark Gear Cutting Machine Co.

The hobbing of helical gears made of chrome-nickel steel is illustrated in Fig. 7. These gears have 22 teeth of 3 pitch and 7½ degrees angle. The face width is 6 inches, and the cutting time thirty minutes. This is an example of work done on one of the Gould & Eberhardt machines. Another helical gear-hobbing operation on a machine of the same make is shown in Fig. 9. These gears are made of chrome-vanadium steel, and have a pitch diameter of 3¾ inches, and a face width of 1 inch. They are used for driving the speedometer shaft of an automobile. This is an example of cutting helical gears having a large helix

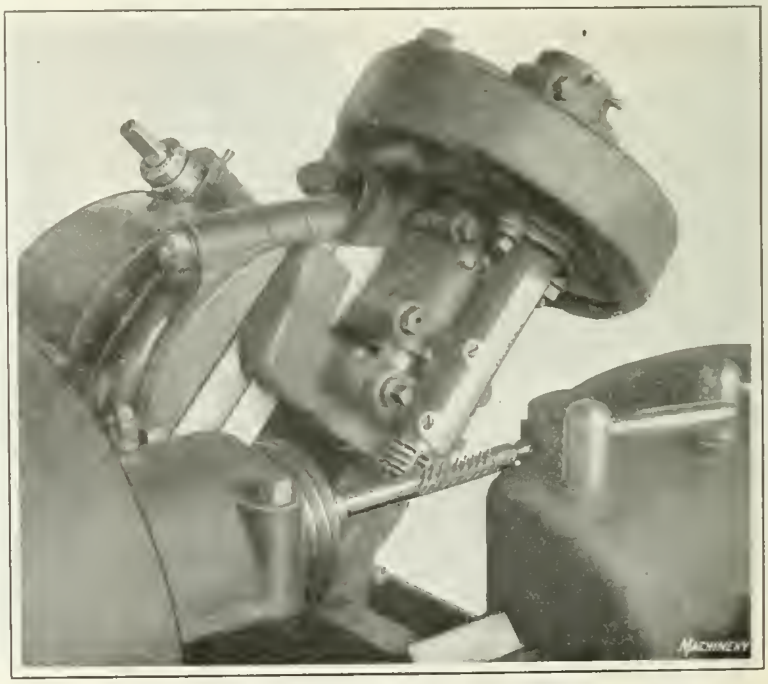


Fig. 12. Cutting a Small Helical Pinion of 45-degree Angle

angle. Fig. 10 shows a Farwell machine hobbing helical gears having a 70-degree angle. Other gears of 20-degree angle are shown on the base of the machine.

The hobbing of an automobile timing gear on a Brown & Sharpe machine is shown in Fig. 5. The gear is held rigidly between two heavy disks or plates, which extend out as far as possible without interfering with the hob. These gears must be cut very true, and all chattering eliminated, so that a rigid support is essential. On this machine the slide carrying the hob feeds along horizontal ways of the main bed (instead of feeding vertically, as on the other machines previously referred to) and the work-spindle is horizontal.

Examples of work on Lees-Bradner machines are illustrated in Figs. 11, 12 and 14. Another automobile timing gear job is shown in Fig. 11, two gears in this case being cut together. This machine is another design having a horizontal work-spindle; the feeding movement, however, is not applied to the hob-carrying slide but to the slide that supports the work. The small left-hand helical pinion, Fig. 12, has six teeth of 12 normal diametral pitch, a 45-degree angle, a pitch diameter of 0.707 inch. The cutting time for this job is 3.6 minutes. The machine illustrated in Fig. 14 is engaged in hobbing a gear of steep angle, the teeth inclining considerably relative to the axis.

Fig. 15 illustrates a method of holding a helical gear blank on a Lees-Bradner machine. The diameter of this blank is 6 inches, and the width 3/4 inch. As the hole in the center of the gear is very small, the arbor is used for centering purposes only. The gear is clamped by the rim between sleeve *A* and plate *B*. The bolt holes in this clamping plate (see end view) have a key-hole shape, so that the plate may be removed by simply turning it about 30 degrees. This arbor provides a very solid, accurate means of supporting the gear, and is not subjected to stresses due to tightening the clamping nuts. The small end of the arbor is supported by the machine center, and the opposite end has a taper shank that is inserted in the machine spindle. A draw-in rod screws into the inner end of the taper shank.

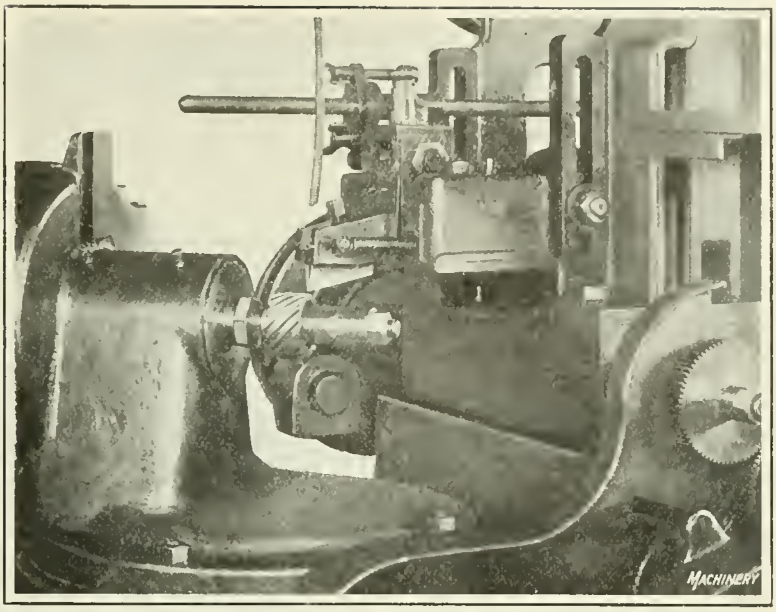


Fig. 13. Cutting Helical Gears on a Shaper of Horizontal Design

Cutting Helical Gears by Generating on Machines of Planer or Shaper Type

A Bilgram machine arranged for cutting helical gears is shown in Fig. 13. The action of this machine in cutting spur gears has been explained in a former article (see April, 1922, Machinery, page 646), and it operates on the same principle when cutting spiral gears. The motions for generating the spiral teeth may be compared with the well-known Sellers drive for planers. Thus, the gear being cut represents a spiral pinion, and the tool corresponds to one tooth of a rack. If the pinion were in mesh with a rack and revolving, the relative motions between the rack and pinion would be the same as the relative motions of the cutting tool on this machine and the gear being cut.

When the machine is at work, the gear blank indexes during each return stroke of the tool (which is lifted to clear the gear), thus bringing the next tooth space around to the cutting position. Inasmuch as the tool is slowly traversed laterally, the indexing movement is increased enough to compensate for this lateral travel, and all the teeth of a gear are formed while the tool passes from one side to the other. The traversing and indexing are controlled by change-gears. The work-holding head is set to agree with the helix angle of the gear being cut.

The Fellows helical gear shaper generates tooth curves, but the action is different from the Bilgram machine just described. Instead of rolling the gear blank in contact with a tool representing a rack tooth, the cutter used resembles a helical gear and has a rotary movement in unison with the gear blank being cut, the principle of operation being similar to that of the shaper for spur gears. Fig. 8 shows one of these machines cutting a helical gear and operating, in this particular case, with a push stroke.

The cutter teeth have the same lead and pitch as the gear being cut, and as the cutter is reciprocated vertically it is given a twisting or turning movement so that the cutting teeth follow a helical path corresponding to the teeth of the gear. This turning motion is controlled by a positive helical guide made up of two main sections. One section is attached to the top of the cutter-spindle, and the mating guide is secured to the enlarged hub of a worm-wheel through which the cutter-spindle is rotated in

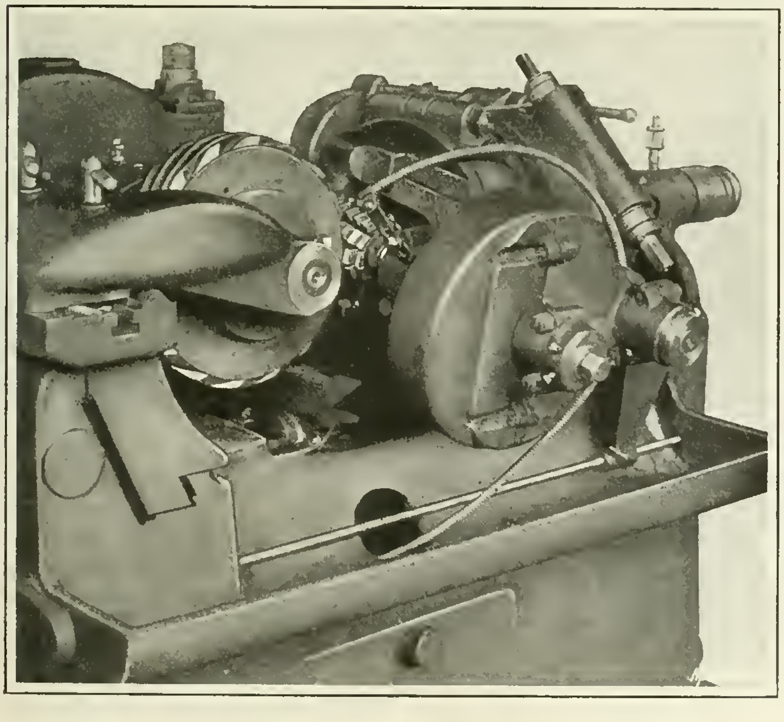


Fig. 14. Cutting a Helical Gear having Teeth of Very Large Helix Angle

unison with the gear. This helical guide has the same helix angle as the gear to be cut, and a separate one is required if the machine is to be used for cutting a different helix angle.

This machine is intended for cutting gears of the same angle in large quantities and may be used continuously on one size of gear; then only one pair of helical guides is required, one being for right-hand and the other for left-hand gears. The cutter used for a right-hand gear has a left-hand helix. The work is withdrawn from the cutter on the return stroke by a relieving mechanism acting on the work-holding apron, thus preventing any dragging action over the tooth surfaces. In view of the fact that this helical gear shaper is similar to the spur gear shaper described in a preceding article, except for changes that give the cutter-spindle a helical or twisting motion, the machine itself will not be referred to in greater detail here.

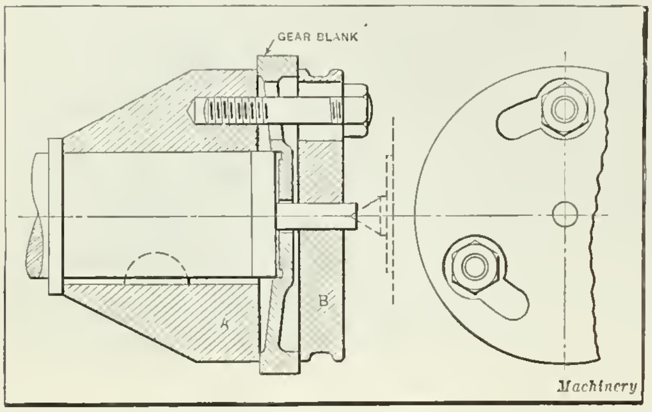


Fig. 15. Method of holding Helical Gear Blank on a Lees-Bradner Machine

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CUTTER GRINDING ON A PRODUCTION BASIS

By DONALD A. HAMPSON

It is seldom that more than one cutter or one set of duplicate cutters can be ground without readjusting or changing the grinding machine set-up. Frequent changes in the set-up are made necessary by the variety of cutters used and by the change in form that every cutter undergoes when subject to wear. Under these conditions it is not surprising that but few manufacturers have attempted to place their cutter grinding on a production basis or to consider it in the same light as regular production work.

In small well-organized plants one skilled workman, provided with a cutter grinding machine of the universal type, may be able to handle all the cutter grinding, while in the larger plants several workmen operating a variety of cutter grinding equipment may be required. In the latter case, it is an advantage to give all the cutters of a certain kind or type to one man, those of another type to the next man, and so on. With this plan, the total number of changes in set-up made by each workman will be considerably less than if the cutters were given out indiscriminately. A further saving in time can be made if the cutters of each type are grouped according to size, so that as many cutters as possible can be sharpened without materially changing the grinding machine set-up.

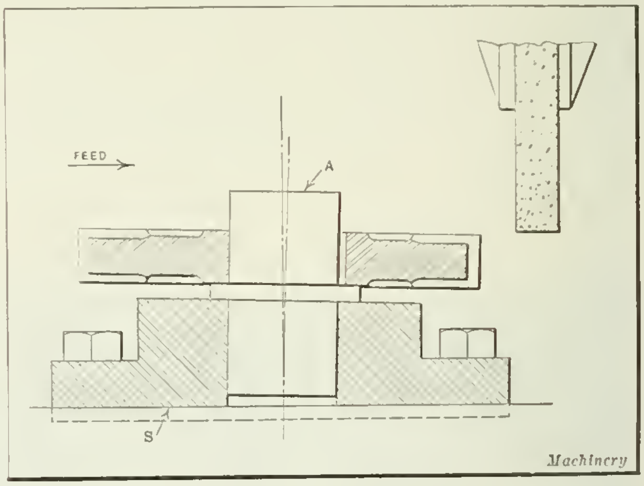
The standardization of taper shanks and threaded arbors will generally prove a distinct advantage. It should also be borne in mind that two sizes of milling machine arbors are generally sufficient for ordinary purposes, the sizes usually employed being 1 and 1½ inches in diameter. The use of more than two sizes of arbors lessens the degree of interchangeability of cutters and requires more equipment for the cutter grinding machines. It also results in an unnecessary waste of time in changing set-ups.

The advantage of having all cutters in duplicate, when possible, should not be overlooked. This is an important factor, not only from the milling machine production viewpoint, but also from the viewpoint of efficiency in cutter grinding. In many cases it is simpler and quicker to make an out and out change in the grinding machine set-up than it is to make the various adjustments necessary in using the universal type of cutter grinding fixture.

It is possible in many cases to put cutter grinding on a production basis by replacing the universal type of fixtures, which require many adjustments and "cut-and-try" methods, with simple grinding fixtures of the type illustrated. It will be noted that the cutter-holding arbor is tilted at an angle to give the correct clearance or taper to the sides of the cutter teeth. This particular fixture is designed for use in sharpening straddle milling cutters. Bushings may be used to adapt this fixture for holding cutters having arbor holes of different sizes. A tongue on the base *B* locates and holds the fixture in place on the grinding machine table.

In making a set-up with the fixture shown, the operator first clamps the base *B* in place on the table and puts the cutter over the post *A*. The grinding machine table is then locked and the correct indexing finger inserted. There is no chance for error in setting up this fixture, and the sharpened cutters will have an exact predetermined side clearance. Fixtures made on this principle can be used for nearly all kinds of milling cutters, on grinding machines that are equipped with either cup or plain disk grinding wheels.

When a surface grinding machine or, in fact, any type of grinding machine is used for cutter grinding, the adjustable members that are required to be in fixed positions during the grinding operation should be firmly set in place by taper pins. In short, the arrangement should be such that the machine can be changed from one set-up to another with the least possible number of adjustments. Ordinarily the change in set-up should affect only the index-finger, work-holding fixture, and head or bed of the machine. The only additional adjustment left for the workman is that of bringing the cutter into proper contact with the grinding wheel.



Fixture for Use in grinding Straddle Mills

* * *

Stainless steel has been found quite suitable for several purposes in internal combustion engines. Inlet and exhaust valves are now made from this material, and in at least one case it has been employed for piston-rings and for the bolts and nuts of exhaust pipes and mufflers. Stainless steel is a cobalt-chrome alloy which is less susceptible to corrosion when subjected to extreme temperatures than other steels. The best results are obtained when the objects made from it are polished to a very high degree.

Knuckle-joint Embossing Presses

By N. T. THURSTON

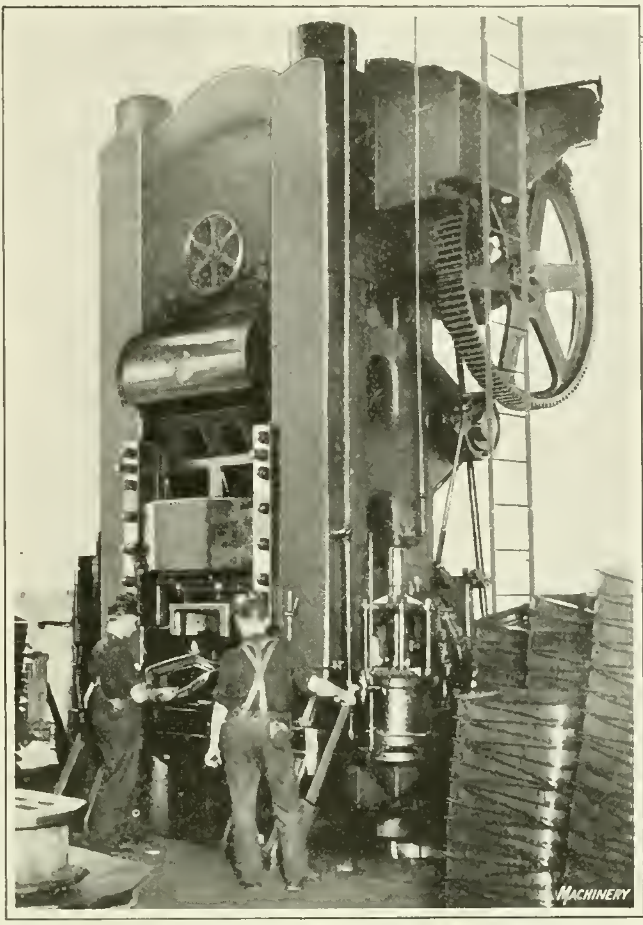


Fig. 1. Knuckle-joint Press forming an Automobile Frame Connection

KNUCKLE-JOINT power presses are used extensively for embossing coins, medallions, and other intricate forms, as well as for lettering or embossing that requires a large amount of pressure for a comparatively short time. Because of their use for this class of work these presses are often termed "coining" presses. There is a demand for many different sizes, and consequently these machines are built in over-all heights of from 5 to 20 feet, weighing from 6000 to 150,000 pounds. The smaller sizes are not geared, while the largest are double-geared and are reinforced with vertical tie-rods shrunk in place to insure strength and rigidity. The way in which these tie-rods are used was described in the article "Utility of Single-action Straight-sided Presses," which appeared in February, 1922, MACHINERY.

In the knuckle-joint embossing press, the slide is operated by two knuckle arms, the upper end of the top arm being attached to a bearing held stationary in a vertical plane by the frame. The knuckle arms are actuated by a crankshaft at the rear of the press, which is connected by a link to the joining ends of the knuckle arms. By this arrangement the arms are moved in and out relative to the frame as the crankshaft revolves. When the arms are straightened, the slide is forced down with a constantly increasing pressure on the work until the end of the stroke is reached. The increasing pressure is due to the fact that as the knuckle arms are straightened, the vertical movement of the slide is small, compared with the horizontal movement of the knuckle. The longer the knuckle arms, the greater the difference in the two movements near the end of the stroke, and consequently the greater the pressure exerted. When the knuckle arms are pushed out as the crankshaft completes a revolution, the slide is again raised.

While an enormous pressure is exerted by the knuckle joint embossing press, this pressure is unlike an equal force obtained from the impact of fast-acting machines, such as drop-hammers and other types of power presses.

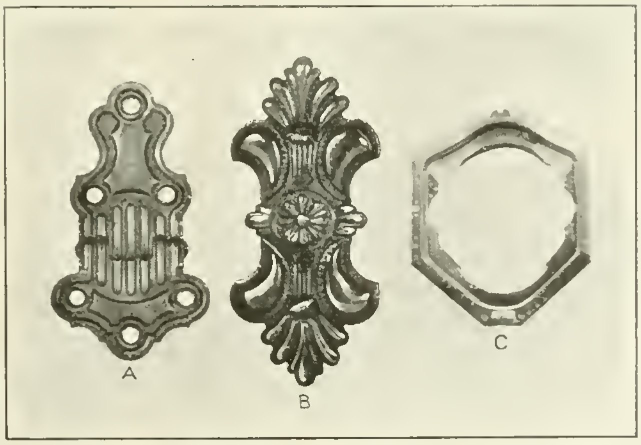


Fig. 2. Examples of Intricate Work produced on Knuckle-joint Embossing Presses

In comparison with other power presses, the knuckle-joint press gives a force similar to a squeeze, as distinguished from a sharp blow. It is this slow increasing pressure that distinguishes the knuckle-joint press from other types. Such a pressure enables the metal to flow under the force of the punch, and fine intricate embossing is possible. An equal pressure in the form of a sharp blow would not give the metal the same opportunity to enter the delicate markings of the die, and for this reason a slower pressure is essential. It allows the metal to form over sharp edges and into curves, where a quicker-acting force would cause it to crack and tear.

A 2500-ton double-geared knuckle-joint embossing press in operation on the frame connection of an automobile is illustrated in Fig. 1. This operation forms the inner edges of the part upward. The stock is hot-rolled pickled steel, 3/16 inch thick. The slide is shown in position near the top of the stroke, with the arms of the knuckle brought close together, and it will be seen that the joint extends out from the press like a crooked finger. When the joint is in this position, the press has comparatively little power. The handwheel directly above the knuckle is used for adjusting the position of the slide relative to the bed of the press. The range of adjustment is slight, being only a few inches. An electric motor mounted on a bracket at the top of the machine is direct-connected to the pinion of the first set of gears.

At the right-hand side of the machine is a compressor belonging to an equipment used to exert hydraulic pressure on the water expansion dies with which the press is provided. The small gear just below the large driving gear is also part of the hydraulic equipment, and causes the press to stop at the bottom of the stroke long enough for the water pressure to be exerted on the part being formed. Then, when the operator again trips the press, the slide is raised to the top of its stroke, where it is stopped by the gearing. The operator is able to control the press at any point in the stroke by means of a hand-lever connected to a friction clutch at one end of the driving shaft.

The three parts shown in Fig. 2 are representative of work done to the best advantage by knuckle-joint embossing presses of various sizes. The part at *A* is a hinge pressed from 3/16-inch sheet brass. The blanking, piercing, and curling of the hinge are done in inclinable presses, and the forming and embossing are done in one operation on a knuckle-joint embossing press. The ornamental drawer plate shown at *B* is a still more intricate piece. This part is embossed, without annealing, in one operation on a knuckle-joint press. Although these parts require sharp and distinct lines, the finest type of work performed on presses of this type is the coining of money. On a silver dollar the metal is forced into impressions of hair-line depth, and an enormous pressure is required for a very limited portion of the stroke. The work of knuckle-joint presses can often be fed to the die from a hopper and automatically removed after the operation. By such an arrangement high rates of production are possible without danger to the operator.

This article was written in collaboration with the Acklin Stamping Co., of Toledo, Ohio.

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TWO DRILL JIG DESIGNS

By EDWARD HELLER

Production costs were considerably lessened in the manufacture of two simple parts, by means of the drill jigs described in the following: The jig shown in Fig. 1 was designed to facilitate drilling the ⅛-inch hole in part *A*. in the proper location relative to the shoulder. This part is produced in a screw machine from ¼- by 11/64-inch stock; in this operation the large end is left square and rather rough. The jig consists mainly of a cold-rolled steel body *B*, bushing plate *C*, drill bushing *D*. clamp *E*, and clamping screw *G*. The bushing plate is doweled to the body so as to maintain the required distance *Y*, and is held to it by means of machine screws. Clamp *E* is held in a recess in body *B* by means of pin *F* upon which it is free to slide up and down.

When loading work in this jig as indicated by the heavy dot-and-dash lines in the plan view, clamp *E* is held in the lowest position. The clamp is then raised by lifting the head of screw *G*, and a slight turn is next given to the screw so as to tighten the clamp on the work and push it against the locating face of the body. The work is now ready to be drilled, after which screw *G* is again loosened to let the clamp drop down. The finished part is then pushed out of the jig from the back and a new piece inserted.

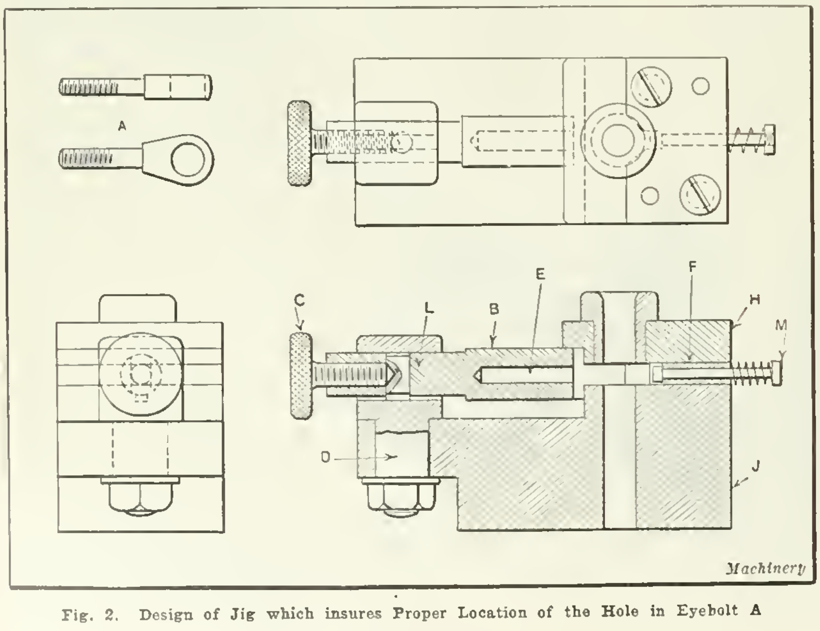


Fig. 2. Design of Jig which insures Proper Location of the Hole in Eyebolt A

The jig in Fig. 2 was designed for use in drilling the eyebolt shown at *A*. This eyebolt is produced in a screw machine. A straddle-milling operation follows the screw machine work and brings the bolt to the form illustrated, except for the hole. As the hole is rather large for the amount of metal surrounding it, the jig was designed with a V-block which locates the work from the outside of this end and insures that the hole will be drilled central with respect to the end.

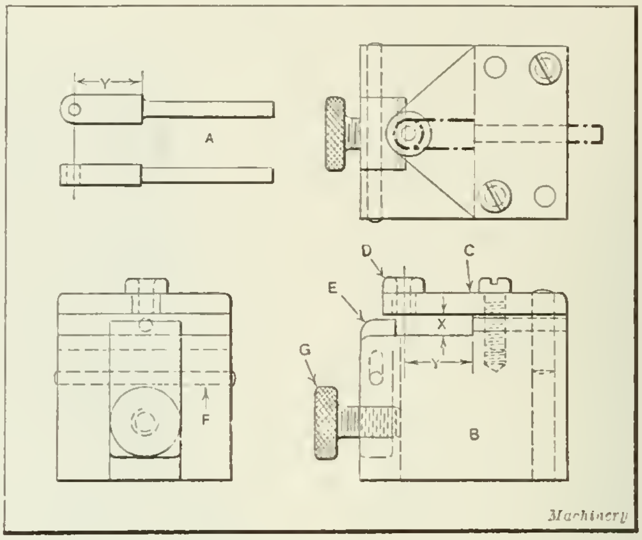


Fig. 1. Jig designed for Use in drilling the ⅛-inch Hole in Part A

In loading the eyebolt in this jig, push-rod *B* is withdrawn by pulling on screw *C* and swung at right angles to the position it occupies in the illustration. Bearing *D* swivels to permit this. The shank of the eyebolt is next inserted in hole *E* of the push-rod, after which the latter is swung back again and pushed forward to bring the head of the eyebolt in contact with V-block *F*. The V-block is held between bushing plate *H* and body *J*. When the work has been brought against block *F*. the screw is given a slight turn, which causes its conical point to force pin *L* upward against the bearing surface of swivel *D*. This is occasioned by having the spot in the pin drilled slightly above the center line of the screw. The movement of pin *L* serves to lock the push-rod in position (for a more detailed description of the pin action. see the article entitled "Adjustable-plunger Stops for Fixtures," which was published in October, 1922, MACHINERY). By this arrangement no undue pressure is exerted on the eyebolt.

After the operation, screw *C* is loosened and rod *B* is withdrawn and swiveled to permit replacement of the work. In case the eyebolt sticks between the bushing plate and the body, it may be forced out by pushing against the outer end of knock-out rod *M* with one hand. The spring on the knock-out rod normally holds the opposite end in a recess in block *F*.

There is one point that should be observed in designing jigs of the type described; width *X*, Fig. 1, of the slot in which the work rests and the thickness of V-block *F*. Fig. 2. should be about 0.010 inch greater than the thickness of the work. This allowance should be proportioned in the ratio of about 4 to 6 above and below the work, respectively. Both jigs were designed for drilling about 4000 pieces. If the required production had been larger, it might have been advisable to provide a tool-steel button at the point where the drill comes in contact with the body of the jig.

Making Gears on the Punch Press

By FRANK LUX

THE punch press offers one of the most economical methods of manufacturing certain classes of gears when the work is of a suitable size and design. The rapidity with which work can be produced in this way is remarkable. Most manufacturers of adding machines, typewriters, cash registers, etc., make the gears entering into the construction of their product by this method. Not only is the punch press one of the cheapest machine tools to operate, but when compared with a gear-cutting machine, its upkeep is also much less. Thus gears may be produced on the punch press at a fraction of the cost involved by other methods.

The main initial cost in setting up a press for producing gears is the expense of the dies. However, a well designed and properly constructed set of dies will produce over 100,000 gears, provided the material from which the gears are punched is not hard enough to cause the dies to wear rapidly. The labor cost of operating punch presses is very small. In considering the adaptability of a product to this manufacturing method, there are three points to be analyzed: (1) The material from which the gears are to be produced; (2) size and design of work; and (3) accuracy required.

Three Factors Governing the Adaptability of Gears to Punch Press Manufacture

The most suitable materials from which gears may be punched are good grades of punching steel, which generally run soft, medium, or hard. Soft steel, as a rule, is likely to tear in punching, with the result that the gears have rougher edges than when produced from medium or hard steel. On the other hand, if the material is too hard, there is difficulty in maintaining the cutting edges of the punch and die. However, the material to be punched may be annealed before stamping and rehardened after the operation. A cast-iron gear cannot be successfully machined by means of dies, and neither can brass nor aluminum castings, even though both brass and aluminum flat or strip stock can be blanked satisfactorily.

It is impossible to give hard and fast rules regarding the maximum size of gears that can be produced; this must be decided mainly from experience. In the opinion of the writer, the maximum thickness of metal that can be successfully punched ranges from 5/16 to 3/8 inch, the exact thickness depending on the over-all diameter of the gear. It is possible to obtain smooth and uniform teeth with metal of a thickness up to this maximum range.

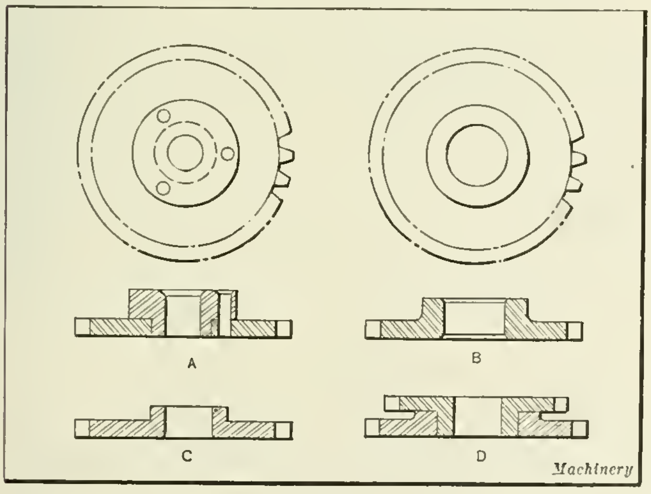


Fig. 1. Typical Examples of Gears that may be manufactured by the Use of Punches and Dies

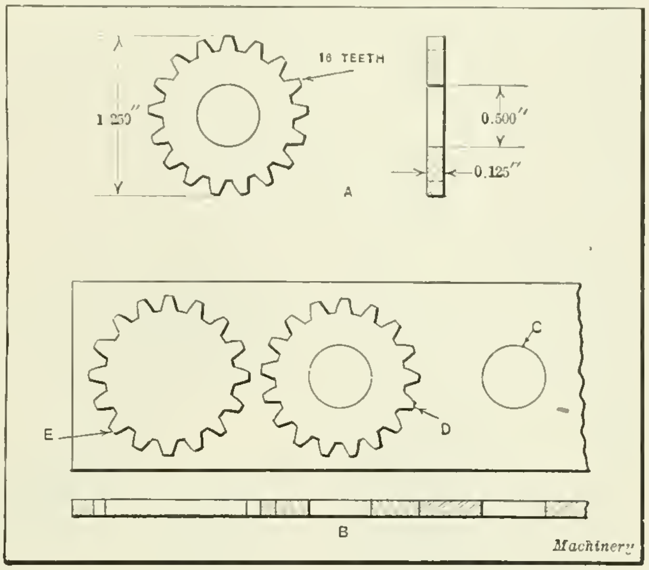


Fig. 2. (A) Gear for which Dies were designed; (B) Appearance of the Stock as it is fed through the Blanking Die

The pitch of the teeth does not have to be considered to any great extent; however, it is best not to attempt to blank gears, say, 3/8 inch thick, having fine-pitch teeth, because the load on the punch and die would be likely to strip the teeth. The size of the hole in a gear also determines the possibility of producing the work in a die. It would not be advisable to attempt to produce a gear of say, 24 pitch, 1 inch diameter, 1/4 inch in thickness, having a 5/8-inch hole at the center, because experience shows that the pressure applied when blanking, would twist the gear out of shape, and would cause the cutting edges of the punch and die to become rounded.

As it is possible to maintain accurate limits on die work, not much trouble is encountered in manufacturing gears to the required accuracy by this method. The greatest difficulty in maintaining accuracy arises from the material that is used. There is generally a difference in the hardness of the stock, and this affects the size of the blank to a certain extent. However, the variation is small, and in most cases the size will be within the required limits of accuracy. If the important dimensions of a gear are held to a tolerance of 0.0005 inch, the gear can be successfully produced. It is, of course, necessary to regrind the faces of the punch and die occasionally in order to produce the work within the required limits. The average tolerance specified on punched gears is about 0.001 inch.

Cost of Punching Gears

After it has been determined that a gear may be satisfactorily produced by the punch press, it must be estimated whether the quantity to be manufactured will be sufficiently large to warrant the expense of making a set of dies. Obviously, it would not be advisable to construct dies for a comparatively small quantity of gears, because the cost per part would probably be prohibitive. The approximate cost per piece of producing gears on a punch press may be determined by dividing the cost of the die by the estimated number of parts which can be produced by it, and adding the labor and overhead costs.

For example, if a gear such as shown at *A*, Fig. 2, is to be produced in 100,000 lots, and the set of dies costs $1000, the tool cost per piece is one cent. Now, assuming that a time study shows that a gear can be produced in one minute, and allowing 90 cents per hour for labor cost, the labor cost per gear would be 1.5 cents. An allowance must also be made for the cost of regrinding the punch and die faces as they become dull, and assuming that ten regrinds at $2 each will be required in manufacturing the entire lot, the total cost for this item would be $20, or 0.02 cent per gear. Adding the three items, the total cost per gear, not including the cost of material or overhead charges, is found to be 2.52 cents. If the die is properly designed and made, the cost of repairs will not be worth considering.

Method of Production

The procedure in manufacturing gears on a punch press is to employ a progressive blanking die to blank the gear and pierce a hole through its center, and then use a shaving die to smooth the contour of the teeth and the hole to the required accuracy. Various styles of gears can be produced by means of dies, the most common form being a flat gear having a hole at the center but no projecting hub. Fig. 1 shows a number of typical examples.

At *A* is shown a flat gear having a hub fastened to it by means of three rivets. This hub is fitted into the gear blank after the blank has been finished. At *B* is shown a similar example with the exception that the hub is integral. In this case the hub is first produced on a screw machine, after which blanking and shaving dies are used to form the teeth and the hole. In some instances when a small-diameter hub is desired, it is possible to form the work from flat stock as shown at *C*. Gears of this kind are blanked, drawn, and swaged prior to the shaving operations. It is often necessary to assemble gears together, and at *D* is shown an example of this kind, the two gears having their hubs produced on screw machines. These gears are riveted together in a manner similar to that employed in attaching the hub to the gear in the example shown at *A*. In addition to these examples, other forms of gears, such as sectors, racks, etc., may be successfully produced by means of dies.

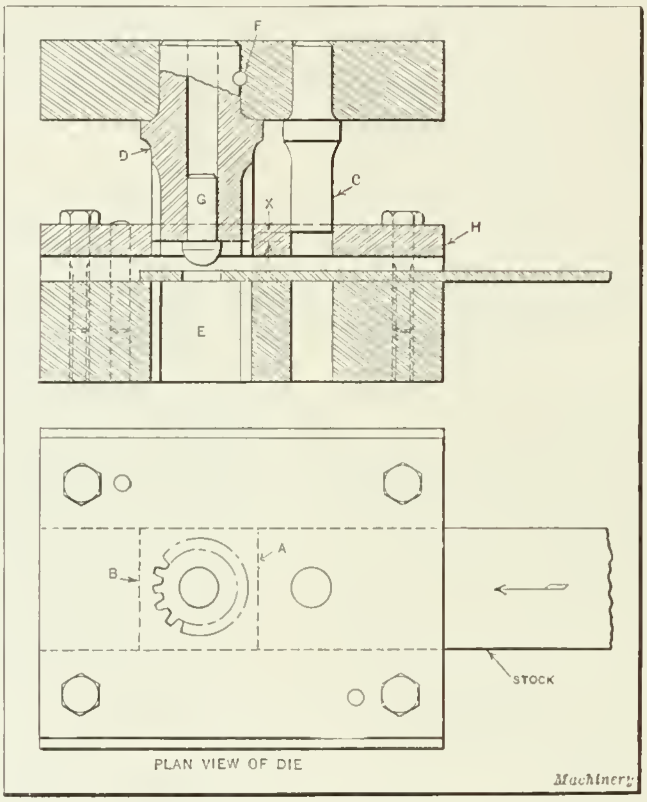


Fig. 3. Progressive Blanking Die which pierces the Hole at the Center of the Gear and blanks the Teeth

Design of a Progressive Blanking Die

In order to illustrate the method followed in designing a blanking die for punching gears, it will be assumed that the gear shown at *A*, Fig. 2, is to be produced from a medium-grade punching steel 0.125 inch thick. It will be further assumed that the required accuracy necessitates shaving 0.012 inch of stock from both the hole and the contour of the teeth.

The first step is to determine the width of stock required, and then make a lay-out, such as shown at *B*, which indicates the various operations performed by the progressive die. It will be seen that the center hole *C* of the gear is pierced first, a sufficient amount of stock being allowed for the shaving later. Teeth *D* are then blanked, after the stock has been moved sufficiently to the left to bring the center of the punched hole in alignment with the center of the punch used in blanking the teeth. The appearance of the stock after the gear has been removed is shown at *E*.

It is necessary to allow a width of stock between each blanked hole and the edges of the strip, about equal to the thickness of the blank. A similar amount of stock should be allowed between the blanked holes. In this instance, the strip must be 1½ inches wide to provide the proper amount of stock between the blanked holes and the edges of the strip, and the center-to-center distance between the blanked holes must be 1⅜ inches. The latter dimension makes it possible to determine the length in which the strips should be supplied in order to avoid unnecessary scrap loss.

In designing a progressive blanking die, particular care should be taken to obtain proper alignment between the punch and die members, because the life of the tools greatly depends upon this. Fig. 3 shows the progressive blanking die designed for producing the gear. The stock is fed through the die in the direction indicated by the arrow in the plan view shown in the lower part of the illustration.

Before blanking the first gear, the strip is fed until the end reaches the point indicated by the dotted line *A*. The ram of the press is then brought down and the center hole of the gear pierced. The strip is then advanced until the front end reaches position *B*, when the press is again brought into action and the gear blanked out. From the sectional view it will be seen that the hole of the gear is pierced by a punch *C* attached to the same holder as the blanking punch *D*. The blanked gear falls through the opening in die-block *E*. Punch *D* has teeth machined on its lower end for producing the teeth on the work. This punch is held from turning in the punch-holder by pin *F*.

Locating the Stock for the Blanking Operation

In operation, the blanking punch passes through the stock before the piercing punch comes into contact with it. This will be obvious by referring to dimension *X* which is equal to the thickness of the stock. The strip is stopped at the right positions by means of a finger-stop, which is not shown because, in most cases, it is a standard equipment of punch presses. As there may be slight inaccuracies in the operation of this finger-stop, it is common practice to provide the blanking punch with a pilot *G* which fits into the hole previously pierced in the stock, and aligns this hole properly for the blanking step in case the strip has shifted out of place.

A stripper plate *H* is assembled on the die-block to prevent the blanked work from sticking to the punch on the upward stroke of the ram. Spacing plates support the stripper sufficiently above the die-block to permit passing the stock between the stripper plate and the die-block. The stripper and spacing plates are assembled to the die-block by means of four machine screws, after being doweled in the correct alignment. The die-block is beveled on the sides and held in a shoe by means of set-screws. The punch-holder has a dovetail fit in a member attached to the press ram.

In making a die of this kind, the diemaker should be extremely careful to align all parts correctly, and so machine the teeth in both the punch and the die that these members will fit one another properly. These parts should be made from a good grade of tool steel, and the die should be of sufficient size to prevent spreading or cracking when it is being hardened. There is danger of this happening if sufficient stock is not left around the die opening. In the die illustrated, 1½ inches of stock is allowed all around the opening, and this is considered good practice for work of this size and shape. It would be possible to use a sectional die with each section taking in a cértain number of teeth, but there is more danger of spreading and other troubles with a die of this kind than when the die is constructed from a solid piece of steel. The method illustrated of securing the punches to the holder is probably the best, although in some shops a large flange is provided on the punch instead of a shank, and the punch is attached to the holder by screws. Such a change in design need not alter the construction of the other parts of this die.

Amount of Stock allowed for Shaving

If a part produced in a punch press is carefully examined, it will be found that its edges are comparatively rough, due to the cutting action of the punch and die. In most cases the punch cuts the metal through about one-third of its thickness and the die cuts it the same amount. The remaining one-third at the middle is torn or sheared off. The result of this action may be clearly seen by examining the edges of a punched part through a magnifying glass. As a rule, the metal near the edge of the part on the side nearest the die is smoother than near the edge on the side next to the punch. In order to mesh properly, it is necessary for the gears to have smooth tooth faces. If they were used as they came from the blanking die, they would only bear at points close to the edges and would wear rapidly, resulting in considerable backlash and other inaccuracies.

The purpose of the shaving operation is to smooth the tooth faces, tops and roots, and the hole. It is generally found most satisfactory to perform this operation in two steps, but this depends upon the accuracy required, and in many cases only one shave is needed. The amount of metal removed by a shaving die should be proportionate to the thickness of the blank. With a medium-steel gear, 3/16 inch thick, which is shaved in one operation, the amount of stock removed should be about 8 per cent of the gear thickness, or 0.015 inch. If there are to be two shavings, it is necessary to allow 10 per cent of the thickness, taking off two-thirds of this amount in the first shave and one-third in the second.

The shaving operation must be performed on all materials, but the amount of stock removed varies with the kind of material. With soft steel, a smaller amount need be removed than with hard steel, and in shaving brass gears it is generally necessary to allow the same amount as for hard steel gears. The correct amount of stock to be removed is an important matter, as it is quite possible to remove too much on the first shave and produce surfaces practically as rough as the original blanked edge. Likewise, the deepest ridges will not be eliminated if sufficient stock is not removed. In many cases, gears properly shaved are smoother than those produced by milling, and have very good wearing surfaces.

A compound die designed to shave both the contour of the teeth and the hole of the gear illustrated in Fig. 2, is shown in Fig. 4. The work rests on blank-holder *A* as shown, being located by means of three nests *B*, which may be clearly seen in the plan view at the right. The nests are not shown in the sectional view. Two of these nests locate the gear by means of one tooth, while the third has two teeth. Besides providing a good means of locating the work, the nests hold it rigidly in position. The thickness of the nests should be somewhat less than that of the work; in this die, they are 0.100 inch thick, whereas the work has a thickness of 0.125 inch.

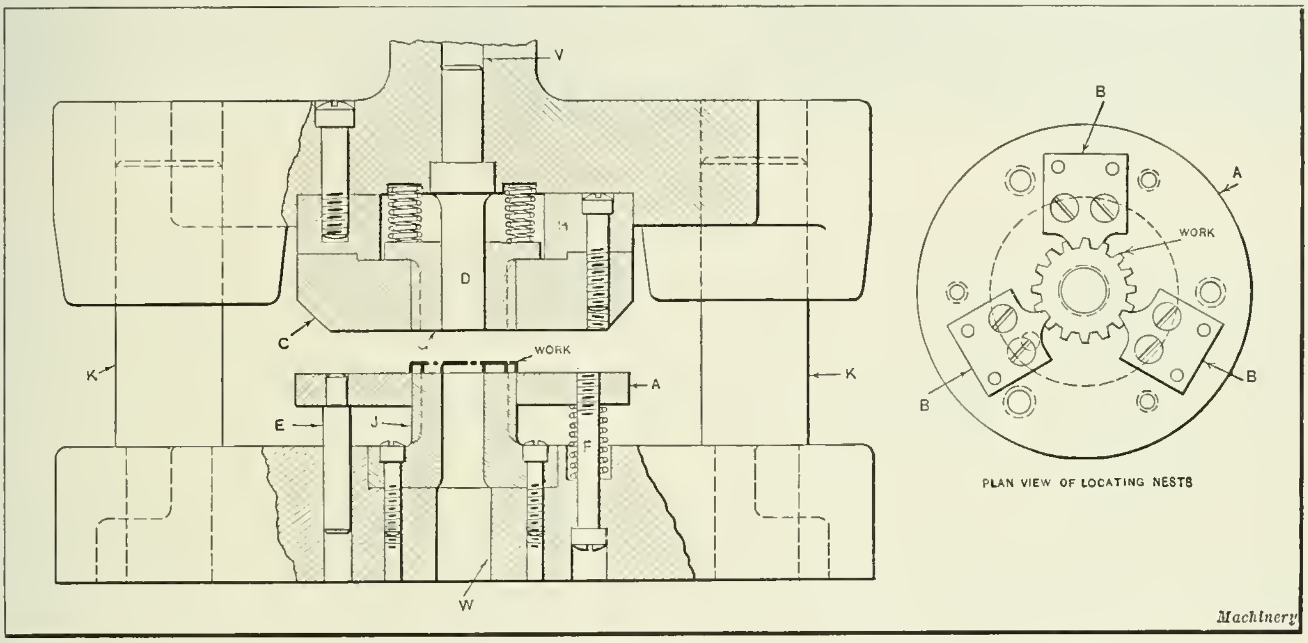


Fig. 4. Compound Die employed for shaving the Contour of the Gear Teeth and the Hole at the Center

Operation of the Shaving Die

The upper die *C* shaves the work on the downward stroke of the press ram. When this die reaches the nests it carries them and the blank-holder downward until the bottom of the stroke is reached. The hole in the work is shaved by punch *D* at the same time that the contour is machined by the die. The blank-holder is provided with three guide pins *E* which prevent it from buckling under the pressure exerted by the ram. The raised position of the blank-holder is controlled by means of three fillister-head machine screws *F*, the blank-holder being actuated on the upward stroke of the ram by coil springs around these screws.

Work sticking in die *C* on the upward stroke is removed from this member by ejector *G* which fits the center of the die and is forced downward relative to the die by means of coil springs. On the downward stroke of the ram the ejector remains stationary against the work. Die *C* is assembled on a sub-plate *H* by means of a tongue and several fillister-head machine screws. This sub-plate, in turn, is fastened to the punch-holder by screws, after being properly aligned by means of a counterbored hole and dowel-pins. Block *J* is also located on the die-bed by means of dowel-pins and a counterbored hole, and is fastened by machine screws. The punch-holder is held in alignment with the die-bed by guide pins *K*.

A die of this type is not difficult to make and the alignment of the parts is comparatively simple, because all parts are round and easily assembled. Holes *V* and *W* may be drilled and reamed in the punch-holder and die-bed, respectively, by mounting the two units together on the faceplate of a lathe with the die-bed next to the faceplate, and then feeding the tools through both units. The punch-holder may then be removed and the die-bed counterbored to receive block *J*, after which the die-block may be removed from the faceplate and the punch-holder mounted on it to be counterbored for sub-plate *H*.

If these counterbores are carefully machined and the parts that fit into them are properly turned, little trouble will be experienced in aligning the parts. All working parts should be made of a good grade of tool steel and hardened. As die *C* and punch *D* become worn, they may be reground across the face, about 3/32 inch of stock being allowed for regrinding. The die used in the second shaving operation is of the same design as the one just described, but the dimensions of die *C* and punch *D* are such that a different amount of stock is removed from the work. The locating nests are also made to slightly different dimensions so as to accommodate the gear as it comes from the first shaving operation.

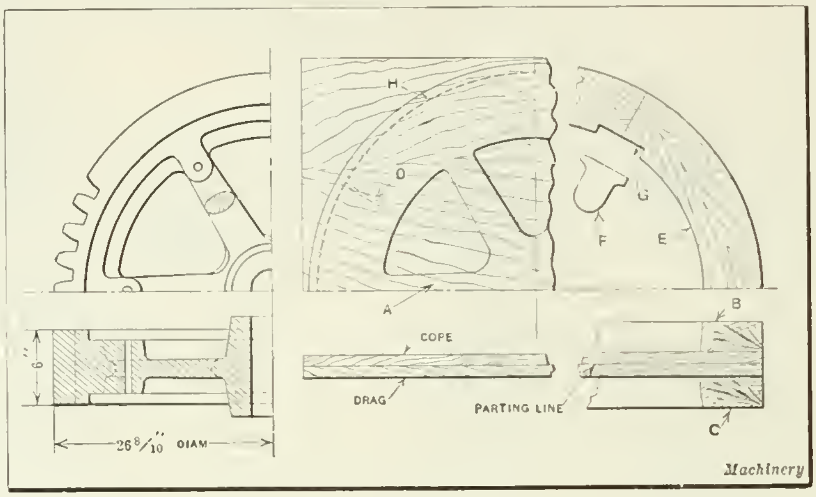
* * *

GEAR BLANK PATTERN FOR REPAIR JOB

By M. E. DUGGAN

The master mechanic of a certain plant, in addressing the patternmaker, said, "I don't care how you make this pattern so long as the casting answers the purpose for which it is used, and we can get the machine started in the shortest time possible." Such instructions, when issued to an experienced patternmaker, invariably save time. They give him permission to eliminate all unnecessary refinements and make any changes in design that he has learned by experience will expedite the production of a serviceable casting. However, such latitude could not be allowed in all cases, for the inexperienced patternmaker might be at a loss as to how to follow such instructions or hesitate to take the responsibility of making any changes in the original design.

In this particular instance, a casting for a gear blank was required. The design of the gear to be replaced is shown by the upper and lower views at the left-hand side of the accompanying illustration. It will be noted that the rim of the gear is rounded and that the arms are tapered and oval in shape. All these refinements are in accordance with carefully worked out rules of machine design, but they are not necessary for the successful functioning of the gear and were therefore disregarded by the patternmaker.



Gear Details and Diagram showing Method of making Pattern for Gear Blank

The way in which the pattern was made should be of interest to all those who are likely to be called upon to make patterns for quick repair work. Nearly all the work was done on the band saw so that very little hand work was required.

The cope and drag section of the pattern were laid out to include the six arms and part of the hub and rim. The rim section of the gear was completed by two ring sections *B* and *C*, which were fastened to the sides of the arm sections *A*, as indicated in the lower right-hand corner of the illustration. Two boards dressed to one inch in thickness were used in making the arm sections. The outline of the hub arms, and rim was laid out on the top board, as shown. A band saw was employed to cut out the pieces on the full lines, sufficient stock being left on the outside diameter to permit sawing the pattern to the inner circle or dotted line *H*. The six openings between the arms were cut out and finished on the band saw by sawing through the rim as indicated by the dotted lines at *D*. Lumber 2 inches thick was dressed down to 1¾ inches for the rings *B* and *C*. Each of these rings was made in six segments, the segments being rough-sawed, glued, and fastened together to form a full ring.

One joint in each ring was left open to permit the saw to be passed through the open joint for sawing or finishing the inside of the ring on the line *E*. For finishing this surface the table was tilted so that a bevel or draft of 1/4 inch was produced. The open joint through which the saw was passed was temporarily fastened during this operation. The slots *G* for the bolt pads *F* were sawed out with a band saw after setting the table back to the 90-degree position. The twelve bolt pads *F* (six on each side) were set in the recesses *G* and fastened in place. The circumference circle was struck on the top of the rim and cut in one pass of the band saw. The band saw was also used to cut the hubs to shape. The drag hub was fastened to its respective arm section and the cope hub left loose. The whole pattern was given a rough finish with coarse sandpaper.

* * *

LARGE TESTING MACHINE

What is said to be the largest testing machine in the world has recently been installed at the Bureau of Standards, Washington, D. C. The machine is capable of exerting a crushing force equal to the weight of fifty loaded coal cars of one hundred tons each. It is to be used in testing specimens for the towers of the Delaware River bridge now under construction at Philadelphia. The machine has two massive heads, one set in a concrete foundation beneath the floor, and the other supported on four steel screws, each over a foot in diameter and two stories high. The specimen to be tested is placed in the machine by an electric crane capable of lifting twenty tons. The upper head is brought down until it rests on the specimen, and the load is applied by a huge hydraulic jack, built into the lower head. Measurements are usually made of the shortening of the column under load, and when it crushes the broken pieces are studied to find the reasons for failure and the method of making stronger columns.

Polishing Room Arrangement

By BRADFORD H. DIVINE, President Divine Brothers Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THE previous articles in this series on polishing methods have dealt with the general principles involved, glue used for polishing wheels, types and classes of polishing wheels and the methods by which the different styles of wheels are made. The subject dealt with in this article relates to the arrangement of polishing departments.

The Glue Room of a Polishing Department

Fig. 1 shows the lay-out of a polishing department. To the left are shown the glue room where the wheels are set up and made ready for use, and the wheel drying room where the wheels remain after setting up until they are used. To the right is the polishing room, where the work of polishing is performed.

The process of preparing polishing wheels by charging their surfaces with abrasives held by glue is known as "setting up." This setting up, which has to be done on new wheels, and continually on wheels in use, is performed in the glue room, which should be separated from the polishing room, as shown in the illustration. The glue room should be well lighted, and while it should have sufficient ventilation, it should at the same time be so arranged that there will be no drafts from doors and windows, as the slightest draft on the glue in the setting-up process will chill and injure it.

A very satisfactory method of securing ventilation is to build up the partitions to a height of about nine feet from the floor, leaving a space open from the top of the partition to the ceiling, and openings at the bottom of considerable size so that the air may enter at the bottom freely and pass out at the top. (See Fig. 2.) If it is necessary to open windows, deflectors should be provided as shown at the right to direct the air upward and permit it to enter the room easily without creating a draft which would strike the glue or wheel in the process of setting up. All doors should be of the double-swing type, which will close automatically. The glue room should contain all the equipment necessary for the setting up of wheels and should also have provisions for the storage of the materials used and for the drying of wheels that must be dried in an oven, as mentioned later.

Referring to Fig. 1, the storage for glue is shown at *A*; the glue heater, which is kept at a temperature of 150 degrees F., at *B*; the abrasive troughs in which the wheels are rolled after glue has been applied to the surface, at *C*; and the storage for abrasives, at *D*. The abrasive troughs are provided with steam coils for heating the abrasives to about 110 degrees F. They are made 6 inches wide by 6 inches deep by 6 feet long, and are set directly on the floor. The troughs should be provided with hinged covers to prevent coarse abrasives from becoming accidentally mixed with finer abrasives, a condition which ordinarily is not noticed until the wheel is put into action, when scratches will be found on the polished surfaces.

At *E* is shown the wheel-heating oven, the construction of which is shown in greater detail in Fig. 3. This oven may be made of either galvanized iron or wood; it contains two compartments, one for heating the wheels before setting up, and the other for drying the wheels after they have been set up. It is kept at a temperature of 110 degrees F.

The drying oven is not intended for permanent use every day in the year, but rather as an emergency outfit for use on winter days in the morning before the drying room has reached its normal temperature of from 60 to 75 degrees, or in summer weather when the humidity is very high and when evaporation is slow. It is always better for glue to set in the normal atmosphere of the factory, than to apply the use of direct artificial heat.

The Wheel Drying Room

The wheel drying room should be located so that it is easily accessible, both from the glue room and the polishing room. If the wheel drying room is to be built into an already established room, the partitions should preferably be of glass, and like the partitions for the glue room, there should be a liberal opening between the floor and the bottom of the partition and between the top of the partition and the ceiling to provide proper circulation of air. All the doors leading to or from the wheel drying room should be double-swing doors, which will automatically remain closed and prevent drafts.

There are several methods of conserving space in hanging wheels in a wheel drying room. A good method is to place 6-inch square posts in the room, far enough apart so that there is plenty of space to pass between the posts in order to put up and take down wheels. Holes should be

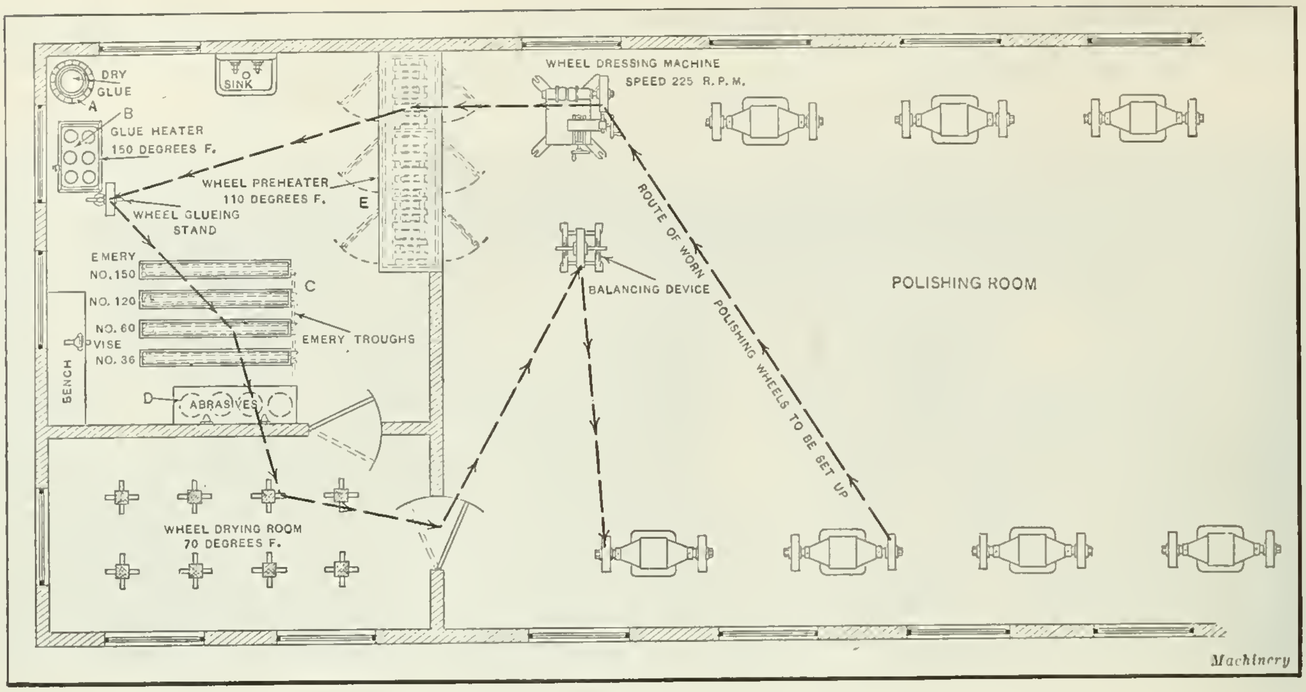

DRY GLUE
A
B
GLUE HEATER 150 DEGREES F.
SINK
WHEEL PREHEATER 110 DEGREES F.
E
WHEEL GLUEING STAND
EMERY NO. 150
NO. 120
NO. 60
NO. 36
VISE
BENCH
C
EMERY TROUGHS
D
ABRASIVES
WHEEL DRESSING MACHINE SPEED 225 R.P.M.
BALANCING DEVICE
ROUTE OF WORN POLISHING WHEELS TO BE SET UP
POLISHING ROOM
WHEEL DRYING ROOM 70 DEGREES F.
Machinery

Fig. 1. Lay-out of a Polishing Department with Facilities for treating Used Polishing Wheels

drilled in the posts to receive ½-inch pipe or iron bars that should extend through in both directions. These pipes or bars may be of any length, depending on the number of wheels it is desired to hang on each support. Slatted iron racks are often used so that the wheels may lie flat on them, the purpose of the slats being to permit air circulation.

Some concerns have followed the practice of using two parallel iron bars which are placed at an angle to each other, forming a shallow trough open at the bottom, in which the wheels are placed on their faces, as shown in the upper right-hand corner of Fig. 3. Sometimes only two parallel round bars or pipes are used. The objection to this kind of rack, however, is that if a wheel freshly set up is placed on it so that the wheel rests with its polishing or grinding surface on the pipes or iron bars, the face, especially if the wheel is heavy or large, is likely to be marred by dents or depressions. In the wheel room there should be a permanent location for wheels of different sizes, wheels used for different purposes and wheels having different abrasives, each location being plainly marked. The arrangements will, of course, depend upon the size of the room and the number of wheels in use.

If the locality is near the seashore or where high humidity or excessive dampness is likely to prevail, it may be necessary to install one or two lines of pipe from a heating system along the walls of the wheel drying room. Then, when the room is damp, enough heat can be turned on to dry up the moisture. Care should be taken, however, not to overheat the room, as this will cause the glue on the wheels to crack or shrink. The temperature should preferably be kept around 70 degrees F. Dryness is what is required in a wheel room, not heat.

The Wheel Preheater

The preheating compartment *E*, Fig. 1 (also shown in Fig. 3) is heated to 110 degrees F. Preheating of the wheels is necessary to prevent sudden cooling of the glue when it is applied to them. If the glue is suddenly cooled from the

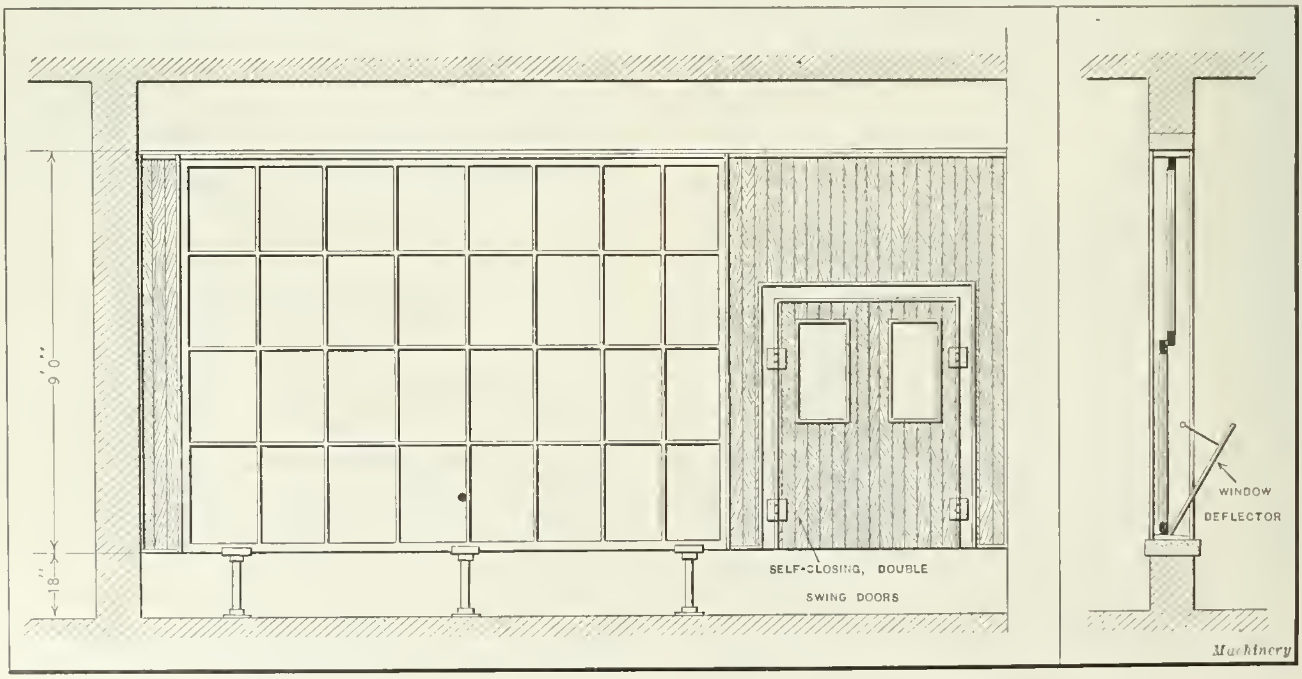


Fig. 2. Partitions for Glue Room and Wheel Drying Rooms, and Deflector for Windows

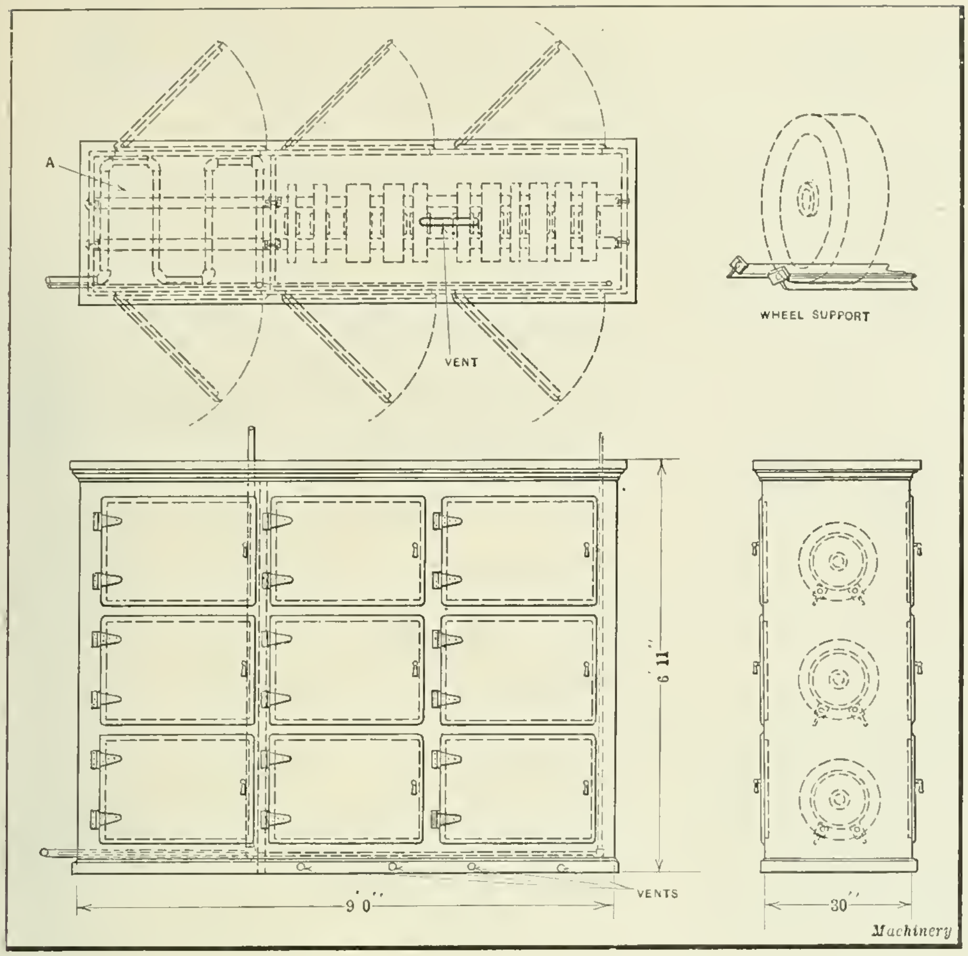


Fig. 3. Oven with Compartments for preheating Wheels before setting up, and for Wheel Drying

temperature of 150 degrees F. at which it should be kept while heated, it loses a great deal of its holding power and shrinkage cracks develop across the face of the wheel. Currents of air striking the hot glue while it is being applied to the wheel have the same effect. The proper way of handling glue was described in the article "Properties of Glue for Polishing Wheels," published in October, 1922, MACHINERY.

The heating oven, or preheater, has swinging doors on both sides so that the wheels from which the old "head" (the coating of glue and abrasive on the polishing wheel) has been removed, may be passed in from the wheel dressing machine in the polishing room directly to the preheating compartment, and removed on the other side; they can then be taken directly to the gluing stand where the heated wheel is immediately set up with a new head, without danger of the glue becoming seriously chilled.

The heated wheel and abrasive will hold the heat longer than the liquid glue, and the glue will soon assume the temperature of the wheel and the abrasive, the whole mass cooling gradually together. Although the abrasive feels cold to the hand in a short time, the setting and solidifying action of the glue requires fully forty-eight hours. After thoroughly setting, the wheels should be removed, when required for use, from the drying room or drying compartment and balanced in the polishing room.

General Methods of Setting up Polishing Wheels

Enough wheels should be provided so that each wheel will have fully forty-eight hours of setting, without requiring the operator to waste time waiting for it. The extra wheels permit plenty of time for the glue to dry, and the investment necessary is far less than the waste of time, glue, and abrasives, to say nothing of the poor quality of the work done, when using wheels that are too green. On the other hand, there should not be so many wheels that they cannot all be used in rotation within seventy-two hours after they are ready. This is especially true during damp weather, because if allowed to stand over a long period, the glue will absorb enough moisture to make it work badly. If this method is followed carefully, and the best materials are used, no trouble will be experienced in the glue not holding the abrasive properly, and the best results will be obtained from the glue and abrasive.

In some plants the operators set up their own wheels. This is poor practice. When the volume of the work permits, the care of the wheels should be entrusted to one man who has charge of all the facilities and equipment for the setting-up process. When the glue room is in charge of one man, he will soon become an expert in setting up and taking care of the wheels, with the result that all the wheels will be uniform. Uniform wheels will give uniform production and, furthermore, by keeping the polishers constantly at work, the extra profit on the increased production will in most plants more than pay for the wages of the wheel man. This is especially true in large plants. The setting up of polishing wheels should be so standardized that the wheels can be passed out to the operators the same as tools from tool-rooms. This applies particularly to concerns that may be crowded for room,

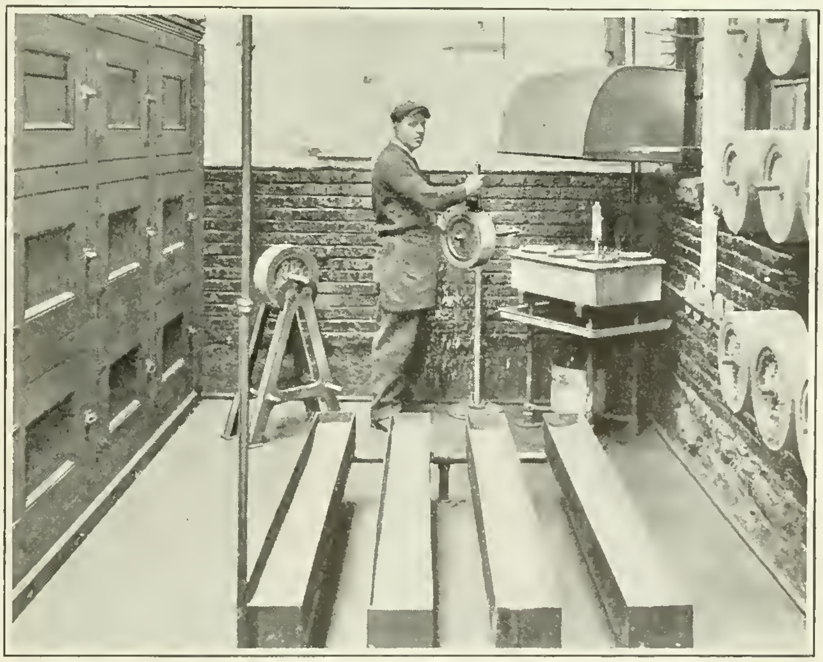


Fig. 4. Example of Well Arranged Glue Room

where the extra production may be secured as described, without putting in extra machines and polishers, thus saving both space and the cost of new equipment.

If artificial abrasives are used, the grain should be well rolled into the glue until the surface presents a packed appearance. Artificial abrasives do not become packed or embedded into the glue as readily as emery. The man in charge of the glue room will soon realize this fact, and will take the necessary precautions and care when artificial abrasives are used. Although it is not practicable to lay down specific instructions for the preparation of polishing wheels, because each case requires particular attention, it is possible to standardize to a large degree the equipment used, so that a more uniform procedure can be followed in all polishing departments.

The diagram Fig. 1 shows the route that a wheel follows from the time it is removed from the polishing lathe until it is remounted, and also shows what may be considered a standard arrangement for handling the setting up of polishing wheels. It was prepared by the engineers of Divine Brothers Co. with a view to showing a typical, well arranged polishing department with the necessary equipment. The glue room installation shown in Fig. 4 is part of the polishing department of the International Heater Co., Utica, N. Y., and is similar in its general arrangement to that shown in Fig. 1, but is laid out to suit the space available. Extra wheels are hung on pegs in readiness to be set up. The heated abrasive troughs are shown in the foreground, and the balancing equipment with a wheel in place may also be seen. The preheating and drying oven are shown at the left, and the glue heater and wheel stand in the far right-hand corner. A hood is provided for the glue heater, to remove excess heat and humidity from the room. The walls are of brick, the floor of cement, and the arrangement such that the room may be easily kept clean.

* * *

STANDARD BABBITT SPECIFICATIONS

The Society of Automotive Engineers has published standards adopted by the society for various types of babbitt. These specifications are given below. The limits for the chemical compositions specified for metal in ingot form are closer than the limits specified for cast products, as allowances have been made for unavoidable variations in the chemical content due to casting. All compositions are given in percentages.

Specification for No. 13 Babbitt

	Cast Products	Ingots
Tin	4.50 to 5.50	4.75 to 5.25
Antimony	9.25 to 10.75	9.75 to 10.25
Lead, maximum	86.00	85.50
Copper, maximum	0.50	0.50
Arsenic, maximum	0.20	0.20
Zinc and aluminum	None	None

This is a cheap babbitt and serves successfully where the bearings are large and the service light. It should not be used as a substitute for a babbitt with a high tin content. It is also suitable for die-castings.

Specification for No. 14 Babbitt

	Cast Products	Ingots
Tin	9.25 to 10.75	9.75 to 10.25
Antimony	14.00 to 16.00	14.75 to 15.25
Lead, maximum	76.00	75.25
Copper	0.50	0.50
Arsenic, maximum	0.20	0.20
Zinc and aluminum	None	None

This is a cheap babbitt and serves successfully where the bearings are large and the service light. It should not be used as a substitute for a babbitt with a high tin content. It is also suitable for die-castings.

Specification for No. 10 Babbitt

	Cast Products	Ingots
Tin, minimum	90	90.75
Copper	4 to 5	4.25 to 4.75
Antimony	4 to 5	4.25 to 4.75
Lead, maximum	0.35	0.35
Iron, maximum	0.08	0.08
Arsenic, maximum	0.10	0.10
Bismuth, maximum	0.08	0.08
Zinc and aluminum	None	None

This babbitt is very fluid and may be used for bronze-backed bearings, particularly for thin linings, such as are used in aircraft engines. It is also suitable for die-castings. When finished bronze-backed bearings are purchased a maximum of 0.6 per cent lead is permissible in scraped samples, provided a lead-tin solder has been used in bonding the bronze and the babbitt.

Specification for No. 11 Babbitt

	Cast Products	Ingots
Tin, minimum	86.00	87.25
Copper	5.00 to 6.50	5.50 to 6.00
Antimony	6.00 to 7.50	6.50 to 7.00
Lead, maximum	0.35	0.35
Iron, maximum	0.08	0.08
Arsenic, maximum	0.10	0.10
Bismuth, maximum	0.08	0.08
Zinc and aluminum	None	None

This is a rather hard babbitt which may be used for lining connecting-rod and shaft bearings subjected to heavy pressures; its "wiping" tendency is very slight. It is also suitable for die-castings.

Specification for No. 12 Babbitt

	Cast Products	Ingots
Antimony	9.50 to 11.50	10.25 to 10.75
Copper	2.25 to 3.75	2.75 to 3.25
Lead, maximum	26.00	25.25
Tin, minimum	59.50	60.00
Iron, maximum	0.08	0.08
Bismuth, maximum	0.08	0.08
Zinc and aluminum	None	None

This is a relatively cheap babbitt and is intended for bearings subjected to moderate pressures. It is also suitable for die-castings.

* * *

BRITISH SPECIFICATIONS FOR STANDARD SHAFTING

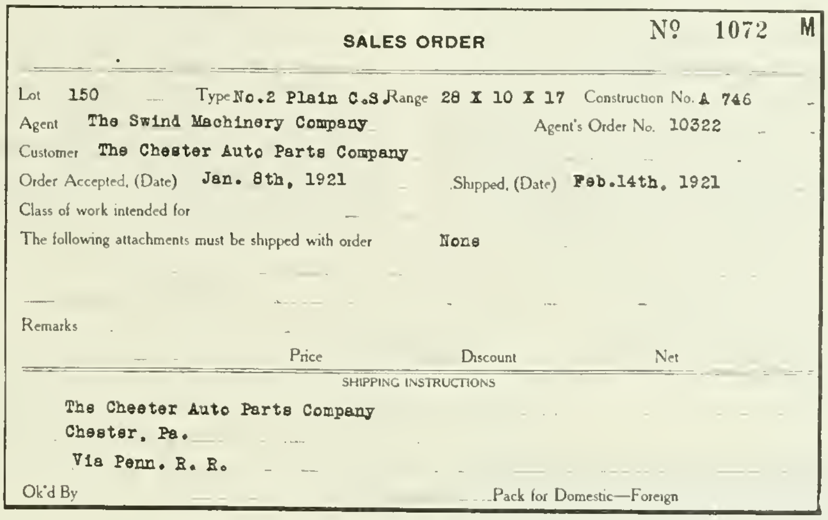
The British Engineering Standards Association has brought out a set of specifications dealing with shafting for marine purposes—more particularly tail-shafts, propeller fits, keys, and flanged couplings. The range of shafts covered is from 6 to 20 inches in diameter. These specifications may be obtained for a price of 1s 2d from the British Engineering Standards Association, 28 Victoria St., S.W., 1, London, England. They should be of considerable value to American engineering firms engaged in shipbuilding and marine engine work, as they have behind them the best thought in the British shipbuilding field.

* * *

An enterprise is being promoted in England for bringing British manufacturers into closer touch with possible customers in Canada, the plan being to run a special train across Canada and back, calling at every city and town of importance on the journey. The train is to consist of cars fitted up as show-rooms for goods of all kinds and accompanied by qualified representatives. Stops will be made at the various cities and towns lasting from one to seven days. The train is to be preceded by a publicity agent, who will create interest in the business communities in advance of the arrival of the train.

Machine Tool Sales and Service Records

By GEORGE M. MEYNCKE, Sales Manager, The Oesterlein Machine Co., Cincinnati, Ohio


SALES ORDER №. 1072 M

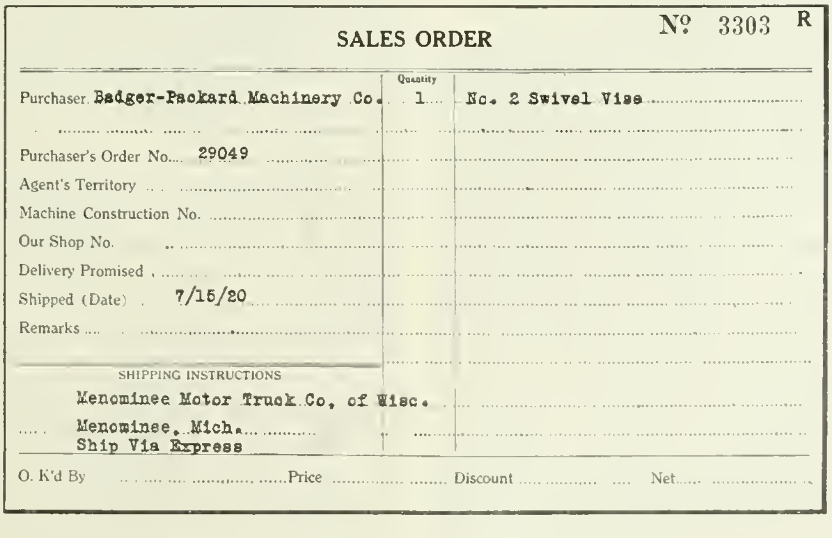
Lot 150 Type No.2 Plain C.S Range 28 X 10 X 17 Construction No. A 746
Agent The Swind Machinery Company Agent's Order No. 10322
Customer The Chester Auto Parts Company
Order Accepted, (Date) Jan. 8th, 1921 Shipped, (Date) Feb.14th, 1921
Class of work intended for
The following attachments must be shipped with order None
Remarks
Price Discount Net

SHIPPING INSTRUCTIONS
The Chester Auto Parts Company
Chester, Pa.
Via Penn. R. R.
Ok'd By Pack for Domestic—Foreign

Fig. 1. Information given on the "M" Order Slips for Machines

An efficient sales department record system is of service to a machine tool maker in at least three ways: First, it emphasizes the necessity of keeping delivery dates promised on orders in process, and furnishes records of the destination of each machine built. Attachments, tools, or repair parts may be ordered in the future for any machine shipped, and it is then that the destination record becomes valuable. Machine tools have a longer life than most products, and requests for repair parts on machines built twenty or more years ago are not unusual. Machine tools have been developed greatly in the past fifteen years and changes in design and construction have been frequent, so that it is often difficult to meet such requests. There is a desire on the part of machine tool builders to be in a position to give better service in supplying repair parts in the years to come than has been the rule in the past, and the records that will make future service ideal must be built up from today.

Second, the sales department record system is of assistance in planning production. Almost all types of machine tools are built in a series of sizes and styles by each builder specializing in one or more types. For instance, The Oesterlein Machine Co. builds sixteen plain and fourteen universal milling machines, and in addition, four other types of machines. Yet this is not exceptional. For these thirty-four machines the company makes a total of sixty-eight standard attachments, approximately 150 small parts such as arbors, collets, and face mills, and many other attachments which are built only on special order. In the normal operation of the plant, five months elapse from the time some material is put into operation until finished machines are available for delivery. This means that the planning of production must be based on estimates made as much as six months in advance of the shipping date.


SALES ORDER № 3303 R

Purchaser Badger-Packard Machinery Co. Quantity 1 No. 2 Swivel Vise
Purchaser's Order No. 29049
Agent's Territory
Machine Construction No.
Our Shop No.
Delivery Promised
Shipped (Date) 7/15/20
Remarks

SHIPPING INSTRUCTIONS
Menominee Motor Truck Co. of Wisc.
Menominee, Mich.
Ship Via Express
O. K'd By Price Discount Net

Fig. 2. The "R" Order Slip used for Attachments, Repair Parts, etc.

The demand varies for different sizes and styles of machines and attachments; for example the company sells more No. 2 milling machines than any other size, and attachments for this machine rank the same. Because of this variation in demand, a study of sales records will give information of value in shaping production schedules. If records covering a three-year period indicate an average yearly sale of fifty attachments of a given size and type, one can safely plan on a yearly production of fifty of these attachments. When a six months' inventory is being figured on, the attachments should be produced in lots of twenty-five, because there are always irregularities in sales and often there is an unforecasted run on certain attachments. Without the help of a readily obtained "history of sales" the result will be either poor service or an unnecessarily high inventory. With this history, service will be improved and inventory charges will be in a desirable proportion.

Third, accurate sales records assist the sales managers. They enable the sales manager to work for an even distribution of the machines and tools manufactured by the company, and serve as a basis upon which to keep a check on the activity of the sales organization.

A Simple System Carries a Low Overhead

In starting to keep sales records, there is always the question as to what extent the overhead expense of record making is justified by the value of the records. The general tendency in office management is to inaugurate a routine that requires independent clerical work for each record. Such a system is frequently expensive, and its accuracy is dependent upon the thoroughness of those whose duty it is to fill out the records. Errors are likely to creep in when the records are made by different clerks at different times. The ideal system would be one in which all records would be made at one time. The system to be described closely approaches that ideal.

When an order is received, it is necessary to send some form of written instructions to the shop, either to build or to prepare for shipment the machines that have been ordered. The only way to avoid this would be to give verbal instructions and that would rightly be considered poor management. With the system here described the instructions given to the shop are at the same time entered on all the record slips of the system.

All the orders that are received are divided into two classifications—"machines" and "replacements." Thus an order for a machine is entered on the "M" form illustrated in Fig. 1, while all other orders, whether for standard or special attachments, arbors, collets, or replacement parts are entered on the "R" order form shown in Fig. 2. Each of these order forms has three bond paper slips and one cardboard, between each of which a sheet of carbon paper is placed. These four blanks differ only in the heading, and so contain identical information when filled out. The top slip of the "M" order is headed "Sales Order"; the second, "Agent's Record"; the third, "Machine Record"; and the bottom card, "Customer's Record."

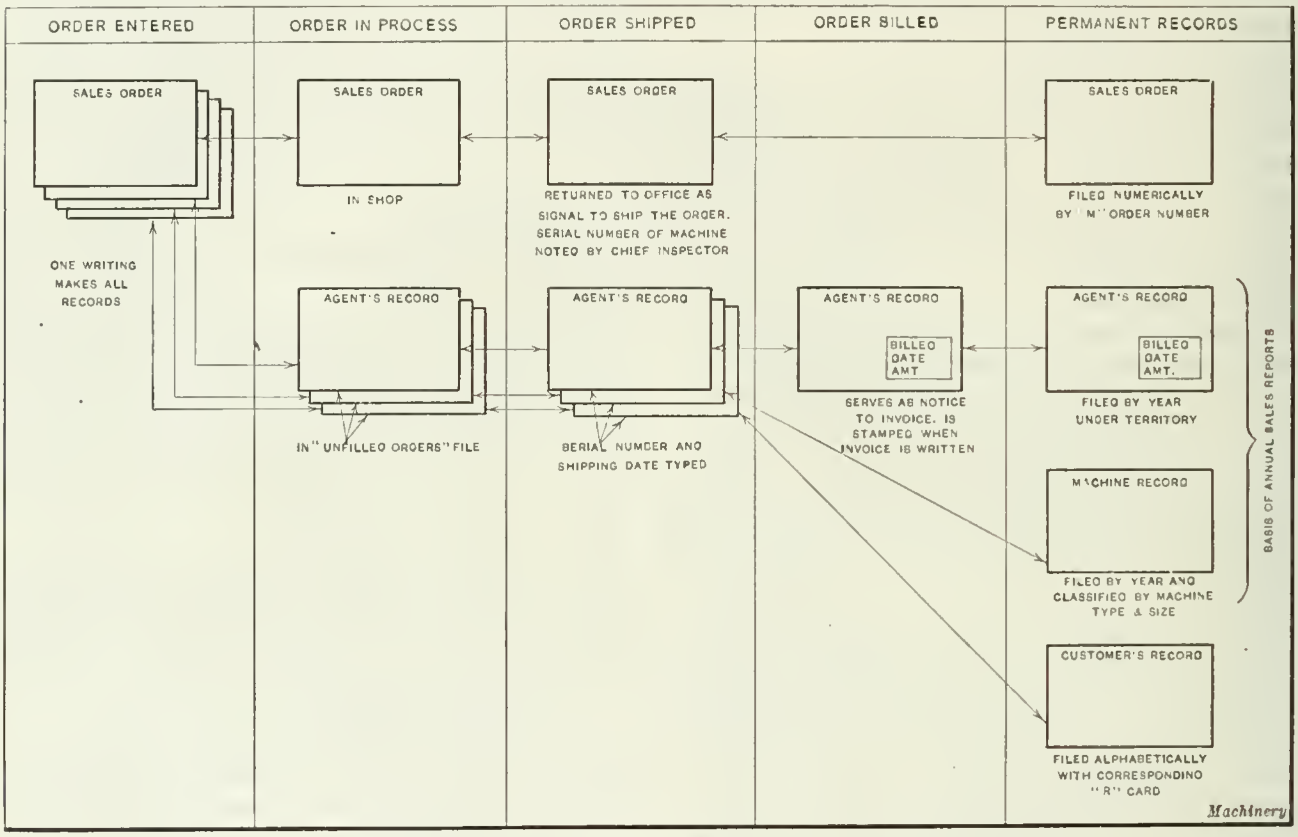

ORDER ENTERED
ORDER IN PROCESS
ORDER SHIPPED
ORDER BILLED
PERMANENT RECORDS
SALES ORDER
ONE WRITING MAKES ALL RECORDS
SALES ORDER
IN SHOP
AGENT'S RECORD
IN "UNFILLED ORDERS" FILE
SALES ORDER
RETURNED TO OFFICE AS SIGNAL TO SHIP THE ORDER. SERIAL NUMBER OF MACHINE NOTED BY CHIEF INSPECTOR
AGENT'S RECORD
SERIAL NUMBER AND SHIPPING DATE TYPED
AGENT'S RECORD
BILLED DATE AMT
SERVES AS NOTICE TO INVOICE. IS STAMPED WHEN INVOICE IS WRITTEN
SALES ORDER
FILED NUMERICALLY BY "M" ORDER NUMBER
AGENT'S RECORD
BILLED DATE AMT.
FILED BY YEAR UNDER TERRITORY
MACHINE RECORD
FILED BY YEAR AND CLASSIFIED BY MACHINE TYPE & SIZE
BASIS OF ANNUAL SALES REPORTS
CUSTOMER'S RECORD
FILED ALPHABETICALLY WITH CORRESPONDING "R" CARD
Machinery

Fig. 3. Diagram showing the Routine of the "M" Order Slips to the Permanent Files

Functions of the "M" Order Slips

There are five steps in filling an order and establishing the permanent records, and as the steps are interdependent, no gaps can occur in the records, such as might happen if each step required a distinct clerical operation. The progress of an "M" order slip through these five steps is illustrated diagrammatically in Fig. 3. When a lot of machines is put into production, and this is ordinarily done some time before the machines are actually sold, the record slips for the lot are filled out as to size, lot number, and specified date of completion. These cards are filed according to the type and size of the machine, and deliveries are quoted from these "In Production" cards.

A pencil notation is made on the sales order slip when a delivery quotation is made to a prospective customer; thus a definite machine is actually quoted. If all the machines in process of a particular size have been quoted, no additional quotations are made until the company has been released from a quotation. If no releases occur, the delivery is quoted on the next lot of machines of that size to be put through the shop. This system has two advantages; first, it prevents the quoting of delivery dates for more machines than will be available on those dates, and second, it enables any member of the office organization to promise a correct delivery date.

When a formal order for a machine is received the order slips are filled out with the agent's name, customer's name, and order number, shipping instructions, and any other necessary notations. The sales order is then torn off and sent to the shop and the remaining group of three slips remains in the "unfilled orders" file, as indicated in the second column from the left in Fig. 3. When the machine is shipped, the shipping clerk marks the serial number of the machine on all four cards and turns over the agent's record slip and the bill of lading or express receipt to the auditor for billing. The fifth column shows the final disposition of the records.

When the order is completed, the sales order slip is filed numerically by the "M" order number as a permanent record of that particular order. The agent's record is stamped with the selling price of the machine and the date of billing, and is then filed in a yearly permanent file, classified according to the territory in which the plant of the customer is located. From this file the sales of a given territory, as represented by machines or by dollars, may be conveniently reviewed.

The machine record is filed yearly in a file classified by machine types and sizes, the purpose of which is to lighten the clerical work of the engineering department. As the serial number and lot number of the machine appear on all records, the number of every blueprint used in making the machine is quickly available by referring to the parts list for that lot. The machine record slips also furnish a ready reference as to the number of machines of a size or kind shipped during a given year. The customer's record is filed alphabetically with corresponding cards from "R" orders. By this arrangement a record of all the machines and tools that each customer has purchased is available.

An example of the service that the customer's record makes possible was demonstrated recently. A letter was received from a customer requesting that a 1¼-inch arbor be sent to the writer. The order was indefinite in view of the fact that The Oesterlein Machine Co. manufactures nineteen 1¼-inch arbors of various styles and lengths, but upon reference to the customer's record file it was found that four years ago this company purchased a 1¼- by 17-inch style D, No. 11 taper arbor. So this order was duplicated without the delay of additional correspondence, and to the satisfaction of the customer. There was better than an even chance that the arbor sent would be the one desired.

Use of the "R" Order Slips

The information furnished on the "R" order slips is quite different from that given on the "M" slips. The "R" forms are not written up until orders are actually received, because standard attachments, arbors, etc., are carried in stock and are withdrawn to fill orders just as individual parts are drawn from stock by the assembly department. The first of the "R" slips is also called the sales order, and the last card the customer's record. The progress of this slip and card to the permanent files is the same as that followed by the corresponding slip and card of the "M" order. The second slip is called the sales order record, and is filed consecutively by the order number. The third slip is called the attachment record, and this slip is classified and filed under attachments, special fixtures, repair parts, etc. It affords a ready reference which is used in estimating the future demand for a particular part and really comprises a sales history of that part.

When attachments are to be included with a machine shipment, the slips of the "R" order covering the attachments and of the "M" order covering the machines, both bear a notation to that effect. The slips of parts sent out for repairs are filed by the piece number of the part. The engineering department studies these slips periodically, and, wherever possible, changes the part in design or material so that repairs will be eliminated. Information of value to the sales department may also be obtained from these records; for example, by checking over the records it was recently noted that no orders had ever been received for the replacement of milling machine shaft bearing. This sales point would probably have been overlooked if the number of repair parts for this particular piece had not been so "conspicuous by their absence."

* * *

MACHINE FOR LAPPING ANGLE VALVES

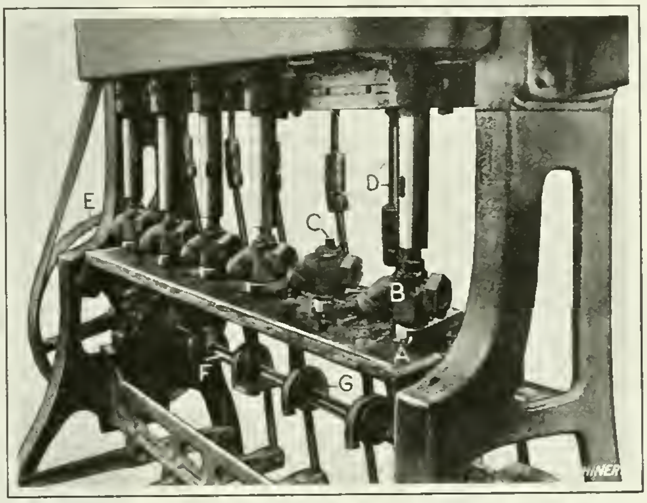
By ROBERT MAWSON

Various types of valves are required to be kept in service by railway repair shops, and as they are used for either steam or air lines it is necessary that they be perfectly tight. The valve parts are first machined on the two seating surfaces so that they will be as nearly interchangeable as possible after which these surfaces are ground or lapped together until a perfect contact is obtained. Many of the valves are lapped by hand, the workman simply oscillating the two parts while in contact after putting the necessary abrasive on the valve seat. When a large number of valves is to be lapped, this method is obviously too slow and costly.

The illustration shows a special machine made at one of the railway repair shops for lapping in the valve seats of an angle type valve. The tapered valve-stem and the valve body are first machined as nearly to the correct angle as possible. The valve body *B* is then placed on the machine, so that it rests on the plate *A*. It is prevented from turning by means of a pin in plate *A*. The valve-stem shown at *C* is placed in the body of the valve before the latter is mounted on the machine. Each lapping spindle is provided with a socket that fits the square end of a valve-stem. Each spindle can be raised by means of a foot-treadle, so that it can be dropped over the valve. Rods, such as the one shown at *D*, actuate the spindle-raising mechanism and are connected to the foot-treadles under the machine frame. The spindles are operated by gearing, the driven gears being attached to the upper ends of the spindles.

It is a well-known fact that parts can be lapped more accurately if the abrasive is moved along the surfaces during the lapping operation. If this is not done, the abrasive particles tend to cut grooves in the surface and spoil the finish, this being more noticeable if the faces are of considerable size, as in the case of the valves shown in the illustration. In the lapping machine shown the abrasive is moved along automatically at regular periods. A pulley *E* drives a horizontal shaft *F* located under the table. Fastened to this shaft are cams or eccentrics *G*, one for each valve lapping spindle, and over these cams are placed yokes, which are fastened by rods to the rear of the plates.

As the horizontal shaft is revolved, the cam or eccentric *G* is also revolved, and through the medium of the yoke and rod the plates *A* and the valve bodies are moved up and down. As the valve bodies are lifted, the valve-stem continues to revolve with the machine spindle. The raising and lowering of the valve body causes the abrasive particles to be moved along the surfaces being lapped, thus preventing grooves from being cut in the work. In operation, the machine is set up with six valves, but the operator can examine any one of these at any time by raising the spindle by means of the foot-treadle. When the valve seat is found to be lapped to a satisfactory finish, another valve and valve-stem are substituted in its place, so that the operation of the machine is continuous.



Machine for lapping Valve Seats

* * *

ALUMINUM-COPPER ALLOY CASTINGS

As far as can be estimated from available figures, according to R. J. Anderson in a publication "Preparation of Light Aluminum-Copper Casting Alloys," published by the United States Bureau of Mines, Washington, D. C., about 97 per cent of all aluminum-copper alloys are made from an alloy containing approximately 92 per cent aluminum and 8 per cent copper. Among the other alloys used for commercial castings are those containing from 2 to 13.5 per cent copper, the remainder being aluminum. In 1920, 81,000,000 pounds of aluminum-copper alloys were made in the United States.

Alloys containing from 4 to 6 per cent copper are reported to have been used in Italy for aircraft-motor castings, and the 96–4 aluminum-copper alloy is used extensively in the United States for sand-cast cooking utensils. In the United States a favorite motor-piston alloy is made with from 9 to 10.5 per cent copper, the remainder being aluminum, but some plants introduce iron as well as copper to increase the hardness. In the United States, the consensus of opinion among foundrymen is that the alloy containing 92–8 aluminum is the best alloy available for general casting purposes.

Press Feeding and Grinding Attachments

TWO patented feeding and grinding attachments, applied to a No. 3 Bliss power press, are used in the manufacture of drop-wires for cotton looms, in the plant of the Hopedale Mfg. Co., Milford, Mass. These drop-wires are punched out from ribbon stock, and vary in thickness from 0.004 to 0.030 inch, and in length from about 4 to 7 inches. Both of these attachments are automatic in operation and have been the means of greatly increasing the output over that obtained with any other equipment.

Fig. 1 shows the feeding device, which is attached to the left-hand side of the press, and driven by sprockets and chains from the crankshaft. A sprocket wheel on the lower sprocket shaft, and chain *A*, drive the feed-rolls through which the stock is fed to the dies. The upper sprocket wheel is integral with a spur gear of the intermittent type, and thus drives the pinion shaft *B* which is geared to the lower driving roll as shown. The feed is varied to suit the different lengths of drop-wires by changing the feed gears, but the intermittent gearing is not changed for this purpose.

The feed-rolls and the gears that drive them are integral, and can readily be replaced by others when desired. The lower roll is supported by two trunnions, each resting in a half bearing box. These bearings are spring-supported and adjustable to compensate for the difference in center distance caused by changing the gearing. The screws *C* are provided for making this adjustment. The feed-roll gears are thrown into mesh by the cam-lever *D*, which, by reason of its cam end, raises or lowers the split bearings in which the lower feed-roll is supported. When in the raised position, this lever constitutes a lock to hold the rolls in engagement while the stock is being fed through them. As the stock is passed through the rolls, it is guided by a curved guard *E* which reaches over between the rolls, thus preventing anything but the stock from passing between them.

Obviously, the stock must be delivered at the same level as the top of the dies; hence when the dies wear or when it becomes necessary to change the feed-rolls, the line of feed must be correspondingly changed. For this reason, vertical adjustment for the entire bracket which carries this mechanism is provided for; this adjustment is effected by screw *F*, shown below the bracket, and a locking nut. As the stock leaves the rolls it is fed through a flat chute, the passage in which is just large enough to permit the stock to move freely through it. The top side of this chute is the stripper plate for the punch, the opening in the top of the chute being just sufficient to enable the punch to enter. There is an adjustable sheet-metal guard *G* attached to the side of the machine, which encloses this feed-chute, to obviate the possibility of tangled stock being fed under the punch in case it should not be delivered properly into the feed-rolls. A riveted sheet-iron drawer *H* is hung under the bolster plate of the machine, into which the scrap is deposited. This box can be quickly and conveniently removed when the scrap is to be dumped.

The grinding attachment, which is fastened to the right-hand side of the machine, is illustrated in Fig. 2. This view also shows the nature of the work. The operation consists of removing the burrs produced by the dies in punching out the work. The grinding attachment is belt-driven from a countershaft on the floor. The driving-pulley shaft of the attachment carries a worm *A*, which drives a short vertical shaft *B* through a worm-wheel at its lower end. Worm-shaft *C* is driven from this vertical shaft by helical gearing, and carries a worm *D* which drives the worm-wheel *E*. This worm-wheel acts like a crank, reciprocating the shifter bar *F*, the right-hand end of which is connected to a driving post in the worm-wheel. Spur gear *G*, also carried on this worm-shaft, drives the grinding wheel, which is located beneath plate *H*, by a suitable gear train.

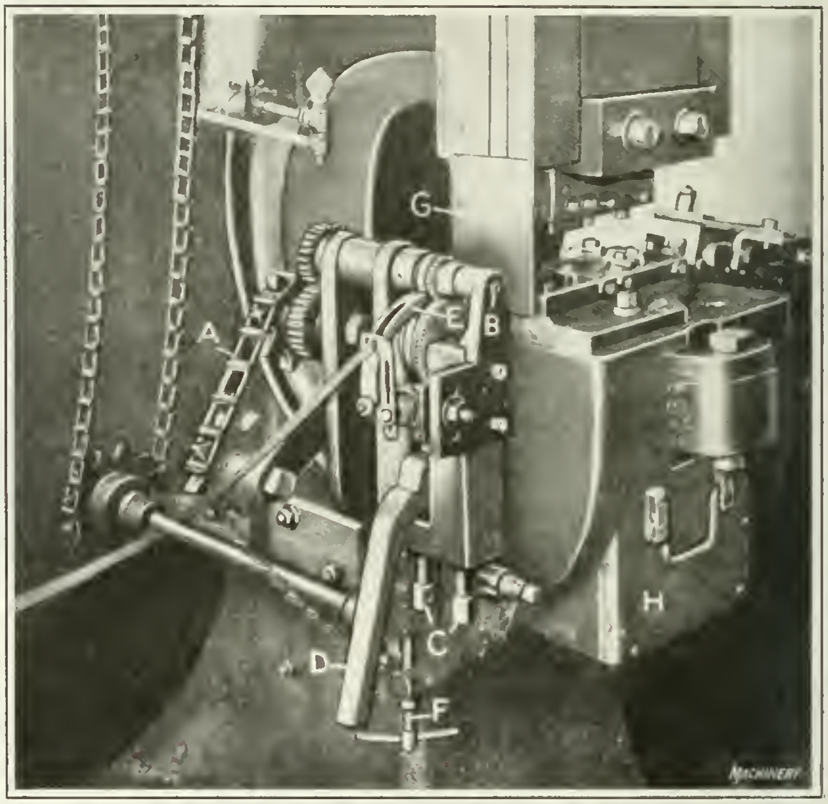


Fig. 1. Intermittent Automatic Feed Mechanism for Power Press

The reciprocating movement imparted to shifter bar *F* causes the delivery chute *I* to swing back and forth and distribute the work over the wide face of the grinding wheel. Obviously, this provision is made to equalize the wear on the face of the wheel. The end of the shifter bar carries shifter arm *J*, the end of which is coiled around an annular V-groove in the special sliding pulley *K*. This pulley is flanged and drives a woven-fabric belt *L*, the opposite end of which passes over a pulley attached to the bolster plate of the machine. The chute is constructed in sections so that it may be adjusted to agree with the length of work being handled. The lower end of the chute simply rests on the sliding pulley.

The feed-rolls, of which there are two pairs, front and rear, and the grinding wheel, are supported in an angular plane on the special bracket *M*, which is attached to the base of the machine and supports the other elements of the mechanism. The grinding wheel is 5 inches in diameter and 3½ inches wide, and is provided with tapered bronze bearings *N* which may be adjusted to take up wear by the collar-screw shown. The casting in which these bearings are located contains two posts *O*, one at each side of the wheel, and the roll-supports *P* are cut out to ride vertically on these posts when the position of the rolls is being adjusted relative to the top of the grinding wheel, over which the work is passed. The lower roll of each pair is supported by a spring-backed bearing *R*, which provides the required variation in tension to suit the different thicknesses of stock.

The entire delivery unit, including the rolls and their supports, is adjusted relative to the end of the chute by the adjusting screw and nut carried in arms at the top of each side post *O*. The work passes between a curved plate and the grinding wheel, the space between these two being adjusted periodically to compensate for wheel wear and to suit different thicknesses of stock. This adjustment is accomplished by tightening or loosening the nut *S*, thus varying the tension on the curved plate exerted by a coil spring carried in the tube *T*.

The drive of this grinding mechanism is independent of the operation of the machine, the shipper-rod handle being shown at *U*. The dies used in this operation are of ordinary construction, and require no special description. The stroke of the press is 2 inches. The machine is provided with a counting device. The unusual production of 230 drop-wires per minute is attained with this equipment, which is two and one half times greater than had previously been obtained.

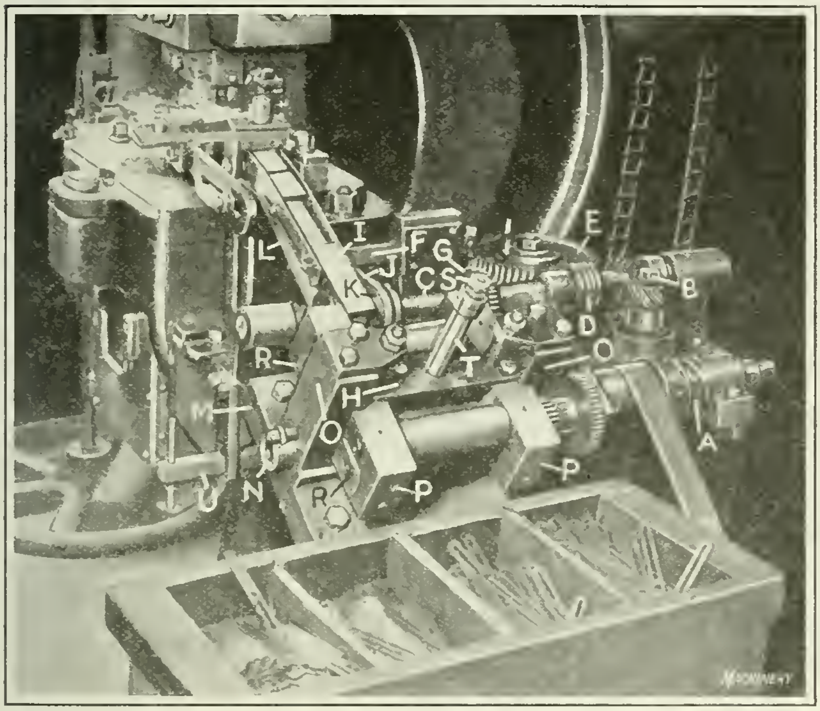


Fig. 2. Grinding Attachment for Power Press

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AUTOMOBILE NUMBERING DEVICE

A drilling device to be used in a new method of "branding" automobiles and trucks, something after the manner in which ranch animals are branded in the West has been developed by a New York engineer, Jack Marshall, of 509 Fifth Ave., New York City. The Marshall automobile-numbering device is a drilling machine which automatically drills any given number, letter, or symbol, or any manufacturer's or license number into the body, motor, or any other part of the car, thereby making it impossible for automobile thieves and dealers in stolen cars to change the numbers. The numbering machine is operated by electricity, and the number is large enough so that it can easily be seen.

KEEPING TOOL-CRIB RECORDS

By A. F. PSYKE

Considerable trouble was experienced in a certain plant in keeping a record of the tools checked out or withdrawn from the tool-crib. This trouble was caused mainly by operators who were absent for several days or who left the plant altogether without returning the tools to the crib. In many cases the tools could not be located without a great deal of delay. When it became evident that this condition was seriously affecting production, the routine outlined in the following, was put into effect.

The foreman of each department was instructed to have his supervisors check all machines and benches a half hour after starting time each morning, and in the event of an operator being absent, reassign his job and tools to another operator, giving the latter a ticket that indicated the change. The operator assigned to the job would then take this ticket and his own checks to the tool-keeper who would change the tools and place the absent operator's check on his hook.

In case the absent operator's job had been completed and he had not turned in his tools, or the job had not been completed and could not be taken over by some other operator, the supervisor simply turned in the tools at once to the tool-keeper who placed the checks on the hook allotted to the absent operator, where they remained until he returned, or a notice that he had left the plant was given out.

If an operator was absent for three consecutive days without notifying the foreman as to the cause of his absence, he was considered to have left, and the foreman, in making out a "leaving notice," ascertained from the tool-keeper whether the operator was charged with any tools, and if so, he made mention of this fact on the "leaving notice," so that when the operator went to the factory office for his termination slip, the employment clerk could notify the tool-keeper who would see that the operator returned all tools charged to him. The tool-keeper would then sign the operator's "leaving notice," and send it to the employment department, where the man was paid off. The final payment of wages was never made until all tools were accounted for.

* * *

INEXPENSIVE DIE FOR ORNAMENTAL EMBOSSING

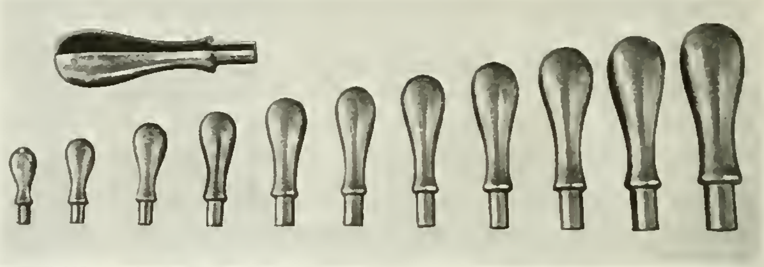
By ELAM WHITNEY

Ornamental embossing such as is found on many tin toys is generally done on punch presses. Embossing dies for this work are expensive to make, due to the care required in matching the engraved face of the punch with that of the die. It has been found practical in some cases to engrave the punch only, and make the die of a hard babbitt, the punch then being pressed into the babbitt to form the die impression. The surplus babbitt raised at the edge of the impression made by the punch is scraped away to leave a smooth matching surface. A die made in this way can be renewed after a few days use by melting the babbitt and making a new impression. Of course, this method of making a die can be used only for light work in tin, brass, or other soft metal of light gage. For such work, however, it will give good results and often make it possible to manufacture small quantities of embossed parts at a profit when the cost of regular engraved dies would be prohibitive.

Pressed-steel Machine Handles

A Process for Manufacturing Hollow Seamless Machine Handles

By FRED R. DANIELS



AN innovation in the manufacture of machine handles has recently been made. The new method consists of drawing the handles from steel blanks. By this means a handle is produced which is light, uniform in shape, and of adequate strength. This process of manufacturing hollow pressed-steel handles has been developed and patented by the Rockwood Sprinkler Co. of Worcester, Mass. A complete line of these handles, comprising eleven sizes, is shown in the heading illustration. The proportions of the handles are given in the accompanying table. The specifications given have been adopted as Rockwood standards, but they are the same as those used by manufacturers of solid handles machined from bar stock. There are two types of these handles; one has a shank integral with the handle, and the other has a loose spindle around which the handle can rotate freely.

In the solid handle of the loose-spindle type, machined from bar stock, these spindles or pins are riveted over at the end and finished to conform with the contour of the handle. With this construction, the headed-over pin may project sufficiently to permit dirt to work in and prevent the handle from turning freely. The projecting pin is also likely to injure the operator's hand. In the pressed-steel handle of this type, the spindle or pin does not project, but is contained in a bearing within the drawn shell, as shown in the upper right-hand corner of Fig. 1, and so cannot become loose.

Sequence of Operations

The evolution of a handle, step by step, is shown by the diagrams in Fig. 1. The dimensions given are for a No. 7 handle (see table); those for other sizes are, of course, in proportion. All sizes are made from strip steel, varying in thickness from 0.062 to 0.100 inch, and sixteen operations are required (including annealings) to finish a handle. The first operation is blanking and drawing on a double-action press, which is followed by annealing. Then there are two redrawing operations, followed by annealing, bringing the shell to shape 4.

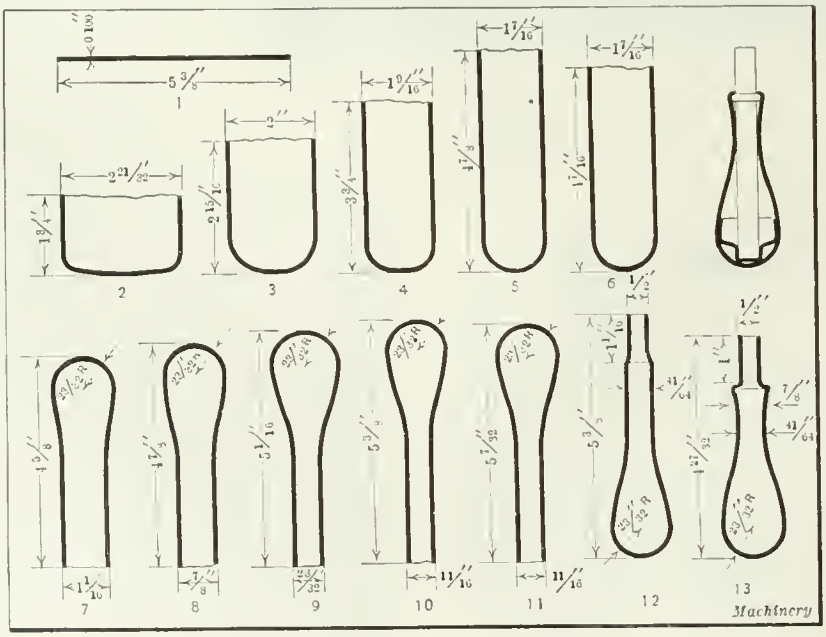


Fig. 1. Sequence of Operations in making a No. 7 Pressed-steel Machine Handle

In the course of manufacture, the stock becomes thickened from the small diameter of the handle to the shank. If special means were not provided to anticipate this thickening, the stock would become so thick that in the final upsetting operations it would be likely to buckle, so that it would be practically impossible to maintain the shape; also, particularly on the smaller sizes, the hole in the shank would be practically filled. Consequently the next redrawing operation is performed with a punch designed to thin the shell at the upper end. This is shown graphically at the left in Fig. 3. The shell is next squared on the end and annealed. If the handle is of the loose-spindle type, the next operation is slipping in a pressed-steel bearing, as shown at the right of shape 6, Fig. 1.

Reverse Drawing or Necking

The necking operations which follow are the same for both types of handles; in the case of the loose-spindle or quick-action handle, these operations result in closing the large end of the handle so that the bearing is prevented from coming out. There are four necking operations produced by what is known as "reverse drawing." Between the first two and the last two necking operations the shells are annealed. The dies employed in the reverse drawing operations are of substantially the same design in all cases, with suitable modifications, of course, to accommodate the various lengths and diameters of shells.

Fig. 2 shows a press set up for the first necking operation, while Fig. 3 shows, in section, the type of punch and die used in all the reverse drawing operations. The dotted lines show the relative positions of the punch and the shell before necking, and the full lines the positions at the completion of the operation. The shell is placed in the die closed end up, and centered between two spring slides. As the punch descends these slides are forced radially outward to permit the punch to make a complete stroke and force the shell into the die. The press is equipped with a device for ejecting the shell after it has been necked. It will be noted that the

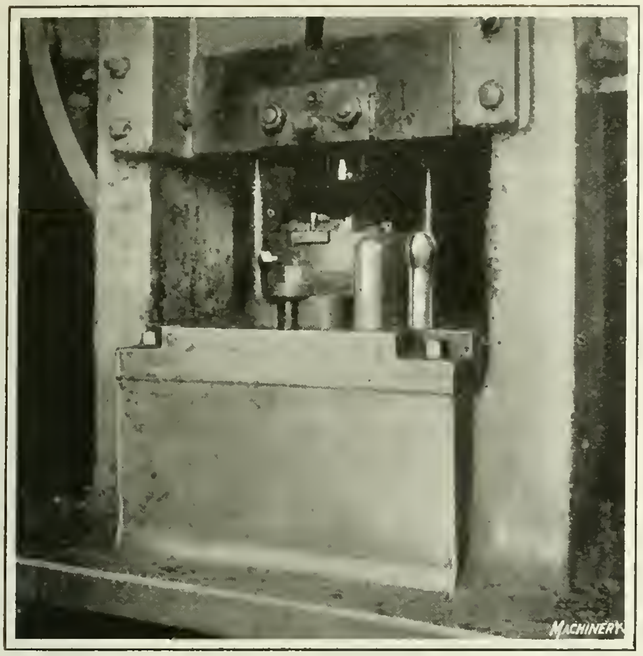


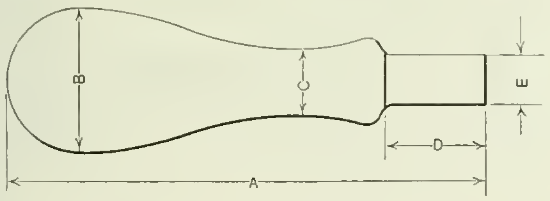
Fig. 2. Power Press Set-up for First Reverse Drawing Operation

punch is a plain cupped-out tool which serves merely to force the shell straight downward. Shape 11, Fig. 1, shows the shell after it has been squared on the end following the necking operations.

Forming the Shank

The next step in the sequence of operations on the type of handle with the integral shank, is drawing the shank end to the finished diameter, which for a No. 7 handle is ½ inch. In this operation, the shell is reversed from the position occupied during the necking operations, and a punch is used which fits over the 41/64-inch diameter and compresses the end to the proper size. This results in elongating the shank end slightly, just enough so that in the final upsetting operation the correct length of shank from the shoulder to the end will be obtained.

DIMENSIONS OF ROCKWOOD PRESSED-STEEL HANDLES



Size	A	B	C	D	E
00	2	⅝	11/32	29/64	¼
0	2 13/64	¾	⅜	½	5/16
½	2 19/32	13/16	13/32	9/16	5/16
1	2 15/16	15/16	15/32	⅝	⅜
2	3 5/16	1	½	11/16	7/16
3	3 17/32	1 3/32	33/64	¾	7/16
4	3 13/16	1 3/16	35/64	13/16	7/16
5	4 3/16	1¼	37/64	27/32	7/16
6	4 17/32	1⅜	39/64	15/16	½
7	4 27/32	1 7/16	41/64	1	½
8	5⅛	1 9/16	¾	1 1/16	⅝

Machinery

The dies used in the final upsetting operation are illustrated in Fig. 4; in this illustration a handle is shown in the die preparatory to upsetting. A safety guard which assures that the handle will be located vertically is used. This guard consists of two sheet-metal members which, when they are together, form a hole large enough for the handle to enter and seat in the die. The handle cannot be placed incorrectly in the die as long as this guard is closed.

On the descent of the ram, a V-shaped cam *A* strikes the rounded end of the two slides to which the guard members are attached, and spreads them against spring tension. This occurs at the same time that the two side cams *B* (see also Fig. 5) come into operation and close the slides that secure the handle in a vertical position. It will be seen from Fig. 5, which is a sectional view of this die at the completion of the operation, that the faces of these slides are formed to give the correct curvature to the handle, and that the upsetting operation not only forms the shoulder but also spreads the handle to give it a reverse curve at the top near where the shank begins. The shape of the punch is clearly indicated.

As soon as the operation is finished and the ram ascends, the die parts immediately spring back into their original

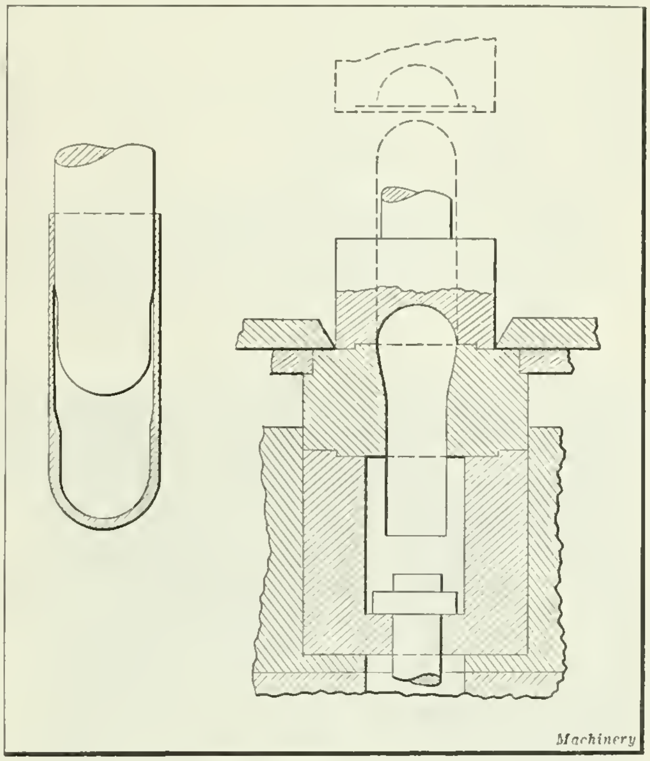


Fig. 3. Diagram illustrating how the Shell is thinned, and Cross-section of Dies used in Necking or Reverse Drawing

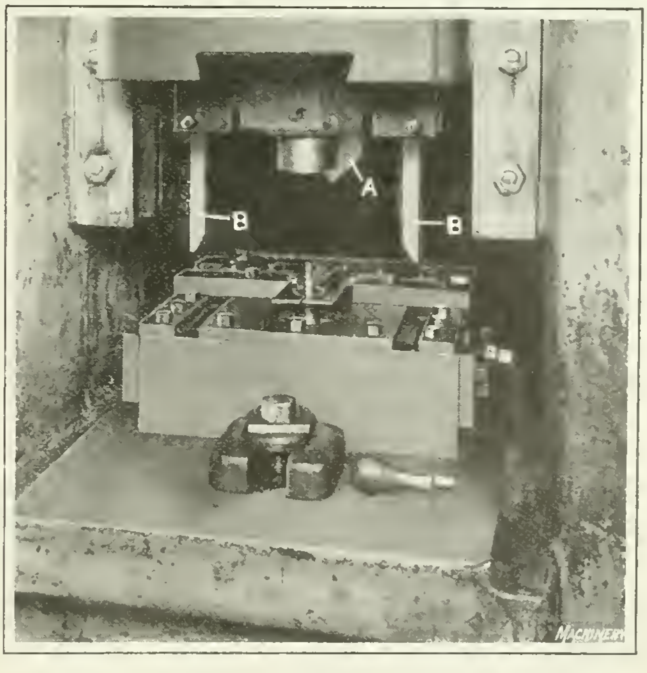


Fig. 4. Set-up of Power Press for upsetting the Shank

position, opening the slides and permitting the completed handle to be removed. In the case of the quick-action handles, the blank size is so calculated that after necking, it is only necessary to force the cold-rolled steel spindle into the shell and close the ends around the flange machined on it.

The weight of pressed-steel handles made by the Rockwood process is about one-half that of solid machine handles made from bar stock. The actual weight of a No. 7 solid steel handle is 15 ounces, while that of a pressed-steel handle of the same size is 7 ounces. The cost of hollow pressed-steel handles is the same as that of the solid type.

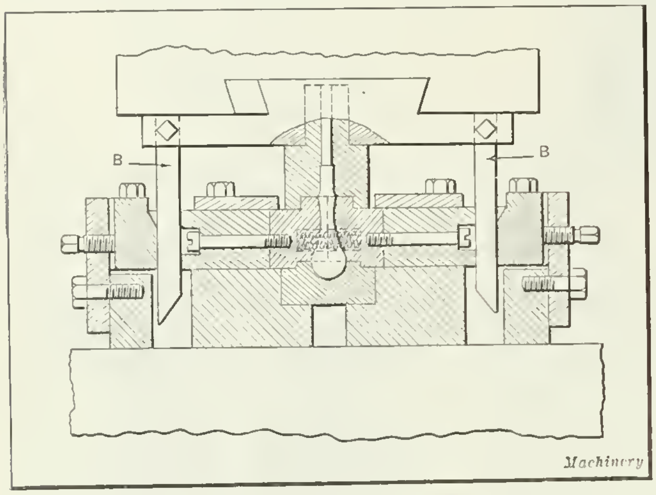


Fig. 5. Cross-sectional View of Dies used in the Final Upsetting

* * *

EFFICIENCY OF GRINDING WHEELS

Grinding wheels cannot be compared accurately without keeping records of their action. Methods of judging the efficiency of grinding wheels are described in an article published in *Grits and Grinds*, of which the following is an abstract. The records kept for determining the efficiency of a grinding wheel should indicate how a wheel compares with others, considering all conditions affecting its use. Wheels for different kinds of grinding operations cannot be judged in the same way, as characteristics desirable in a wheel for cylindrical grinding may render a wheel absolutely unfit for snagging. The following three classes of grinding will be considered: Off-hand grinding, or snagging; precision grinding; and miscellaneous grinding.

Wheels for Off-hand Grinding

The most important factor with regard to a snagging wheel is the cost of removing the metal, the finish obtained not being important. The total grinding cost includes wheel, labor, and overhead costs. The overhead cost per unit of time is constant, whereas the overhead per unit ground varies and depends on the production. Thus the higher production, the lower the overhead charge per unit. The total grinding cost per hour is not so important as the actual cost per unit of production. To obtain the latter, it is essential to know the wheel, labor, and overhead costs, the wheel life, and the rate of production.

The life of a grinding wheel is, in itself, unimportant because no idea of the production can be obtained from this information, and the true cost per unit cannot be calculated. If two wheels are compared on the basis of life alone, the result is that the wheel with the longer life is regarded as the better for the work.

Production rate is the important factor in deciding upon the efficiency of a grinding wheel, and this can be ascertained by determining either the number of pounds of material ground off, the number of castings ground, or the tonnage of castings ground. The first method can be applied to any type of casting, as both large and small castings can be compared on this basis, since the actual material removed is considered. The second and third methods are not as satisfactory on account of the variation in the size or kind of castings, but if castings of the same type and size are being ground, these methods also prove satisfactory. When the size varies greatly, the third method is better than the second, although either one gives only an approximation. From the rate of production per hour, the wheel life, and the operator's wages, the overhead charges, and the wheel and labor costs per unit ground can be calculated, and the total grinding cost per unit determined.

Precision Grinding Operations

The roughing wheels used in cylindrical and surface grinding of a precision nature must be of a structure that will permit rapid removal of the stock, because the finish is not important. As in the case of snagging, either the cost per pound of metal ground off, or the cost per unit of production is the basis upon which the efficiency of the wheel should be determined, and in such a calculation the factors involved in the case of snagging wheels must also be dealt with here. An additional item of importance, however, is the cost of the diamond used for truing the wheel. There are some jobs for which the unit diamond cost is larger than the cost of the grinding wheel. When grinding standard parts, the diamond cost can be obtained easily over a period of time and the cost per unit calculated.

When wheels are used throughout their life on the same kind of work, such as roughing crankshafts and camshafts, pistons, etc., the number of pieces ground is usually a satisfactory production figure. This is because each has practically the same amount of stock to be removed, so that the number of pieces ground is nearly a measure of the total amount of material removed. If the wheels are used for a variety of work, it is impossible to obtain a correct production figure except by going to a great deal of trouble. The cost per unit ground cannot be obtained without keeping detailed records, which would have to be so comprehensive that the expense would probably not be justified, and so these wheels must be compared on a different basis.

Assuming that the wheels are cutting satisfactorily, there are two factors that should be considered—wheel life and the amount of dressing necessary. The best wheel would be the one with the longest life and fewest dressings, bearing in mind the assumption that the wheels are considered equally desirable from the cutting standpoint. The finish obtained with a finishing wheel determines the use of that particular wheel for this class of work. After the desired finish is obtained, the wheel that will produce this finish at the lowest cost per unit should be found and used.

Miscellaneous Grinding Operations

The classification of miscellaneous grinding includes tool and cutter grinding, general off-hand grinding, and any other operation where production is not important. For work of this type, it is impossible to get comparative figures, the operator's opinion of the wheel action being in nearly all cases the deciding factor. In tool, cutter, and drill grinding, finish is important, for the cutting edge must be keen and there must be no burning. The actual amount of stock removed per wheel is not of fundamental importance, although naturally, if the finish and rate of cutting are the same, the wheel having the longest life should be chosen.

The wheels for off-hand grinding jobs are chosen, not because they last longer, but because they fulfill certain special requirements. A wheel may be used for squaring the ends of rods. Such a wheel must hold its shape, so that constant dressing is unnecessary, and in most cases a little burning would not be objectionable. On the other hand, for sharpening lathe and planer tools, the wheel must cut cool and the finish must be good.

Drawing Sockets for Wrenches

Among the many products of the plant of the New England Pressed Steel Co., at Natick, Mass., are sockets for wrench sets and for spark-plug wrenches. This work is essentially plain drawing work. The standard sizes for the wrench-set sockets for hexagonal nuts range from 5/16 inch to 1 9/32 inches across flats, and for square heads from 13/32 inch to 1 9/32 inches square. All sockets are 1¾ inches long. The operations performed in manufacturing the hexagon type of socket will be described in this article.

In the upper part of Fig. 1 is shown a collection of these wrench sockets ranging from ⅜ inch to 1 9/32 inches across flats. Directly beneath these there is a set of samples showing the work after successive operations on one size of socket. A double-end spark-plug wrench, 29/32 inch by 1 1/32 inches across flats, is shown at *H*, and a 31/32-inch single-end spark-plug wrench at *K*. Both of these spark-plug wrenches are 4 inches long, the double wrench being punched at each end for the insertion of a handle or rod, while the single wrench is drawn with a square hole at the neck end to accommodate a ½-inch square extension by means of which the socket is turned when gripped by the wrench. The long spark-plug wrench *I* is a 13/16- by 1 1/32-inch double-socket wrench with separate sockets assembled on a square bar, giving an over-all length of 8 inches. This wrench is made for a large automobile manufacturer, and was designed to replace a more costly wrench previously made from tubing. The remaining example *J* is a 1 5/32-inch single spark-plug wrench with extension, which was also made for a large automobile manufacturer.

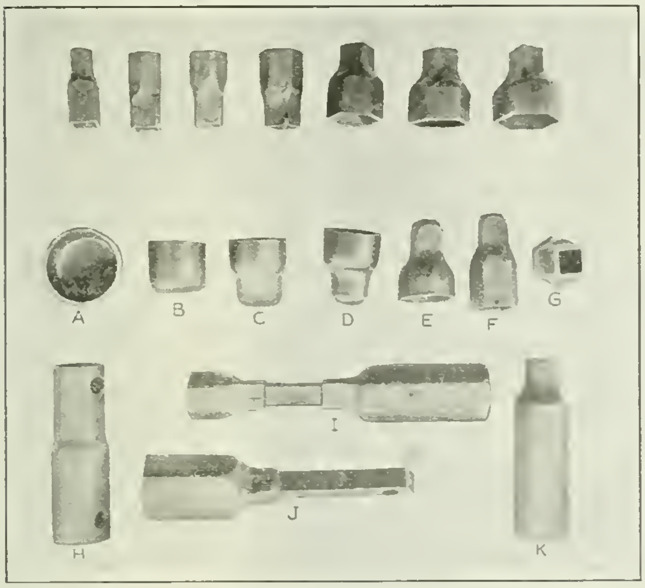


Fig. 1. Socket and Spark-plug Wrenches, and Complete Set of Shells for One Size of Socket

In making the sockets for wrench sets, blanks of one diameter are regularly utilized for drawing up a number of similar sizes. The operations performed in making the ⅞-inch socket are representative, and this size only will be considered in describing the process of manufacture. The socket is made from 0.109-inch hot-rolled annealed stock, using a blank 2 11/16 inches in diameter. In the first operation, the work is blanked and drawn to the shape shown at *A*, Fig. 1; this produces a shell ¾ inch deep, having an inside diameter of 1 9/16 inches. The shell is next redrawn to 1⅛ inches inside diameter, 1⅛ inches deep, and then annealed and oil-treated before any further reduction in diameter can be satisfactorily performed. After annealing, the shell is necked to a length of ¾ inch and to an inside neck diameter of 0.940 inch, as shown at *C*.

In the second necking operation, the same neck length is maintained, but the diameter is reduced to 0.740 inch, which results in slightly elongating the shell to the shape shown at *D*. The punch used in the following operation squares the neck as at *E*. The inside size of the hole in the neck is then 0.518 inch square, which will accommodate a ½-inch square extension, and the outside size is 0.685 inch. The final press operation is drawing the cylindrical end of the socket to a hexagonal shape, ⅞ inch across sides, inside, and 1 1/32 inches outside. This results in lengthening the socket to about 2 inches over-all, so that the ends may be faced to bring them parallel and to the specified over-all length of 1¾ inches. The work at this stage of the manufacture is shown at *F*. All of these press operations, with the exception of the first, may be performed on any press having a 6-inch stroke or over. To complete the socket, it is simply necessary to punch out the closed end and square both ends to the proper over-all length, as shown at *G*.

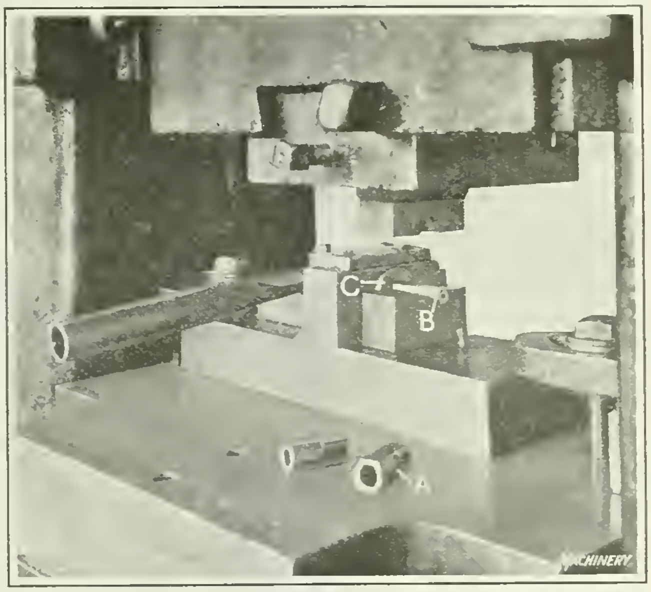


Fig. 2. Restriking the Wrench Sockets after the Hexagonal Hole has been drawn

Procedure in Drawing Various Sizes of Sockets

The regular practice in making sockets for hexagonal nuts less than ½ inch across flats, is to draw the square end of the socket, and then neck the closed end preparatory to forming the hexagonal shape. In the case of sockets for hexagonal nuts greater than ⅝ inch across flats, the reverse order is followed, as described in the foregoing. This practice is necessary, of course, on account of the comparative sizes of the two ends.

However, in making sockets for ½-, 17/32-, 9/16-, and 5/8-inch hexagonal nuts, the difference in size between the two ends of the socket is so little that the inside corners of the square end extend beyond the sides of the hexagonal part and the corners of the hexagonal hole extend beyond the sides of the square end, so that it is impossible to draw the hexagonal end completely with a square-pilot punch, or the square end with a hexagonal-shaped punch. Obviously, the punch must maintain alignment for the two differently shaped ends. Consequently, the punch used on these few sizes is shaped square on the pilot end and the section which otherwise would be hexagonal is made to a special shape, which draws a shell such as indicated at *A*, Fig. 2. This permits a square-ended punch to be used to draw the closed end, but makes it necessary to restrike the special-shaped opposite end to form the required hexagonal shape. The amount of stock in both the hexagonal and square ends of sockets of the sizes mentioned is so nearly equal that the hexagonal end can be formed subsequently in this way without difficulty.

Fig. 2 shows the dies used in restriking the hexagonal end of a 17/32-inch socket. The die is provided with an auxiliary arbor *B*, which is withdrawn from the work after restriking, by means of the hand-lever. Arbor *B* works through a loose washer *C* which acts as a stripper when the arbor is withdrawn from the socket. A rack containing a quantity of punches and dies such as are used in making sockets is shown in Fig. 3.

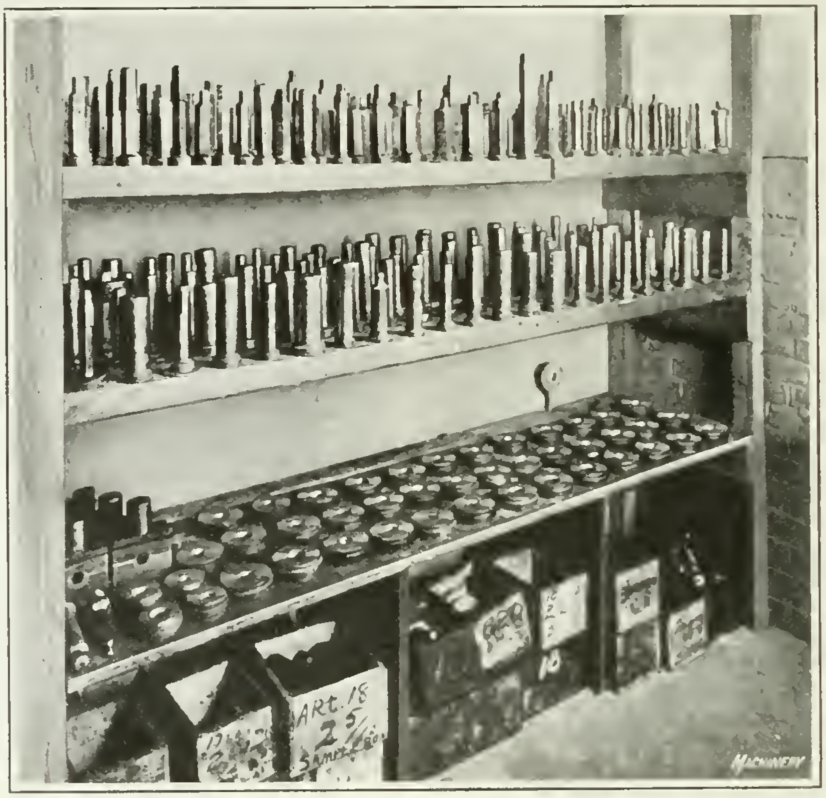


Fig. 3. Rack containing Punches and Dies used in drawing Sockets for Wrench Sets and for Spark-plug Wrenches

Making Spark-plug Wrenches

The sequence of operations followed in making a spark-plug wrench is as follows: The double-end wrench, 29/32 inch by 1 1/32 inches in size, shown at *H*, Fig. 1, may be taken as an example of the work. This is made from 0.095-inch hot-rolled steel, the blank being 4½ inches in diameter. The work is first drawn in a toggle press; this operation produces a shell having an inside diameter of 2⅝ inches and a depth of 1⅛ inches. The shell is next oiled and annealed and subjected to two redrawing operations, in both of which a single-action press is used. The inside dimensions of the shell produced after each operation are 1⅞ inches diameter, 2 inches deep, and 1½ inches diameter, 2⅝ inches deep. The shell is then again annealed to relieve drawing strains and the surface oiled. In a third redrawing operation, the shell is further reduced to 1 5/16 inches inside diameter, 3⅛ inches deep.

A single-action press equipped with a knock-out operating from below is next employed to draw the small end. The length of the neck thus produced is 1⅞ inches and the inside dimension between sides 1.076 inches. Next, this cylindrical end is formed to a hexagonal shape in the same press as was used for the necking operation. This produces the required inside dimension between sides, that is, 29/32 inch, and draws the neck to 2⅛ inches. The opposite end of the wrench socket is next formed to a hexagonal shape, which produces the final inside dimension across flats for the opposite end, that is, 1 1/32 inches, and leaves the socket 4¼ inches over-all.

The socket is next held in a vertical position on a drilling machine table, and the open end squared by means of a fly cutter. This leaves the 1 1/32-inch end 2 inches long, as desired. The closed end of the socket is then punched out, after which the finished over-all length is obtained by squaring the small end on a drilling machine with a fly cutter. There are two holes diametrically opposite each other in the ends of the socket, and these are punched out on a short-stroke press, arbors of the correct size being used to hold the work. The sizes are then stamped on each end, and the wrenches inspected.

* * *

RESULTS OF INVESTIGATION AND RESEARCH

An interesting example of what can be accomplished by research and carefully conducted tests is brought out by the experience of the American Malleable Castings Association. This association was formed about twenty years ago, and has been consistently working since then on improvements in the quality of malleable castings. The ultimate strength of this product twenty years ago averaged 39,000 pounds per square inch, and the elongation was 3.5 per cent. At that time there was no systematic mechanical testing of the products of malleable iron foundries. The metallurgy of the foundries was not well understood, and the character of the product depended largely upon hit or miss methods. Through systematic research, carefully made tests, and thorough investigations, it has been made possible in the past four years to bring up the average ultimate strength to 53,000 pounds per square inch, and the elongation to 15 per cent. Many members can make a product considerably higher in ultimate strength and elongation, but the figures quoted are the averages of all the member foundries.

* * *

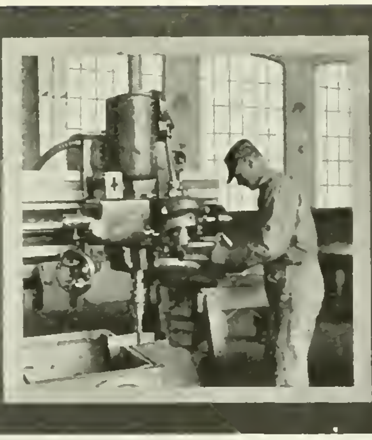
SYSTEM FOR NUMBERING STEELS

A system of designating kinds or qualities of steels by code numbers, each of which would represent a definite specification, will be developed as a result of the decision of a conference of the principal producers and users of steel recently held at Washington, D. C., at the call of the American Engineering Standards Committee. The conference recommended that this code be developed under the procedure of the committee, and suggested that the Society of Automotive Engineers and the American Society for Testing Materials be appointed joint sponsors.

* * *

During the eleven years preceding 1921, over $2,500,000,000 was spent on the building of highways in the United States, exclusive of the amount spent for maintenance. The investment in automobiles and motor trucks in the United States during the same period is estimated at nearly $9,000,000,000.

Letters on Practical Subjects

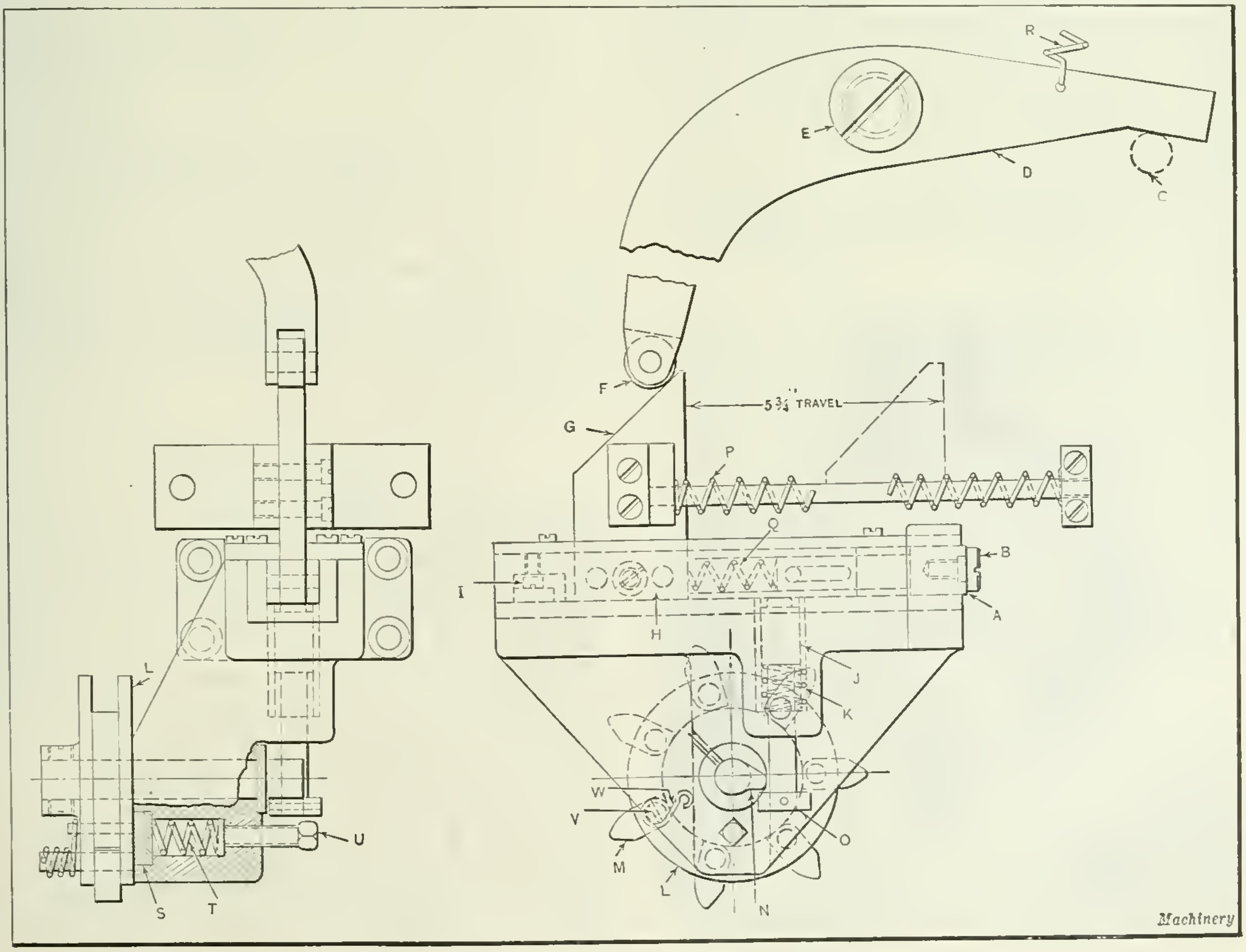


AUTOMATIC FEEDING DEVICE FOR PUNCH PRESS

The device shown in the accompanying illustration was developed for a special purpose, but the principle involved is adapted to a variety of punch press work. The problem was to feed a nut into a die designed to punch out slots or castellations in the nut head. The press used for this operation makes six strokes in producing the castellations on a hexagonal nut, one side only being punched at each stroke. The feeding movement takes place automatically on every seventh stroke of the press. One stroke is required to eject the completed nut and to feed another nut into the die, thus leaving six working or cutting strokes. After the nut is carried to the die, the device holds it there under pressure during the punching operations.

The nuts are placed in a hopper so that they drop down in front of ram *A* of the feeding device, where they come in contact with the head of the locating screw *B* which is screwed into the end of the feeding ram. On the upward stroke of the ram the pin *C* pushes the outer end of rocker *D* upward. The rocker pivots on pin *E*, thus throwing the end that carries roller *F* forward, which, in turn, pushes block *G* to the right toward the die. Block *G* is pinned to part *H*, which is connected through a spring arrangement with plunger *A*. When plunger *A* reaches the end of its feeding stroke, stop-block *I* is directly over pin *J*. Pin *J* will then be forced up by spring *K*, thus locking part *H* in its forward position. The feeding movement as described is completed at the end of the upward stroke of the press ram.

It will be seen that ratchet wheel *L* has seven evenly spaced teeth like that shown at *M*. Attached to the punch press ram is a steel bar (not shown) which on every downward stroke strikes one of the ratchet teeth, so that the ratchet wheel *L* is turned or revolved one tooth space. Thus, on every seventh downward stroke the ratchet wheel completes one revolution. Attached to the ratchet wheel is a



Automatic Device for feeding Work to Punch Press from a Chute cam *N*, which makes contact with the collar *O* on every seventh stroke of the press ram. The collar *O* is pinned to the plunger *J*, and so at every seventh downward stroke the holding plunger *J* is pulled down so that springs *P* force blocks *G* and *H* back into the position in which they are shown in the illustration. This action releases the nut which has been held by the end of plunger *A* against the die under the pressure exerted by spring *Q*. Another nut then slides down in front of plunger *A*, and as the press ram returns to the upward position, this nut is carried to the die, and the slotting operation is repeated.

Spring *Q* has a double duty to perform. This spring holds the nuts, which vary in length, tight in the die during the slotting operation, and at the same time serves as a safety device in case a nut should not be ejected and two nuts should become jammed against the die. Lever *D* is held up and out of the way of pin *C* by spring *R* so that it will operate only on the feeding stroke. A fiber shoe *S* actuated by spring *T*, the pressure of which can be adjusted by screw *U*, holds the ratchet in whatever position it occupies after each indexing movement.

The teeth *M* are pivoted on pins *V* and are normally held in the positions shown in the illustration by springs *W*. This construction allows one of the ratchet teeth to be depressed by the ratchet-operating bar as it rises on the up stroke of the press ram. At the end of the up stroke the tooth that has been depressed snaps back into place so that the bar will catch it on the return stroke and thus revolve the ratchet wheel one tooth space.

Atlanta, N. Y. JOHN E. COLLINS

DRILL JIG WITH TILTING BASE

A drill jig that can be tilted or revolved to any desired position is shown in Figs. 1 and 2. This jig is employed at the plant of an engine manufacturer for drilling the base and cylinder casting of a 1½-horsepower engine. The jig is shown in a vertical position in Fig. 1 and in a tilted position in Fig. 2. The joint faces of the work at *A* and *B*, Fig. 2, are milled and the cylinder bore *C* ground previous to the drilling operations. These finished surfaces are employed in locating the work in the jig, the cylinder bore being placed on a locating plug. There is nothing unusual in the method of locating and clamping the work in place, the point of interest being the universal adjustable feature which permits the jig to be brought into any position.

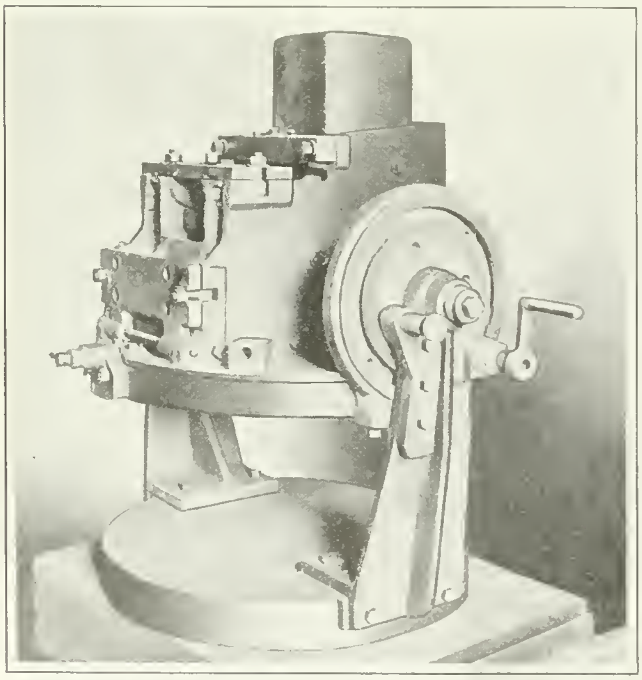


Fig. 1. Drill Jig with Tilting Base

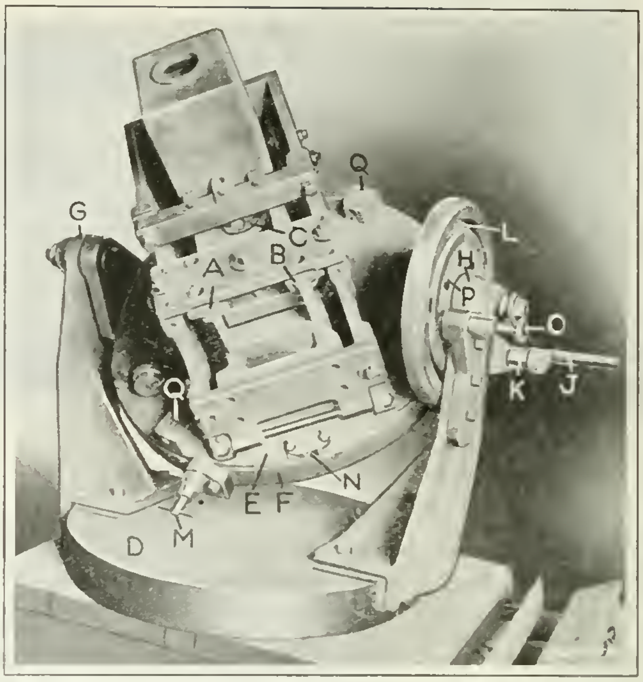


Fig. 2. Drill Jig in Tilted Position

The base casting *D* was designed to fit the table of a vertical drilling machine. The circular base *E* of the fixture can be revolved on the sub-base *F*. The sub-base *F*, in turn, is mounted on trunnion bearings *G* and *H*, and can be tilted to any desired position. No end motion is permitted in the bearings *G* and *H*. The shaft *K* of crank *J* is screwed into a circular T-shaped wedge which fits in the circular groove *L* so that sub-base *F* can be clamped in place by turning crank *J*. The workman can rotate the jig on the trunnion pins of bearings *G* and *H* and also revolve base *E* on the sub-base *F*. The proper location for certain drilling operations is insured by the index-pin *M*, which fits into pockets, such as the one shown at *N*. There are four of these pockets but only two can be seen in the illustration.

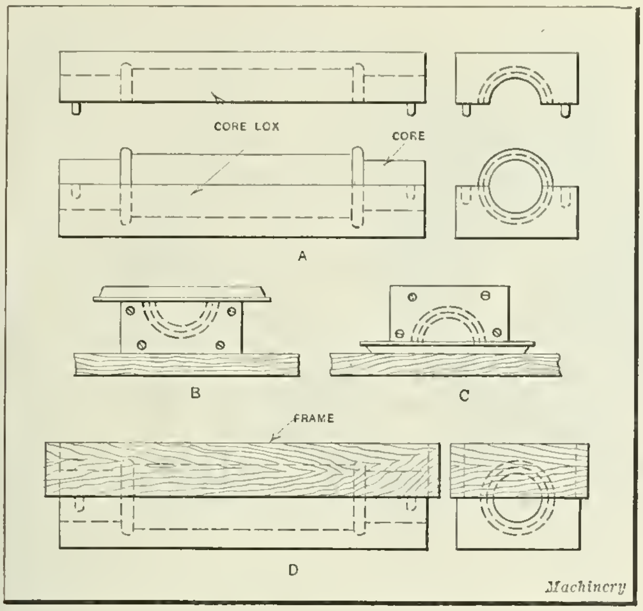
The base *E* is machined to a good turning fit in the sub-base *F* so that the jig and casting will be rigid when located in any position. The index-pin *O* can be inserted in any one of four holes in plate *P* so that the jig can be accurately set in four different positions with respect to its vertical axis. The two bosses *Q* are drilled to allow a bar to be inserted for use in revolving base *F*. In the operation for which this jig is used, twenty-four holes ranging from ¼ to ⅝ inch in diameter are drilled and tapped without removing the work from the jig.

Providence, R. I. ROBERT MAWSON

WHY A FULL CORE-BOX?

Nearly every patternmaker has at one time or another made a full core-box with the parting line through the middle as shown at *A* in the accompanying illustration. If many of the core-boxes made in this way were examined when returned from the foundry, it would be noted that only the upper or lower half was made use of. The molder usually finds it much easier and simpler to use only one-half of the core-box, but the patternmaker is often unaware of this and continues to make full core-boxes when only a half core-box is necessary or desired by the molder.

The method of using the half core-box will be evident from an inspection of views *B* and *C*. After attaching wooden blocks or pieces to the end of the half core-box, the latter is laid on the coremaker's bench. The core sand is filled in and rodded (if necessary), and the surplus sand struck off. A core-plate is then laid on the top of the half core-box and the latter rolled over into the position shown at *C*. The half core-box is next lifted off and the core is



(A) Full Core-box; (B) Half Core-box with Core-plate on Top; (C) Half Core-box in Position to be drawn from Core preparatory to baking; (D) Frame required to support Core when Full Core-box is used

ready for the oven. The venting is done after the cores are baked. Two half cores made as described are pasted together to form the complete core. The ends of a half core-box should always be closed, as shown in views *B* and *C*, in order to retain the core sand.

One of the advantages gained in using the half core-box is that the half core can be laid on an iron core-plate for the baking operation, while a round core such as made in the box shown at *A* must have a black sand bed to support it during the baking operation. It is therefore necessary to provide a frame such as shown at *D* for the black sand bed when the full core-box is used.

Kenosha, Wis. M. E. Duggan

PREVENTION OF POWER PRESS ACCIDENTS

It is not uncommon for the foreman of a power press department to hear an injured operator offer the excuse that "the trip mechanism repeated." A foreman who has had charge of a large department of power presses for more than twelve years informed the writer that he never had known one of his presses to repeat. He stated that the greater number of accidents occurred on foot-operated presses, and this fact seemed to indicate that nearly all accidents were due to carelessness alone.

Great care should be taken in the design and construction of guards. It is to be regretted that power presses are sometimes provided with guards that prove more harmful than beneficial. Dial feeds and progressive dies should be used whenever possible, and even though the first cost is greater, the increased production obtained and the greater safety provided will more than compensate for the additional expense.

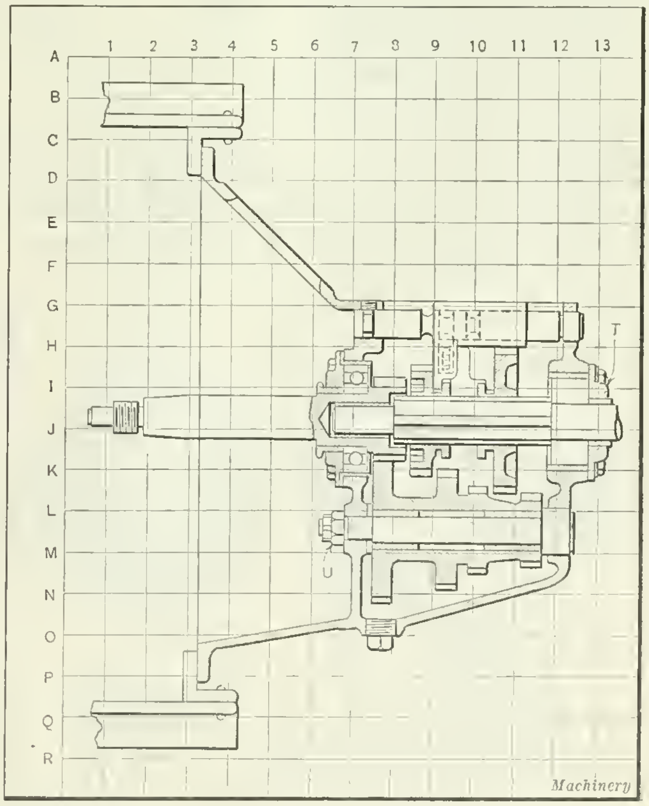
The piece-work system should never be applied to dangerous press jobs, and rules regarding the use of "pick-ups" or workholders for placing the work on the die should be strictly enforced. This refers to such operations as forming, shaving, bending, etc. Power presses should be enclosed by a fence or partition, whenever possible, in order to prevent the operators from engaging in any chance conversation with those whose duties require them to pass through the department. When new work is being tried out, the press should be slowed down as much as possible until the operator has become accustomed to handling the pieces. The writer has always been of the opinion that the only reliable safety device for a power press is one that requires the operator to use both hands, and that is so designed that the knee cannot be used to operate either of the handles.

S. N. Bacon

LOCATING AND DESIGNATING PARTS ON ASSEMBLY DRAWINGS

Assembly drawings are sometimes made confusing by the large number of arrow-heads or leaders used in connection with letters or numerals to designate different parts. This commonly employed method, however, can be easily avoided, as shown in the accompanying illustration. The assembly drawing in this case is made in the usual way, but no leaders or arrows are used to point out different parts. Instead, very light vertical and horizontal parallel lines are drawn, which divide the drawing into square sections as shown. These lines should be drawn with ink of some color (light red or yellow) that forms a contrast with the black lines of the drawing itself, and they should be so light that they will not spoil the general appearance of the drawing.

It will be noted that the vertical parallel lines are numbered while the horizontal lines are lettered, A, B, C, etc. In this way it is necessary to give only the number and letter of the vertical and horizontal lines, respectively, that intersect at some point on any part to enable anyone to find that part quickly. This plan is similar to that used on many maps, except that it is sometimes necessary to place the lines closer together so that a point can be located definitely within a fraction of an inch. The notation "flange I–13" will enable one immediately to locate the part *T*. The letter *T*, however, will not appear on the drawing. The spaces between the vertical and horizontal lines may, in some cases, be required to be divided into tenths or even finer subdivisions of an inch. Assuming that this has been done in the case of the drawing shown in the illustration, nut *U* might be referred to as "L.5–6.5." N. G. Near



Assembly Drawing with Vertical and Horizontal Lines for locating or designating Parts

SLOTTING AND INDENTING DIE

The die shown in Fig. 1 was designed for use in the production of cases for electrical instruments. It is used for punching the slot *A* and producing the two indentations at *B* and *C*, Fig. 2. The lugs or projections formed on the inside of the case by the indenting operation, in conjunction with the slot, serve to support the dial of the instruments. The cups for the case are blanked and drawn in the usual way, and two holes *D* are punched in the bottom to receive two wire terminal screws.

The design of the slotting and indenting punch is clearly shown in Fig. 1, while the details of the die member are shown in Fig. 3. The die *F* is so shaped as to provide a clearance on all sides of the work except at the points where the hole *A* is punched and the indentations *B* and *C* are made. Die *F* is counterbored to receive the pivoting pin-plate *G* which is provided with two pins *H* and *I*, as indicated by the view in the lower right-hand corner of the illustration. When the work is placed on the die, the pins *H* and *I* pass through the pierced holes *D*, Fig. 2, and hold the work in place during the punching and indenting operation. Pin *I* passes through the pin-plate and extends into a slot in the die *F*, where it is normally held in the correct operating position by the coil spring *J*.

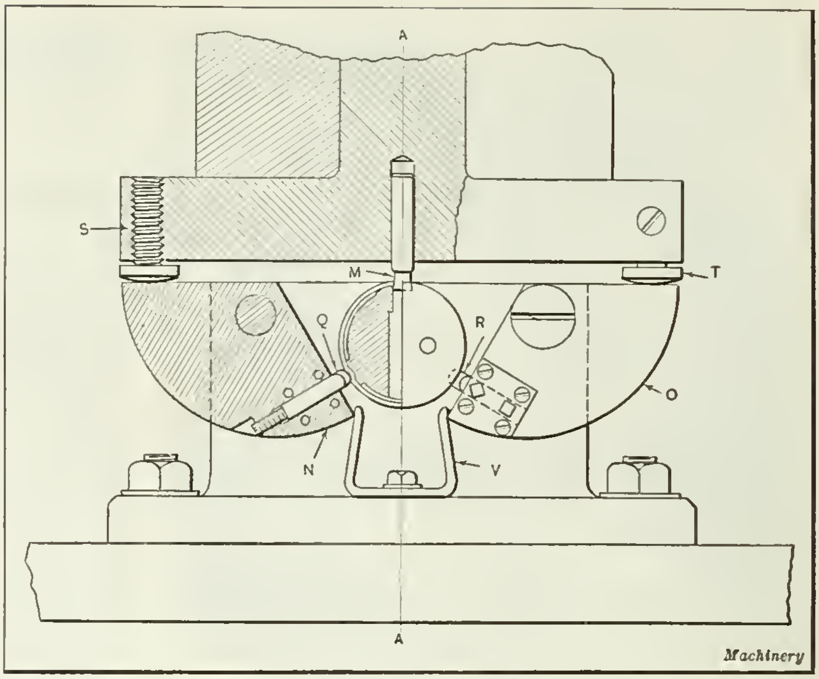


Fig. 1. Slotting and Indenting Die for Electrical Instrument Case

The work is removed from the die after the forming and indenting operation has been performed, by giving the cup a slight twist so that it is rotated sufficiently to bring the lug impressions at *B* and *C* out of their die slots. The slot punchings at *A* fall down through a vertical hole into the inclined hole *K* and thus out at the rear of the bolster plate. The bottom of the vertical hole is closed by a beveled plug *L*. The two indentations or lugs at *B* and *C* are produced by punches located in swinging segments *N* and *O*, Fig. 1, which are pivoted on substantial supports on either side of the work.

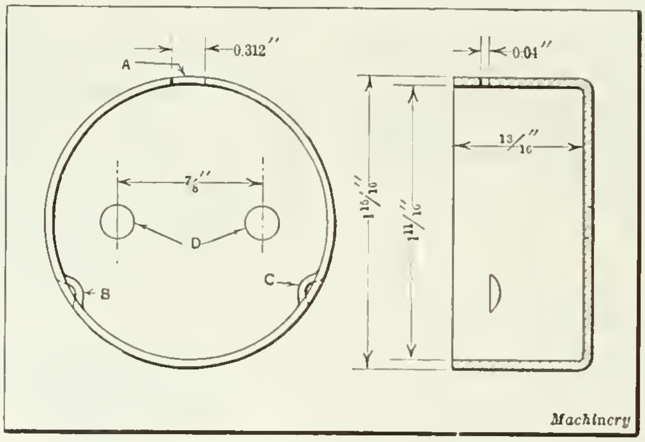


Fig. 2. Case on which Slotting and Indenting Operation is performed

The swinging segments *N* and *O* of the die are slotted to receive the indenting punches *Q* and *R*, which are made from ordinary tool bits. These punches are firmly clamped in their respective slots by means of two set-screws which pass through plates that are securely fastened to segments *N* and *O*, as shown in the illustration. Adjustment of the indenting punches is obtained by screws *S* and *T*. A flat single leaf spring *V* of U-shape is used to separate the swinging segments on the up stroke of the press. When placing the blank cups on die *F*, Fig. 3, no motion is imparted to the indexing plate, and only a slight twisting motion is required to permit the work to be withdrawn after the completion of the punching and indenting operation.

Allentown, Pa. JOE V. ROMIG

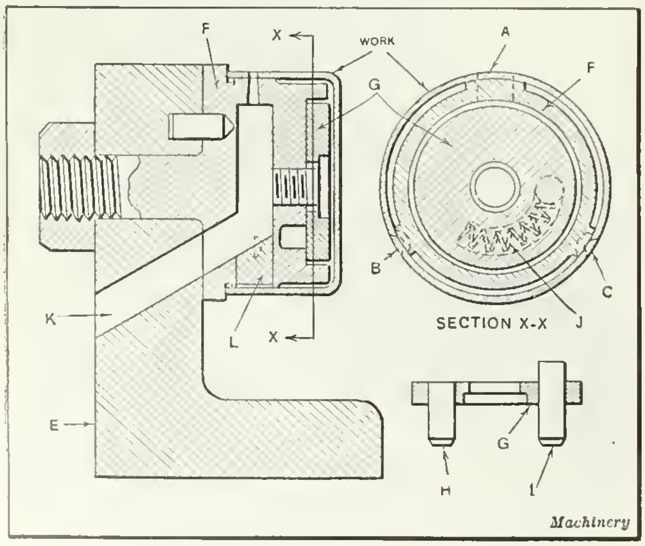


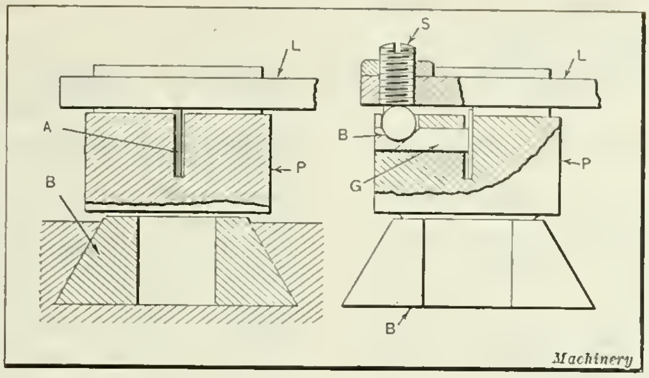
Fig. 3. Sectional View of Die shown in Fig. 1

FEEDING DEVICE FOR WIRE-FORMING MACHINE

Feeding mechanisms of various designs are employed on automatic wire-forming machines. The design shown in the view at the left in the accompanying illustration is often used for flat or ribbon stock. The ribbon stock *A* is run on edge throuh a slot in the post *P* which reciprocates with the feed-slide *B*. The feed-slide is actuated by a lever *L* having a roller that travels against the face of a feed-cam. A second motion is imparted to lever *L* by a "rise-and-dwell" cam on the hub part of the feed-cam. The latter cam has a dwell which continues for about one half revolution. The action of this cam causes the feed-slide end of lever *L* to press downward on the stock so that the latter is gripped between the lever and the bottom of the slot in post *P* during the forward movement.

With this type of feeding device there is necessarily a sliding of the gripping surface on the stock before a firm grip is obtained. There is also excessive friction and wear on the working parts. A realization of the disadvantages of this feeding device in one plant where a number of machines were employed on ribbon stock led to the development of a new device. The improved device is shown in the view at the right-hand side of the illustration. Most of the parts in the original device were used in the improved design. The post *P* was drilled for a plunger *G*. which is forced to grip the stock on the feeding stroke by the downward movement of the ball *B* which is in contact with the beveled end of the plunger as shown. When the end of lever *L* is depressed by a cam during the feeding stroke, it causes ball *B* to maintain pressure on plunger *G*. This pressure on the plunger is sufficient to keep the stock from slipping in the slot in post *P*. The screw *S* provides a convenient means for obtaining close adjustment for stock of different thicknesses. The principal advantage of the improved feeding device is the lighter tension required to obtain a positive grip on the stock (which is clamped on its flat surfaces instead of on its edge), a feature which eliminates bending or marring of the stock. The parts of the device which are subjected to wear are hardened. The plunger and ball fit loosely in their pockets so that the stock is instantly released when the lever *L* drops from the cam dwell at the end of the feeding stroke.

Middletown, N. Y. DONALD A. HAMPSON



Plain and Improved Types of Feeding Devices for Wire-forming Machine

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DETERMINING HEIGHT OF ANGULAR FACED BLOCK

A block with its top surface at an angle to its sides, and one of its sides of a predetermined height, is sometimes required to be accurately machined and measured. The top surface of two blocks of this type is represented in Figs. 1 and 2 by the lines *VW*. In both illustrations *H* represents the height or dimension that is required to be exact. In this article a convenient method of checking height *H* is described. Referring to Fig. 1, it will be noted that the short side of the block is the one to be checked, while in Fig. 2 the longer side is to be checked.

By placing a square against the side of the block, or preferably by clamping a parallel against the side of the block so that the edge of the parallel can be shimmed up and clamped in a true vertical plane, a known angle *UVW* can be formed. A button is placed in the corner thus formed, and a height gage employed to determine the height from the top of the button to the surface plate on which the piece rests. The exact height of the side of the work can then be determined by the formulas given in the following. If the corner of the piece has been rounded off, the height of the projected corner will be found.

First considering the case illustrated in Fig. 1, we have

R = radius of button used;

a = angle that top of piece makes with surface plate;

C = height from base of surface plate to upper side of button as determined by means of a height gage.

The height H of the side of the block can now be found as follows: First we have,

$$b = \frac{90 \text{ degrees} - a}{2} \quad \text{and} \quad P = R \cot b$$

Now

$$C = H + P + R$$

By substituting

$$C = H + R \cot b + R$$

and

$$H = C - R \cot b - R = C - R (\cot b + 1)$$

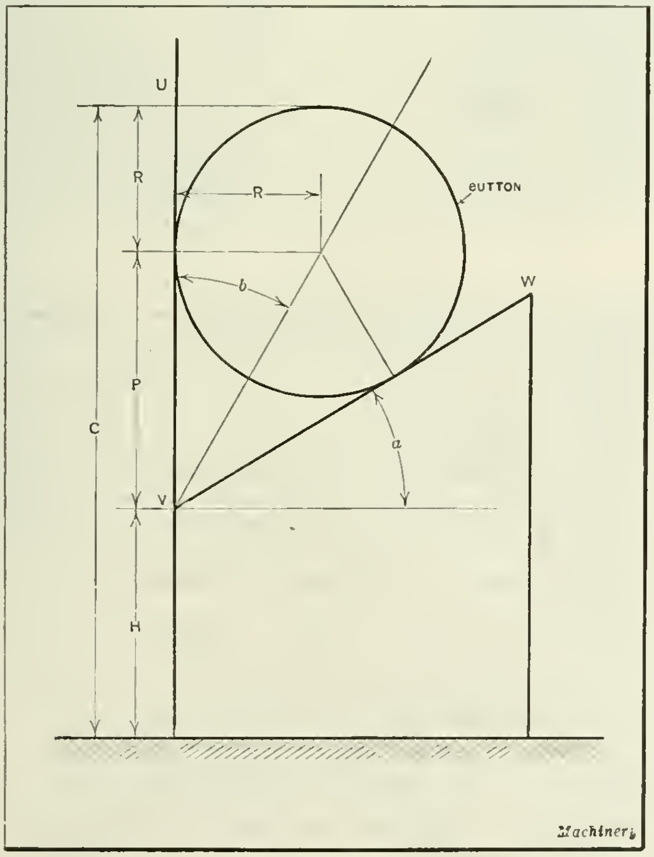


Fig. 1. Diagram used in finding Height of Angular Faced Block

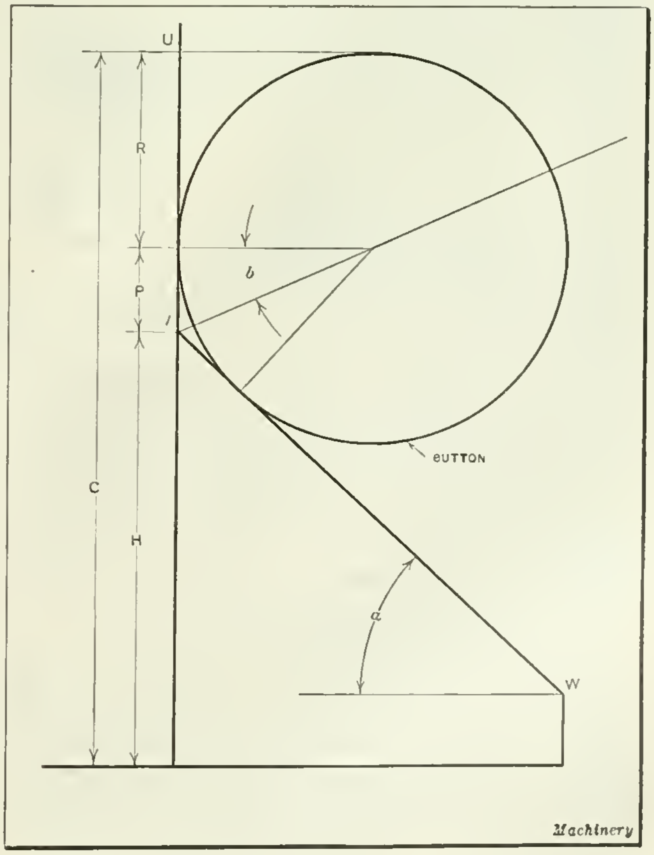


Fig. 2. Diagram showing Method of determining Height H

Now considering the case illustrated in Fig. 2, we have,

$$b = 90 \text{ degrees} - \frac{180 \text{ degrees} - (90 \text{ degrees} - a)}{2}$$

$$= \frac{90 \text{ degrees} - a}{2}$$

Now

$$P = R \tan b \text{ and } C = R + P + H = R + R \tan b + H$$

Then

$$H = C - R \tan b - R = C - R (\tan b + 1)$$

Flint, Mich. W. G. Holmes

BOX TURNING TOOL EQUIPPED WITH A CROSS-SLIDE

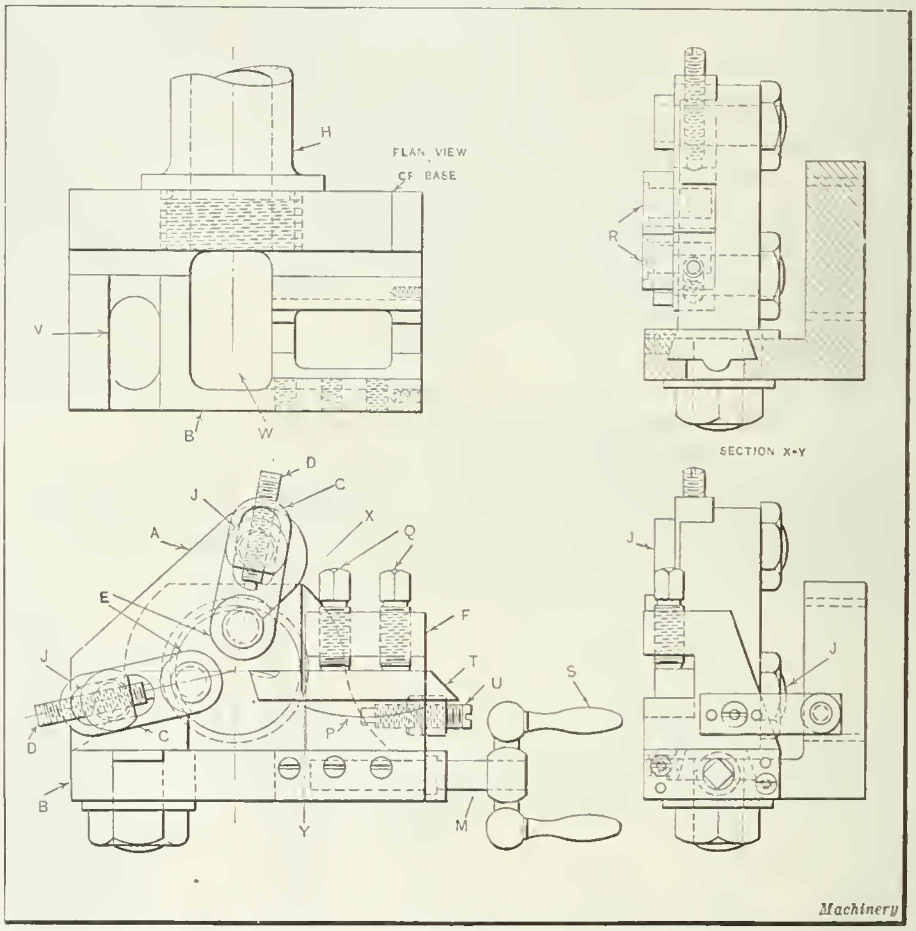
The tool here illustrated was designed to eliminate some of the difficulties experienced in using box-tools for screw machine work. In this tool, hardened and ground rolls mounted in hardened and ground bushings are substituted for the usual V-rest. Set-screws are provided for making fine adjustments of both the tool and the work-supporting rolls. The base *B* is tapped to take the shank *H*, which is made to fit the ordinary type of hand or automatic screw machine. The shank is made hollow to permit the work to pass through it when turning operations on long pieces are performed. The bracket *A* is grooved so that roller brackets *C* may slide in it. Adjustment of the rollers *E* is obtained by means of screws *D*.

The clamping screws *J* are provided for holding the rolls in position. The pins *R* are made a tight fit in brackets *C*. The toolpost *F* slides in a dovetailed slot in the base, and is adjusted by means of screw *M*. The handle *S* is made a loose fit on the screw, so that it can be removed when not in use. The toolpost and adjusting screw are assembled and operated in much the same manner as the cross-slide of an engine lathe. A rocker *P* is provided on the toolpost, which allows the point of the tool to be set above or below the center, depending upon the work being turned.

The clamping screws *Q* are provided for holding the cutting tool *T*. A positive stop on the side of the toolpost allows the tool to be returned to its original cutting position after being withdrawn. The positive stop shoulder on the base is arranged to make contact with an adjusting screw *U*. The feed-screw *M* allows the tool to be adjusted after it is clamped in position in the holder. This feature saves time in setting up the machine, since it eliminates the necessity for hammering the cutting tool into position, which is the method frequently employed in setting a box-tool.

The screw that holds the body bracket *A* passes through an elongated slot *V* in the base, thus permitting the rolls to be set either ahead or in back of the cutting tool. The usual chip opening *W* is provided in the base beneath the cutting tool. The assembled tool takes up about the same amount of space as the usual type of box turning tool, so that no additional clearance is required when it is employed. The tool shown has a capacity ranging from 5/32 to 1 inch.

Turtle Creek, Pa. J. H. Davis and Joseph Demmer



Box Turning Tool which is equipped with a Cross-slide

ALIGNING A PUNCH WITH A DIE

In making dies, a method known as "staking" is sometimes employed to change the position of the punch slightly in the punch-holder so that it will be in accurate alignment with the die. The "staking" operation is often accomplished by making prick-punch marks in the punch-holder close to one side of the punch. The compressing of the metal in this manner forces the punch over a little. When the shape of a die is changed slightly by the hardening process, the punches can often be "staked" over so that they will be brought into alignment again. It is difficult to align punches properly by this method when they are spaced close together. It has been found, however, that punches that have been aligned by "staking" often give trouble, so this method must be regarded as a makeshift and should not be commended except in unusual cases.

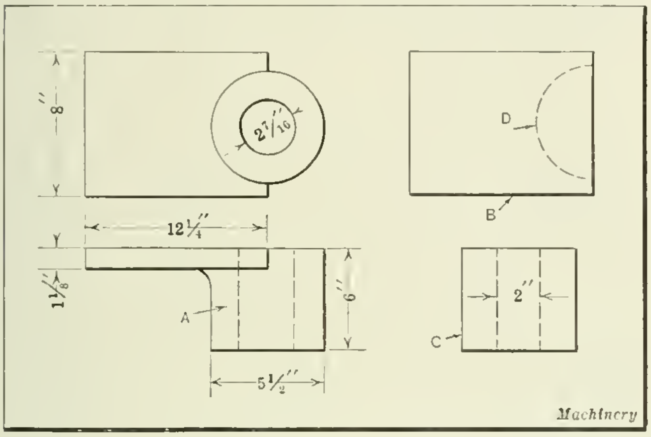
A better method of obtaining accurate alignment of the punches is to harden and grind the dies before making the punch-holder. In this case, the finished die is fastened to the unbored punch-holder by means of accurately fitted temporary dowel-pins. The punch-holder with the die attached to it is then clamped to the faceplate of the lathe. After the hole in the die has been aligned with the spindle of the lathe by the use of an indicator, the die is removed and the hole bored in the punch-holder. The same procedure is followed until the holes for all the punches have been bored.

For irregular shaped punches, it is customary to shave the punch into the die. With this method the die is hardened and ground, and the punch machined to within 0.010 inch of the finished size. The soft punch is then forced into the die to a depth of about 1/64 inch by means of a screw press, after which the punch is filed to within a few thousandths of an inch of the outline produced by the die. This shaving and filing process is repeated until the proper fit has been obtained. Elam Whitney

Shop and Drafting-room Kinks

REPLACING A BROKEN BEARING

Quick thinking and resourcefulness on the part of the foreman machinist in a certain shop were evidenced recently in the promptness with which a broken bearing was replaced and the machine put back in operation. The improvised bearing, as evolved by the foreman, is shown at *A* in the accompanying illustration. While the outside dimensions of the repair bearing are different from those of the cast-iron bearing that it replaced, it served its purpose equally well and made it possible to resume production with little delay.



Repair Bearing and the Pieces from which it was made

To make the repair bearing, the foreman used a piece of machine steel *B*, 1 1/8 inches thick by 8 inches wide by 12 1/4 inches long, and a cast-steel gear blank *C*, which had been bored and turned ready for cutting the teeth. These pieces were taken to the welding department where a section was cut out from the piece *B* (as indicated by the dotted lines *D*) with a cutting torch. The pieces *B* and *C* were then assembled on a flat plate and welded together to form a bearing, as shown by the view at *A*. After the welding operation, the hole in the hub was bored out to a diameter of 2 7/16 inches. After clamping holes had been drilled, the bearing was ready to be assembled in the machine.

Kenosha, Wis. M. E. Dugoan

BENDING TUBING

One of the oldest methods of preventing metal tubing from assuming an oval or flattened shape while it is being bent is to fill the tube completely with rosin or lead. The rosin or lead can be readily melted and allowed to run out after the bend has been completed. A second method, not so well known, is to fill the tube with a snugly fitting coil spring. After the tube is bent, the spring can be readily removed in the following manner:

One end of the spring is fastened to a lathe spindle so that it can be rotated in a direction which will cause it to be wound to a smaller outside diameter. This winding operation will reduce the size of the outside diameter of the spring so that it can be removed from the tubing. The proper size and temper of wire may be determined by experiment. The spring should be well lubricated.

There have been a number of mechanical devices described in Machinery for bending tubing by means of a grooved roller which travels around the periphery of a form plate of the required diameter. The roller is mounted on an arm which is pivoted in the center of the form plate. The groove in the form plate and also in the roller is of a half circular shape so that the two members will completely enclose the tubing at the bending point. The writer has had greater success with this type of bending device by employing a grooved forming block of suitable length in place of the grooved roller. S. N. Bacon

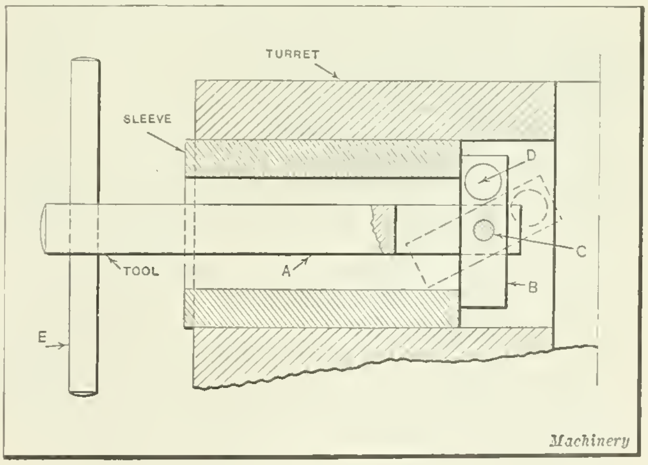
DRILLING DEEP HOLES WITH SMALL DRILLS

The writer recently had to drill a large number of holes 1/8 inch in diameter to a depth of 6 inches. Considerable trouble was experienced due to drill breakage, which usually occurred when the drill had reached about one-third the required depth. As an experiment, the drill was sharpened slightly off center so that one lip was longer than the other. This made the hole slightly larger than the diameter of the drill, thus providing sufficient clearance to prevent the binding or gripping of the drill in the hole. This method might also be used in some cases to prevent center drills from breaking. Elam Whitney

TOOL FOR REMOVING SLEEVES FROM LATHE TURRET

In a certain shop considerable trouble was experienced at times in removing plain sleeves, reducing bushings, etc., from the holes in the lathe turret. Hook-pointed tools and screwdrivers were brought into service for the purpose of prying out the pieces, but such tools did not prove very satisfactory, mainly because the pull was exerted on one side of the sleeve.

The bushing removing tool shown in the accompanying illustration was finally made up. As this tool proved very satisfactory, it may be of interest to others who experience trouble in removing small bushings from the tool holes in lathe turrets. The end piece *B* swivels loosely on pin *C* in a slot cut in body *A*. The length of piece *B* is slightly less than the diameter of the bushing hole in the turret. A hole *D* drilled in one end of *B* causes this part to be unbalanced, so that it will normally assume an upright position in the end of the tool when the handle *E* is held in the vertical position. The dotted lines show the position of part *B* while it is being inserted in the bushing.



Tool for removing Sleeves or Bushings

Rosemount, Montreal, Canada Harry Moore

Questions and Answers

SCREENS FOR SAND-BLAST ABRASIVES

E. C. A.—In connection with the screening of sand for sand-blasting apparatus, what does a No. 10 mesh signify? What are the number of meshes per inch, and how is the sand generally graded?

A.—In reference to screens for sand-blast abrasives, the number of the mesh gives the number of openings to the linear inch. For example, No. 10 mesh means that there are ten openings or meshes to the inch, or one hundred openings to the square inch. A No. 8 mesh would have sixty-four openings to the square inch, etc.

The Pangborn Corporation informs us that there seems to be no standard of usage in the grading of sand for sand-blast apparatus, but taking the ocean sands largely used in the eastern states, they would be graded about as follows:

Sand No.	Passes Screen	Remains on Screen
1	20 mesh	40 mesh
2	14 mesh	20 mesh
3	8 mesh	14 mesh
4	5 mesh	8 mesh

The weight of the wire used for the screens is governed by the weight and character of the material to be screened, so that the size or gage of the wire often varies for the same number of screen, and this, in turn, somewhat determines the size of the openings or meshes. The nature of the sand-blast apparatus is such that precise grading is not necessary, and therefore a variation in the weight of the wire is not of great importance, so that individual requirements at the screening plant in this respect may be met without difficulty. For material that requires accurate grading, the size of the opening or space of the mesh would have to be more carefully considered and determined. In this connection catalogue No. 40 of the W. S. Tylor Co., of Cleveland, Ohio, will prove of interest and value, as a general reference.

MEANING OF "THREADS PER INCH" AS APPLIED TO MULTIPLE SCREWS

R. M. G.—What is the correct meaning of the term "number of threads per inch" as applied to a worm? This term has been used in our plant to mean the number of threads which would be cut in each inch along a longitudinal section of the worm; that is, a worm of 1/3 inch pitch would have three threads per inch, irrespective of whether it was a single-, double-, or quadruple-threaded worm. Is this correct, or should the meaning of the term be the same as when applied to a screw, a double-threaded worm of 1/3 inch pitch having 1½ threads per inch, a quadruple-threaded worm of 1/3 inch pitch having ¾ of a thread per inch, etc.?

A.—It is unfortunate that certain expressions, such as the one referred to, have never been standardized. We believe that for all multiple threads, it is the general practice to give that number which indicates the number of threads per inch corresponding to the lead instead of the number corresponding to the pitch. Perhaps confusion would be avoided if the number of threads per inch were not mentioned in connection with multiple threads, the lead being given instead.

One method of specifying, say, a double-thread screw having three threads per inch is as follows: "Three threads per inch, double." This means that the screw has a lead of one-third inch and a pitch of one-sixth inch, but the very fact that the expression requires explanation indicates that it is not very good. A better way of designating this thread is as follows: "One-third inch lead, one-sixth inch pitch, double thread." Still another expression that might be used indicates just what is meant, by reference to the lathe gearing. Thus the thread previously mentioned could be designated as follows: "Double thread, lathe geared for three threads per inch."

CAN A DEFECTIVE PATENT BE REISSUED?

C. N. T.—I have a patent that has fourteen of the seventeen years for which it was granted yet to run. The specification does not properly describe the invention nor does the drawing sufficiently illustrate it. I have been advised that a reissue of the patent to correct these defects can in all probability be obtained. What is meant by a "reissue," and will it grant me protection for seventeen years from the time it is allowed?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

If a patent is inoperative or invalid by reason of a defective or insufficient specification or drawing, or by reason of the patentee claiming as his own invention more than he had a right to claim as new, and if the error arose through inadvertence, accident, or mistake, and without fraudulent or deceptive intention, the original patent may be surrendered, and new specifications and drawings submitted that correctly describe the invention, together with the government fee required. Then, if on examination the application is found to be in proper form, a new patent will be issued, but only for the unexpired part of the seventeen years for which the patent was originally granted. The life of a patent can be extended only by a special act of Congress, and cases in which this has been done are rare. No new matter may be introduced in a reissue application, nor can the claims be broadened beyond their original scope. Failure of the inventor to claim in his original application all to which he might have been entitled is held in fact to be an abandonment thereof, and its dedication to the public.

WEIGHT OF FLYWHEEL

A. J.—Owing to lack of space, I must replace a 17½-inch flywheel on a small gasoline engine by a 12-inch flywheel. How much does the weight of the rim of the smaller flywheel need to be increased in order to have the same effect as the large flywheel?

A.—According to the formula given in MACHINERY'S HANDBOOK, page 288, the total energy stored in a flywheel is

$$E = \frac{Wv^2}{64.32}$$

in which

E = total energy of flywheel, in foot-pounds;

W = weight of flywheel rim, in pounds; and

v = velocity at mean radius of flywheel rim, in feet per second.

As the energy stored in both flywheels is to be the same, and as the velocity at the mean radius of the flywheel rim is proportionate to the mean diameters of the flywheels, the problem can be solved by the following calculation (assuming, for the sake of simplicity that the diameters given in the problem are mean rim diameters):

$$W_l \times 17.5^2 = W_s \times 12^2$$

$$W_s = \frac{W_l \times 17.5^2}{12^2} = 2.13W_l$$

in which

W_l = weight of large flywheel rim, in pounds; and

W_s = weight of small flywheel rim, in pounds.

Expressed in words, the rim of the small flywheel should weigh approximately 2.13 times the weight of the rim of the larger flywheel.

Drawing a Deep Wide-flanged Shell

By FRANK LUX

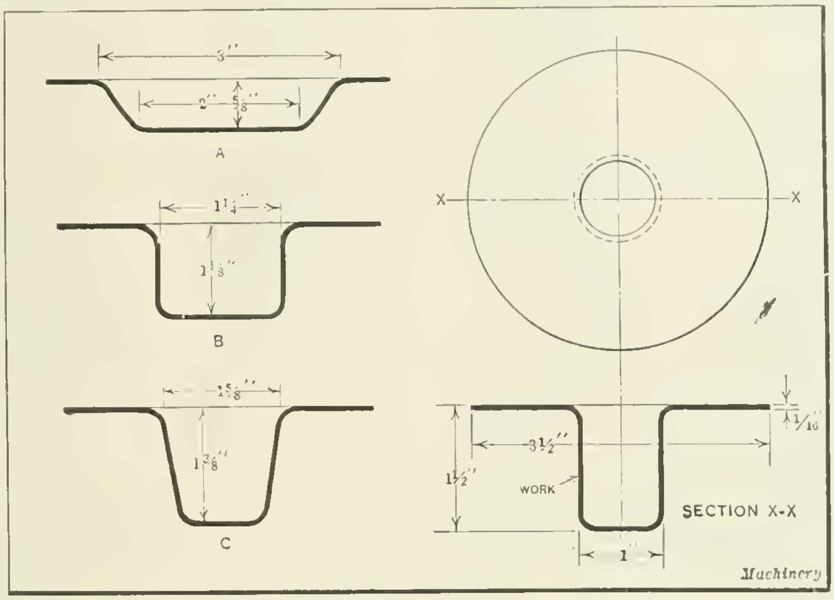


Fig. 1. Successive Steps in drawing a Wide-flanged Shell

THE description of the dies here illustrated was prompted by a query submitted to the How and Why Department of MACHINERY, some time ago. Dies for producing deep drawn work having a flange may be designed along two different lines. The shape of the work, of course, determines the type of die to be used. If the flange is not too large, the work can be blanked to size and then drawn, starting with a push-through die for the first drawing operation, which produces a cup. The succeeding drawing operations reduce the diameter of the work and gradually form the flange. The dies shown in June, 1920, MACHINERY, on page 964 are typical of this design.

A somewhat different line of dies must be used for work having a large flange like that described in the query referred to (see the right-hand view, Fig. 1) in order to prevent wrinkling when the flange is being formed. In laying out the dies for this piece of work, the first step is to determine the amount of draw for each operation and the number of operations required.

The approximate size of the blank is first determined, and as the final size of the work is a known factor it is then possible to lay out the blank size and the finished work on paper. The various drawing operations can next be planned and the shape of the work after each operation sketched in accordingly. This naturally requires knowledge of drawing practice based on experience. Each piece of work to be drawn requires a separate lay-out and the method of procedure is naturally based on the equipment available. For instance, it is necessary to know whether a single- or double-action press is to be used and what the capacity of the press is in tons. Definite knowledge of the material to be drawn is perhaps the most important factor, because the amount of drawing to be accomplished in each operation is governed by the nature of the material. Some materials draw very readily, while others have poor drawing qualities.

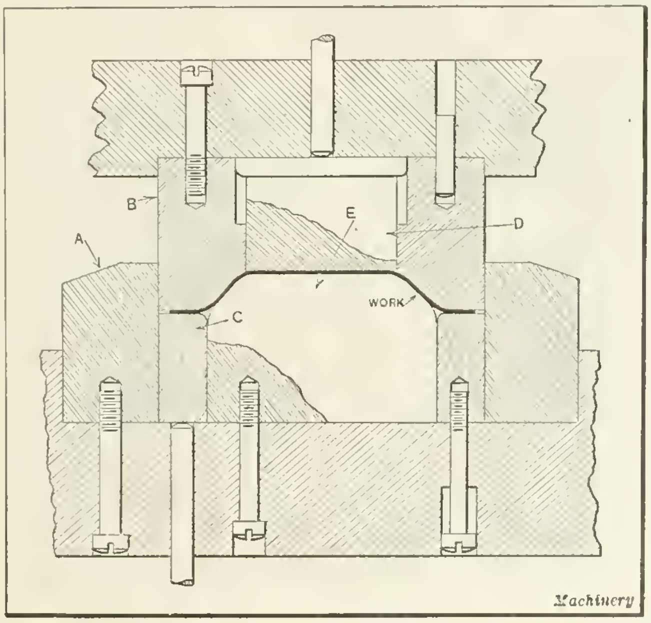


Fig. 2. Blanking and Drawing Die for First Operation

The lay-outs of the dies required for drawing the piece of work shown in Fig. 1 are illustrated in Figs. 2 to 5. It must be remembered that these illustrations are not intended to be actual working drawings but merely to show the best general design dictated by experience and modern practice. They are, however, similar to dies designed and successfully employed by the writer.

The sequence of the drawing operations as they would be planned by the writer for this work is shown in Fig. 1. The dimensions of the finished piece of work are shown in the sectional view in the lower right-hand corner, while the shape of the work after each of the first three drawing operations is shown at *A*, *B*, and *C*, respectively. The dimensions given show the amount of draw in each operation. The fourth drawing operation brings the shell to the desired diameter and length. The size of the blank is determined by the use of tables given on page 980 in MACHINERY'S HANDBOOK. A certain amount of stock is allowed for a final trimming operation, as it is apparent that on deep drawn work the outside diameter of the flange would not be uniform but would have an irregular edge that requires trimming.

The die for the blanking and first drawing operation is shown in Fig. 2. The die *A* and punch *B* blank the work to the correct diameter on the downward stroke of the press and form it to the shape shown by the heavy black line. The work is held securely against the punch by a pressure-ring *C* while the forming is being done, thus preventing wrinkling. Pressure is also exerted on the stock by a pressure-plate *D* acting against block *E*. As the punch is withdrawn, the work is ejected by the pressure-ring *C*, should it have a tendency to stick on the forming block *E*. When it sticks to punch *B* it is stripped by the pressure-plate *D*. If it were desired to blank the work to size in a previous operation, the die would be of similar construction except that the work would then be located in a nest on the die-block *A*.

The die for the second operation, shown in Fig. 3, differs somewhat in principle from the one just described. The work *A* is located on a pressure-ring *B*, which is a sliding fit on the forming punch *C*. Spring pressure is applied to ring *B* through the pressure-pins *D*, which are connected with heavy coil springs or with a rubber cushion under the bolster plate. The forming die *E* is located in a punch-holder *F*, and as the ram of the press is brought down die *E* grips the work against the pressure-ring which moves downward under pressure and reduces the diameter of the work as indicated by the dotted lines *G*. It will be seen that the flange is considerably enlarged by this operation.

The die used for the next drawing operation is shown in Fig. 4. This differs from the dies previously described in that its action is more that of sizing than drawing. The work *A* is located on the top of die *B*. The punch *C* fits down into the work and forces it into the hole in the die, stretching out the drawn part, as shown by the dotted lines at *D*. As the punch reaches the end of its stroke the flange is flattened out between die *B* and plate *E*, which is located in punch-holder *F*.

The final drawing operation is simple, and is performed by a die of the same type as that shown in Fig. 4. After the work has been completely drawn, the flange is trimmed to the required diameter by the die shown in Fig. 5. The work *A* is located in the block *B*, which serves as a punch for trimming the flange. The punch-holder is provided with a die *C* which trims the work to size on the downward stroke of the press. A pressure-plate *D* holds the work firmly while the trimming is being accomplished. On the upward stroke, stripper *E* strips the flash *F* from the punch.

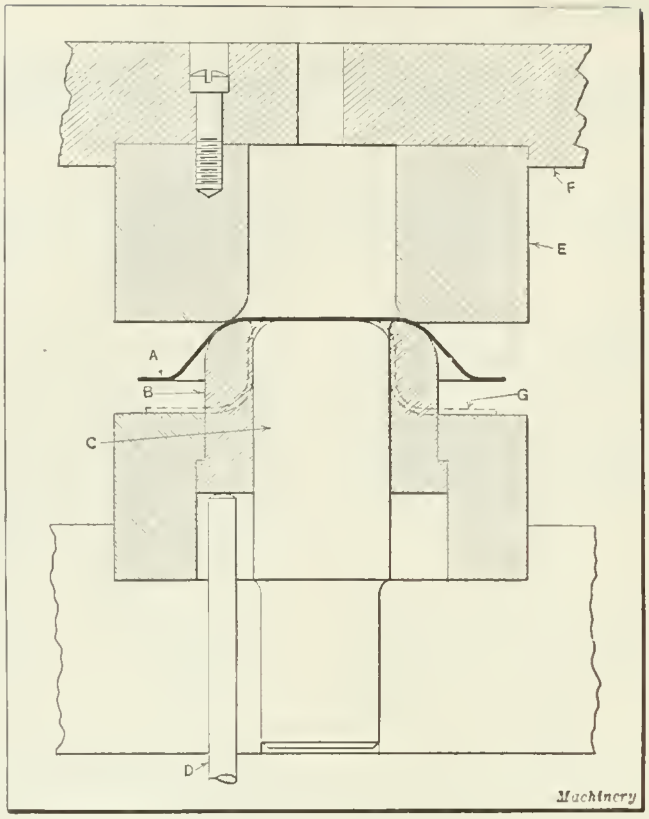


Fig. 3. Drawing Die for Second Operation

THE MACHINE TOOL INDUSTRY IN 1921

The Department of Commerce announces that 349 shops reported to the Bureau of Census that they produced machine tools to a total value of $5000 or more in 1921. Of these shops 98 were located in Ohio, 37 in Massachusetts, 29 in Connecticut, 28 in New York, 25 in Michigan, 24 in Pennsylvania, 23 in Illinois, 17 in Wisconsin, 15 in Indiana, 12 in New Jersey, 12 in Rhode Island, 7 in Missouri, 7 in Vermont, 6 in Kentucky, 3 in New Hampshire, 2 in Minnesota, and 1 each in California, Delaware, Iowa, and Maryland. In 1919 there were 385 shops reporting as builders of machine tools. The smaller number in 1921 is explained by the fact that a number of plants reporting in 1919 had gone out of the machine tool business in 1921.

Considerable fluctuations are noted in the number of wage earners employed in different months during the year. In January, 1921, the month of maximum employment, there were 36,552 wage earners; and in November, the month of minimum employment, only 14,773. The average number employed in 1921 was 21,321 as compared with 53,111 in 1919. The wage payments decreased from 66,000,000 in 1919 to approximately 25,000,000 in 1921. The salaried employes decreased from 8519 in 1919 to 4550 in 1921, and the amount of salaries from about 18,000,000 to 12,900,000.

* * *

A committee composed of members of the four founder engineering societies—the civil, mechanical, electrical, and mining engineers—is cooperating with the national museum of the Smithsonian Institution at Washington in formulating a plan for a National Museum of Engineering and Industry similar to the foreign museums of this type in London, Paris, and Munich.

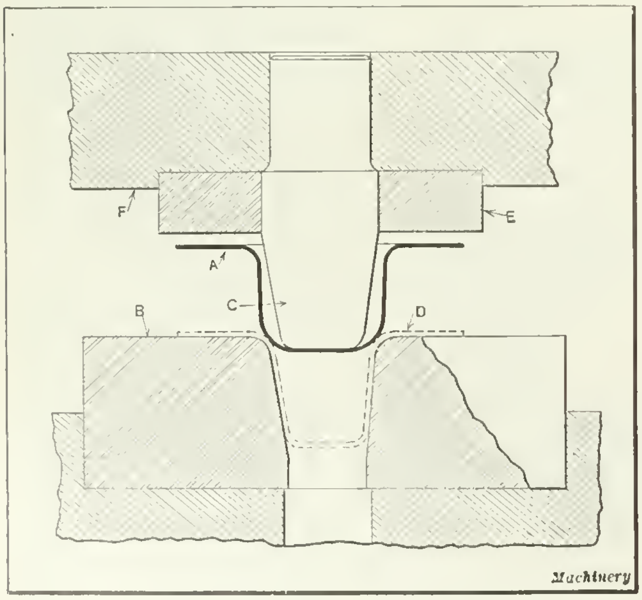


Fig. 4. Die for Fourth Operation on Deep-drawn Shell

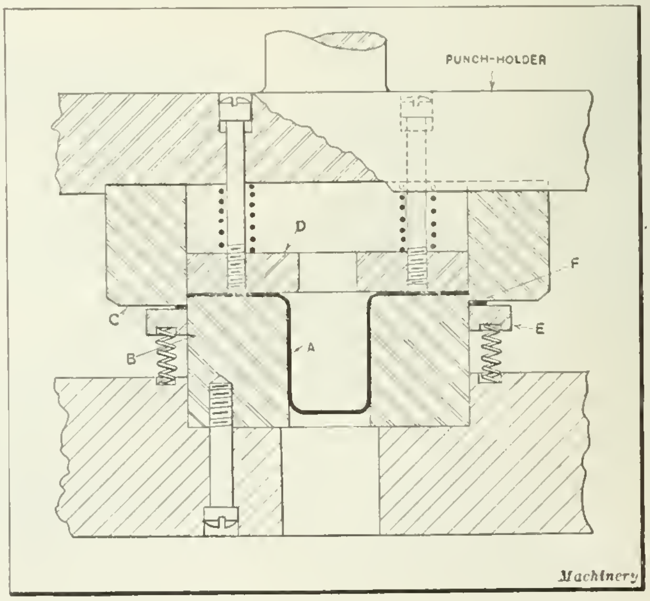


Fig. 5. Die for trimming Flange of Deep-drawn Shell

INDUSTRIAL CONDITIONS IN GERMANY

From MACHINERY'S Special Correspondent

Berlin, January 6, 1923

Owing to the unsettled conditions, it is difficult to present an accurate view of industrial conditions, because they change from day to day. The present letter records conditions as they were at the end of the past year.

The machine industry had a relatively good year in 1922 in the locomotive, machine tool, and agricultural machinery fields. In other machine-building fields, however, the exports scarcely reached one-half the pre-war volume. From January to October the exports of machine tools amounted to approximately 56,850 tons, which averages about 70 per cent of the exports for the same period in 1913. The imports of machine tools during January to October, 1922, amounted to about 1400 tons. The prices of machine tools, as expressed in marks, are constantly rising, but it is practically impossible to give any comparison with prices in other countries, as the rate of exchange varies from day to day.

One of the leading German machine tool builders, whose annual report may be considered typical for many machine tool companies, states that there are abundant orders on hand—enough to keep the company's plant occupied until next summer. The domestic orders, however, are rapidly diminishing, as domestic buyers are no longer able to pay the prices as now expressed in marks. This constant change in the value of the mark causes great difficulty in the manufacturing field, because the expenditures each month, as expressed in marks, always exceed the receipts, the latter being based on a value of the mark no longer in existence. Many manufacturers for that reason are heavily indebted to the banks. As it is practically impossible to foresee the losses due to sudden fluctuations in the value of the mark, German manufacturers are looking toward the future with great apprehension.

Wages and Labor Conditions

It is of little value to mention wages, in marks, because they vary constantly and there is no standard of comparison. The buying power of wages, however, may be indicated by a comparison. In November, wages of skilled and unskilled labor in the metal-working industries, in marks, were from 255 to 386 times as large as in 1914, but the cost of living had increased 580 times. A skilled man now obtains only 7 per cent more than an unskilled man, according to the fixed union rates. This will greatly endanger the future development of the industries, because many young men now refuse to learn a trade, their earning capacity being practically the same whether they are skilled or unskilled. Before the war, skilled men received about 40 per cent more than unskilled men.

The return on capital investment is even more out of proportion with pre-war figures than are wages. One of the large machine tool builders, now paying a dividend of 30 per cent on its pre-war capital, in reality pays only 0.05 per cent, because of the decreased purchasing power of the mark.

The general German labor union, in its annual report, states that it had a membership at the end of 1921 of 7,752,000, of whom 5,896,000 were men. In addition to this union, there are several smaller unions having a membership of approximately 1,250,000, so that in total about 9,000,000 workers are now organized in labor unions, which are said to be the actual rulers of Germany.

The efficiency of the workers, it is said, leaves much to be desired, and in some cases the rules limit the output and the efficiency of the machines employed, even in cases where an increased output would not involve greater effort.

Conditions in Different Industries

While the locomotive industry has been fairly well supplied with work during the past year, the prospects in this field are not very good. Sales to foreign customers are difficult on account of the unstable exchange rate. The shipbuilding industry is in difficulties due to sudden great increases in costs of materials. The bicycle industry is well employed, but the exports have recently been curtailed. The optical and precision instrument industries are well provided with work.

In all the large centers there is a great scarcity of coal and raw materials. The German state railways are buying foreign coal for the coming year's supply, and the iron and steel industry is particularly handicapped by the lack of fuel. Of the total amount of iron ore consumed in Germany, 77 per cent is imported.

The exports of locomotives amounted to 92,700 tons during January to October; and of agricultural machinery, 27,800 tons. The exports of locomotives were more than double the exports during a similar period in 1913, while the exports of agricultural machines were about 80 per cent of the exports in 1913.

Russian Trade

A great deal has been written about the trade between Germany and Russia. The rebuilding of Russia's industrial life involves a big credit problem, which cannot be mastered by Germany alone. Business with the Soviet Government is now very much at a standstill, because of the difficulty of financing this work. Some of the large iron and steel concerns in Germany have secured industrial, mining, and agricultural concessions in Russia. The preparatory work on a general German-Russian commercial treaty is proceeding rapidly, and considerable benefits are expected from it. An Austrian-Russian company has been founded with a view to supplying Russia with manufactured goods, presumably in exchange for raw materials. At present, however, ideas are abundant, while real achievements are lacking.

* * *

ANNUAL MEETING OF AUTOMOTIVE ENGINEERS

During the annual meeting of the Automotive Engineers held in New York City, January 9 to 12, papers were presented covering many phases of automotive engineering. At the Standards Committee meeting many important reports were presented with regard to which action for adoption, revision, or rejection was taken. These reports had previously been published in the journal of the society, so that the members attending the meeting were able to offer carefully thought out suggestions or criticisms. An aeronautic session was held at which several well-known authorities on commercial aircraft presented brief statements on certain fundamental design problems, the solution of which is considered necessary before commercial aviation can progress further.

Professor G. A. Young presented a paper on "Practical Methods of Securing High Compression without Detonation." This paper brought out some interesting results of research work conducted in the laboratory of Purdue University. Thomas Midgley, Jr., read a paper on "Fundamental Laws Governing Detonation," and Stanwood W. Sparrow and S. M. Lee of the Bureau of Standards presented a paper on "Means of Measuring Detonation and Comparing Fuels for Use in High-compression Engines." Robert E. Wilson presented a paper on "The Function of Oil and Fuel in Crankcase Dilution," and C. S. Kegerreis read a paper on "Carburetion of Gasoline and Kerosene."

One entire session was devoted to reports and discussions of the progress made in the fuel research project that was formulated by the Research Department of the society. Two sessions dealing with air-cooled engines were also held, and the body engineering session offered papers of interest to engineers engaged in this phase of automobile building. Copies of the papers presented may be obtained from the Society of Automotive Engineers, 29 W. 39th St., New York City.

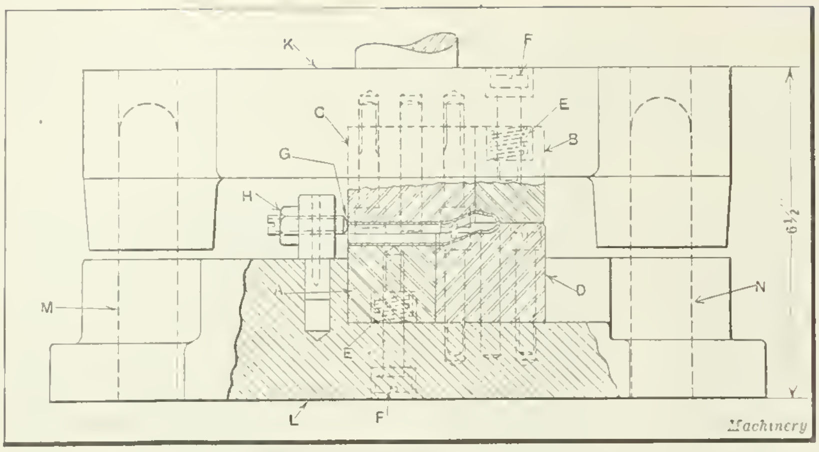


Fig. 1. Die for producing Offset indicated at C, Fig. 2

BENDING OVERFLOW PIPE FOR AUTOMOBILE RADIATOR

By J. A. HONEGGER

The ⅜-inch radiator overflow pipe shown in Fig. 2 is bent to the shape indicated in three operations. The bending equipment consists of the fixture shown in Fig. 4, and the bending dies shown in Figs. 1 and 5. The fixture shown in Fig. 4 forms the 3⅛-inch radius bend at *A*, Fig. 2. The die shown in Fig. 5 produces the ¾-inch radius bend indicated at *B*, Fig. 2, while the die shown in Fig. 1 produces the 3/16-inch offset indicated at *C*, Fig. 2. For the first operation the straight tubing or pipe is passed between rollers *A* and *B*, Fig. 4, and under the clamp *C*. Springs, located in counterbored holes in the clamp, serve to hold the clamping jaws open when nut *G* is loosened. The tubing is pushed through the opening in the clamp until it rests against stop *E*, which is properly adjusted by nut *F*.

When the tubing or pipe is in place, the clamp is tightened by turning nut *G*. By operating lever *H*, roller *B* is caused to rotate about the periphery of stationary roller *A* and thus bend the pipe to the required radius. Lever *H* is provided with a lug *K* which slides or rides on track *L*. This construction gives the lever adequate support and keeps the bending rolls in proper alignment. Stop *M* is adjusted to allow an over movement of lever *H*, as the pipe has a tendency to spring back after being bent. It will be noted that the roller *A* is prevented from turning by four fillister-head screws, one of which is shown at *N*. Stop *P* is adjusted to bring the hole or opening between rollers *A* and *B* into alignment with the hole in clamp *C* so that the work can be easily inserted between the two bending rolls.

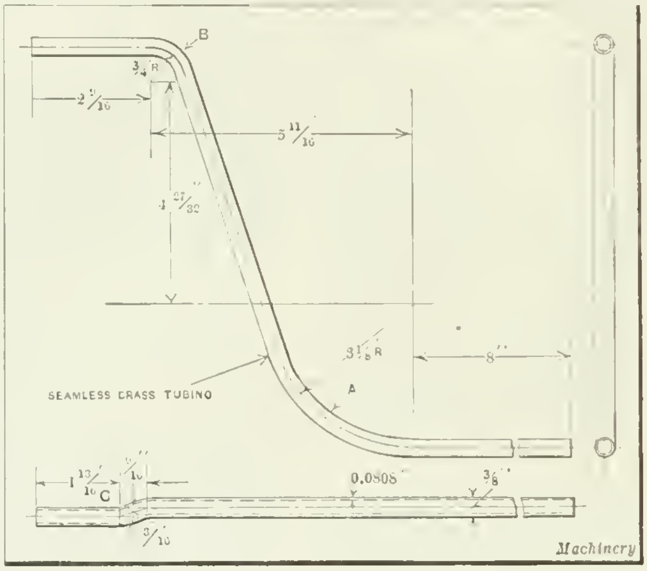


Fig. 2. Details of Overflow Pipe

After removing the work from the fixture shown in Fig. 4, it is placed in the die, Fig. 5, which forms the bend *B*, Fig. 2. The grooves formed in the spring block *A*, Fig. 5, fixed block *B*, and the outboard support *C*, and the stop *D* serve to locate the work. Normally the groove in spring block *A* is located ⅛ inch higher than the groove in block *B*.

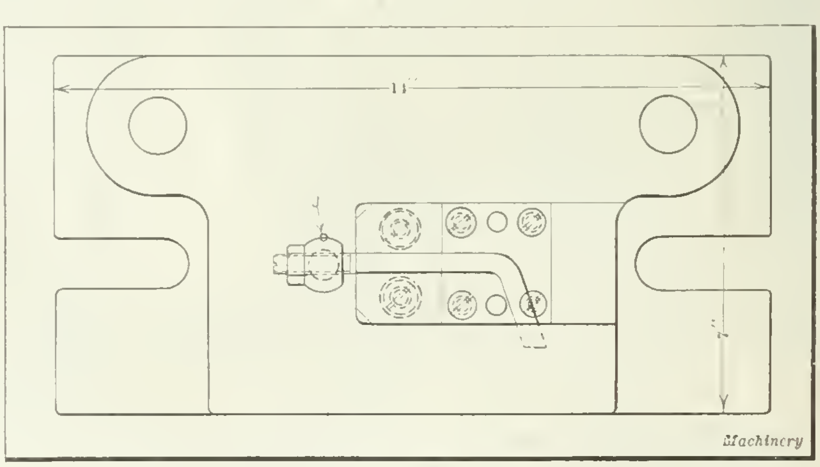


Fig. 3. Plan View of Die shown in Fig. 1

CORRESPONDENCE AND TRADE LITERATURE FOR MEXICO

The Mexican Chamber of Commerce of the United States, in one of its recent bulletins, emphasizes the necessity for writing all correspondence with Mexico in Spanish. All printed matter sent to Mexico for publicity purposes should also be in Spanish. It is true that the majority of the merchants understand English sufficiently to read the correspondence in this language, but they greatly prefer to deal with an American firm that uses the Spanish language. Mexican merchants are swamped with all kinds of circulars, advertisements, and literature from the United States, mostly in English. A large part of this mail goes directly into the waste basket, and, because of the volume of it, even a really interesting sales letter is given little attention, in view of the great mass of matter printed in English arriving in the same mail. Generally speaking, traveling agents or representatives are the most effective means of securing business in Mexico.

* * *

Two factors have particularly aided in increasing the present demand for iron and steel products. The continuation in the building boom this spring, forecast by the upward swing in the sale of fabricated structural steel, is one, and the heavy buying of rolling stock and other equipment by the railroads is another. It is expected that the railroads will spend $700,000,000 for various kinds of equipment and improvement in 1923. The average for the last ten years has been less than $500,000,000 a year. On December 31 there were unfilled orders for nearly 1600 locomotives, and additional orders for both locomotives and cars have been placed during the month of January and are likely to continue to be placed during the early part of the year. The activity in the locomotive and car shops is evidenced by orders for machine tools and shop equipment, as well as forgings and castings.

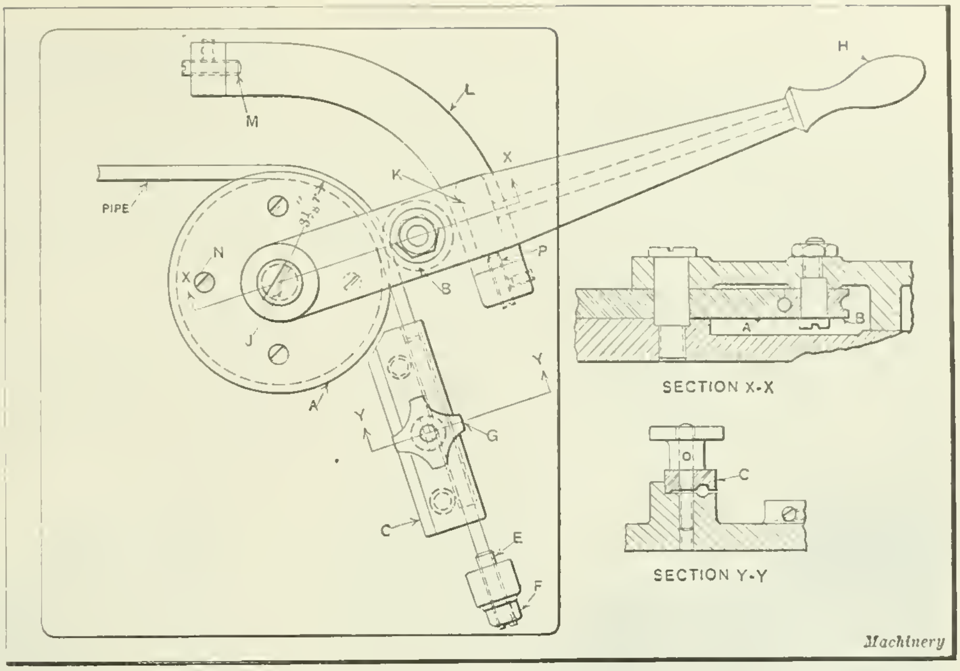


Fig. 4. Fixture for making Bend shown at A, Fig. 2

This position is maintained by the upward pressure exerted by springs *E* and the limiting action of screws *F*. Bracket *C*, besides acting as a support, also performs the function of a guide block, to prevent the bend at *B*, Fig. 2, from being bent to one side, or out of parallel with the bend at *A*.

Referring to Fig. 5, block *G* is provided with a groove similar to that in block *A*. As block or punch *G* descends, the groove closes over the tube in spring block *A* until the flat faces of both blocks *A* and *G* meet. Block *A* then recedes 1/8 inch into the die-shoe, acting against the pressure of springs *E*. This insures a positive grip on the tube before the bending commences. Further downward movement of the forming punch bends the tubing to the shape indicated. A slot is provided in the punch-holder at *H* to give sufficient clearance for the end of the tube. On the return stroke of the press, block *A* regains its normal position through the action of springs *E*. This block is guided in both its up and down movements by pin *J*. The punch and die are aligned by pins *K* and *L*.

The die employed for the final bending operation which forms the offset at *C*, Fig. 2, is shown in Fig. 1. Normally, spring blocks *A* and *B* are level with blocks *C* and *D*, this position being maintained by springs *E* and stop-screws *F*. The bend produced in the second operation is placed in the groove in blocks *A* and *D*, the end of the tube resting against stop *G*, which is adjusted by nut *H*. The stud which holds this stop is prevented from turning by the pin *J* shown in the plan view of the die, Fig. 3. On the downward stroke, punches *B* and *C* close over the tubing so that punch *B* rests on the upper face of block *D*. Continued downward movement causes punch *B* to recede into punch-holder *K*, while block *A* recedes into die-shoe *L*. This forces the tube to assume the form of the grooves in blocks *C* and *D*. The punch and die are aligned by pillars *M* and *N*.

* * *

Labor conditions throughout the country are improving. There is practically no unemployment at present except when due to purely local conditions; and in certain localities, especially in the steel districts, there is an acute scarcity of labor—especially of unskilled men. In the machine-building industries, there is a scarcity of skilled labor, and as the conditions in the industry improve, the shortage of machinists and toolmakers will be severely felt by manufacturers. For the first time in two years the United States employment service announces that there are more jobs registered with state and municipal agencies than there are workers. A year ago there were practically two workers registered for every job. A similar indication of increased industrial activity is reported by the employment department of the American Association of Engineers, which states that engineering employment improved month by month during the past year in the technical and engineering fields. On some railroads the shopmen's strike is unsettled, while in other cases the old employes have gone back to work.

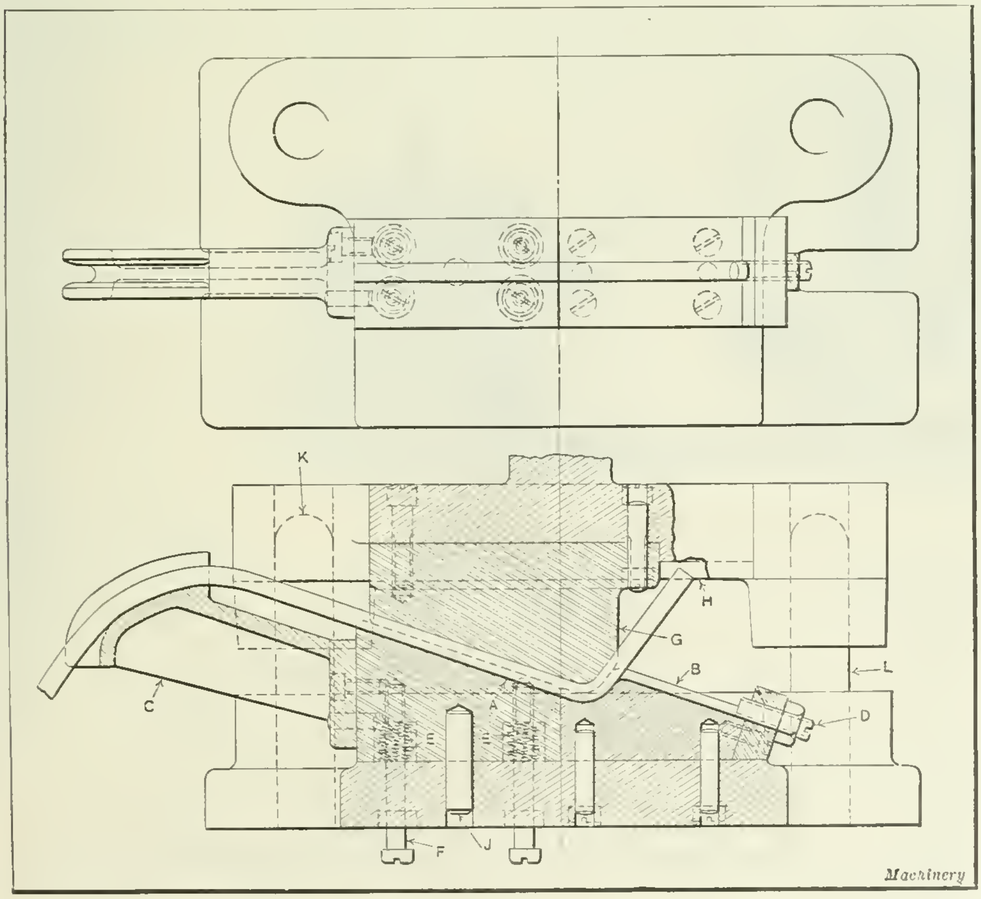


Fig. 5. Die for forming Bend B, Fig. 2

CHUCKING OVER-SIZE PISTONS

A number of interesting chucking devices are employed in the plant of the Houpert Machine Co., Long Island City, in machining over-size pistons. Although this company is prepared to manufacture pistons on a commercial basis by means of automatic machinery, the manufacturing is not carried beyond the semi-finished stage, the final finishing operations being performed on pistons taken from stock whenever a cylinder of any particular size or make is to be refitted. Some of the chucking devices used for this work are shown in the accompanying illustrations.

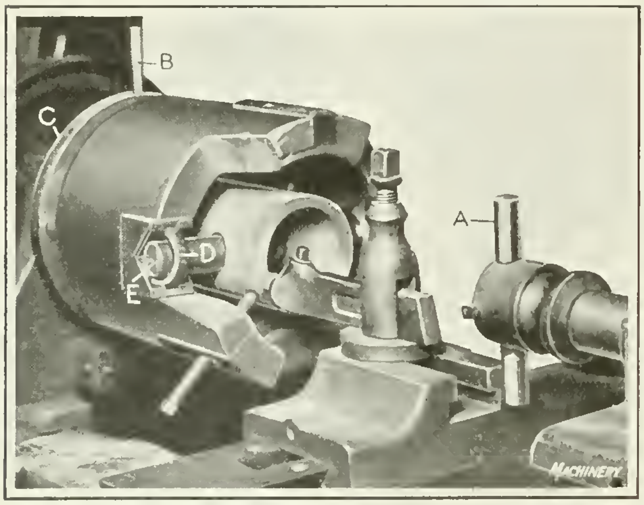


Fig. 1. Chuck for holding Semi-finished Pistons while refacing Ends

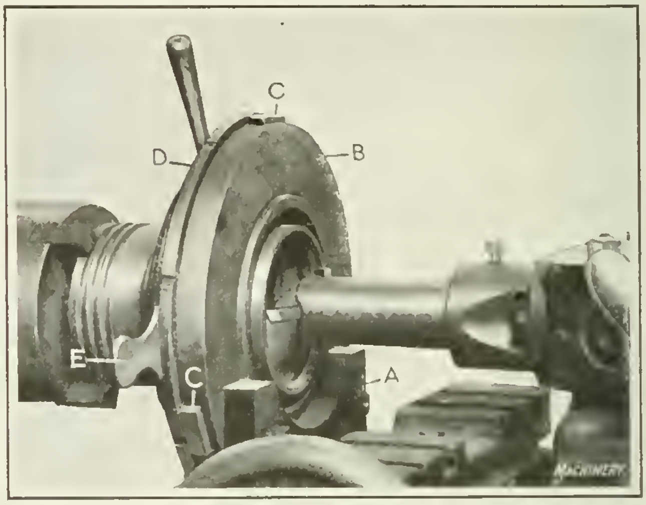


Fig. 2. Cam-operated Steadyrest for Use in machining Over-size Pistons

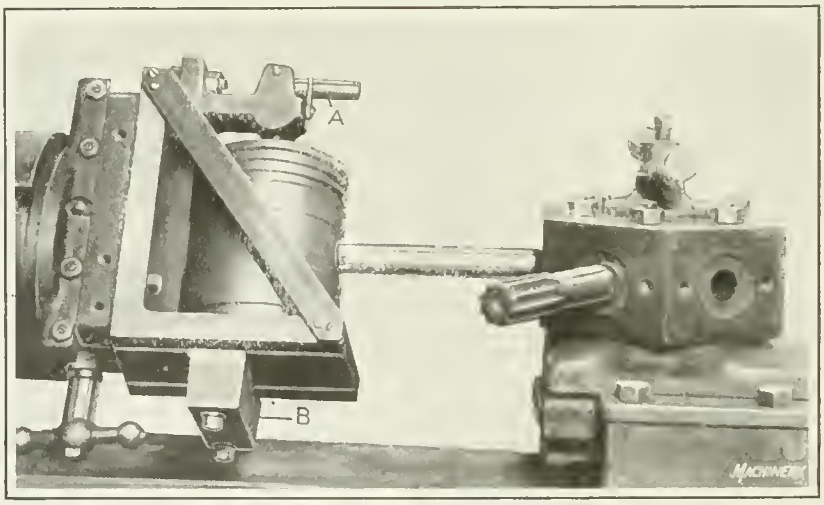


Fig. 3. Piston Fixture with Cross-slide Adjustment Feature

The semi-finished pistons with the piston-hole already machined are chucked in the manner illustrated in Fig. 1, for refacing the skirt end, as special requirements may demand. This pot chuck is shown attached to the spindle of a Reed lathe, and the means employed for holding the work assure that the end will be faced square with the piston-pin hole. The piston is placed loosely in the chuck, the three set-screws being loosened, and is held square by means of the squaring device carried in the tailstock of the lathe. This consists of a short slabbed bar *A* which is held vertically, as shown, and brought to bear against the end of the piston. The three set-screws are then brought up lightly against the periphery of the work to hold the location thus secured, and handle *B* is moved forward, rocking the collar *C* and advancing two eye-bolts, which are located diametrically opposite each other in the walls of the chuck. One of these eye-bolts is shown at *D*.

As soon as the bolts have advanced far enough, a special arbor *E* is passed through them and through the piston-pin hole, and the handle *B* is released, which permits springs located on the eye-bolts at the rear end to draw back and firmly hold the arbor in the V-blocks. This is the position shown in the illustration. The V-blocks have hardened steel faces, and the arbor has a special feature for tightening it within the piston-pin hole, consisting of a key, set into the arbor, which is tightened by a headless set-screw. The arbor is so placed that this key is in line with the V-blocks, so that tightening the arbor in place causes the key to bind in a horizontal plane within the hole. The tightening will not then have a tendency to destroy the setting previously obtained by means of the tailstock and radial set-screws. The springs that draw the eye-bolts back are sufficiently strong to hold the piston securely in its aligned position, which assures a positive location from which the end of the piston can be accurately faced parallel with the piston-pin hole.

Another piston chucking arrangement is illustrated in Fig. 2. Here a Warner & Swasey turret lathe is shown, on the ways of which a special cam-operated steadyrest is attached. In this case the steadyrest is used chiefly in touching up the ends of finished pistons which may not have passed inspection for squareness of end, or which may require some minor correction. The operation shown is that of refacing the skirt end of a finished piston. The work is held in an ordinary jaw chuck, and the steadyrest used to support the outer end and locate it squarely while the operations are being performed.

The steadyrest is attached to a heavy bridge iron *A* which is accurately fitted to the ways of the lathe. The body *B* of the steadyrest carries three radial jaws *C*, the inner ends of which are formed to fit the curvature of the piston so that the work may revolve freely while it is being held in perfect alignment. These jaws operate in three eccentric slots in the cam-plate *D*. The jaws may be quickly advanced against the work by means of the handle shown, in which position they are locked by a binder ring which is threaded on a shoulder of the body and operated by means of the finger-lever *E*.

A third piston chucking set-up is illustrated in Fig. 3. This device is somewhat similar in general construction to that in common use in automobile repair shops. It consists of an angle-plate fixture. The piston is seated on a locating plate of the proper diameter and is secured at the closed end by a cam-operated clamp. The cam is tightened by the small lever *A*, which brings the clamp against the center of the closed end, where it is held by the link shown engaging the handle. A ballast *B* is attached to the base of the angle-plate as shown. This fixture is used extensively for reboring and finish-reaming piston-pin holes, but is not used in the regular manufacturing processes; in the latter case, these operations are performed by the use of an automatic machine.

The centering feature of this fixture is simple, consisting of the cross-slide of a compound rest, which permits the work to be accurately located by means of the cross-feed operating handle. The slide is provided with a gib that is adjusted tightly against the movable member of the slide, so that after the center adjustment has been obtained there is no danger of the work changing position during the operation.

* * *

DIE FOR SPECIAL WASHER

By C. E. STEVENS

The original method of producing the washer shown completed at *A*, Fig. 1, was to pierce and blank the piece in one operation and form or bend the ears in a second operation. The cost of the forming operation was many times that of the piercing and blanking one, because, in forming, it was necessary for the operator to handle each washer separately. In order to eliminate the second operation the die shown in Fig. 2 was designed. This die produces one complete washer at each stroke of the press. The die-block *A* is of tool steel, and is fastened to the cast-iron die-shoe *B* by three ¼-inch fillister-head screws, four ¼-inch hexagonal-head cap-screws and two dowel-pins. The fillister-head screws are screwed into die-block *A* from the bottom, while the cap-screws enter the castings from the top side. The cap-screws also serve to hold the stripper *C* in place. Spacers or strips 1/16-inch thick are placed between the die-block and the stripper to give the clearance required to permit the stock to be fed through the dies. One of the spacer strips *D* extends beyond the end of the stripper plate, and acts as a guide for the stock when entering the die.

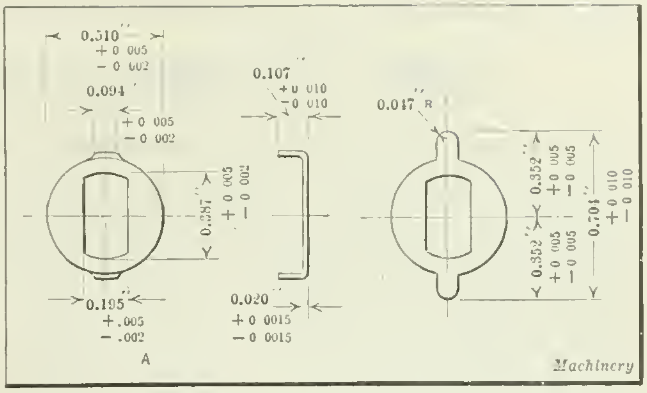


Fig. 1. Details of Special Washer

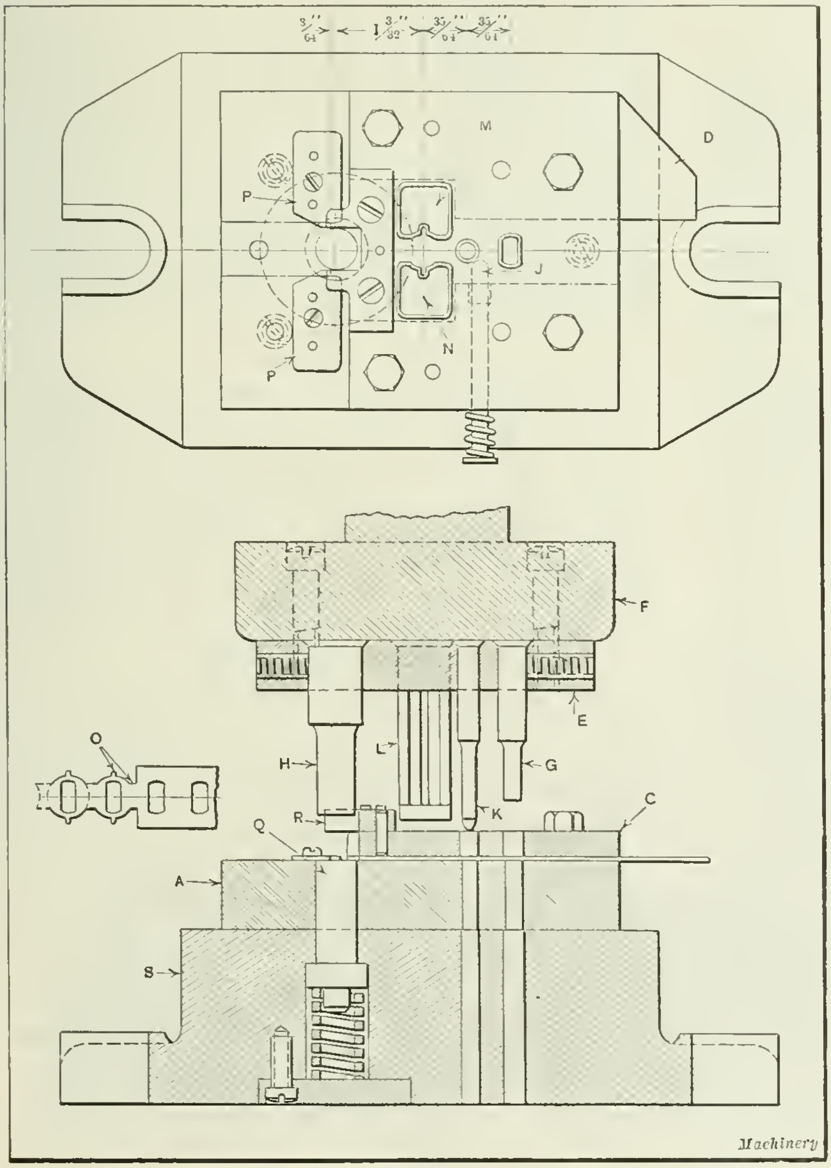


Fig. 2. Die for producing Washer shown in Fig. 1 at One Stroke of the Press

The punches are set in a machine-steel part *E* and are riveted over at the top of this member. The part *E* is mounted on a cast-iron punch-holder *F*, and held in place by four 5/16-inch fillister-head screws and two dowels. The punch *G* and the forming punch *H* are kept from turning by small headless set-screws. The stock is fed into the die against the finger-stop *J*, which is normally held in the outward position by a small coil spring. When starting a new roll of stock, this stop is held in by the operator so that it serves to locate the stock while the elongated hole is pierced by punch *G*. The stock is then fed in so that the pierced hole lines up with the pilot *K*. A second elongated hole for another washer is next pierced by punch *G* while pilot *K* holds the stock in place. The stock is then fed into the third position, and the first step or blank is trimmed by punches *L*, which enter the die member at *M* and *N*. (See upper view). This punch leaves the ears and a small web in the center of the strip as shown at *O*. An idle or blank space is left between punches *L* and *H* to provide ample wall thickness for the die-block between the trimming and forming openings.

When fed in to the final blanking and forming position, the small ears on the work are brought in contact with the locating gages *P* so that the stock is properly centered. The edges of the forming punch *H* which are in contact with the ears are slightly stoned or rounded, while the remaining part is ground to a cutting edge. As this punch descends, the blank is cut free from the web and the ears are bent or formed. It will be noted that punch *H* acts against the spring-backed plunger *Q*. The blank is stripped from punch *H* by the stripper block *R* on the up stroke of the press, after which the blank and web are ejected from the die by compressed air. The stripper *R* is fastened to plate *C* and is made a slip fit on punch *H*.

The Machine-building Industries

ALL authorities on business conditions agree that 1923 opens under favorable auspices. General industrial conditions continue to improve. Contrary to the usual trend at this season, production in the basic industries is gaining. Since July, 1921, when the average production of all industries was lower than at any time in recent years, there has been an almost uninterrupted rise month by month. The production of pig iron is larger than at any time in over two years. The automobile industry shows no signs of seasonal decline, the locomotive plants are busy, the textile industries are unusually active, and building operations are maintained on a great scale, despite the season. This activity is having a far-reaching effect upon many other industries.

Mr. Hoover, in making a forecast of business conditions during 1923, says, "The odds are favorable for 1923; the world begins the year with greater economic strength than a year ago; production and trade are upon a larger and more substantial basis, with the single exception of the sore spot in Central Europe. The healing force of business and commerce has gained substantial ascendency over destructive political and social forces. There is ample reason why there should be continued progress during the coming year.

The Machine Tool Industry

The improvement in the machine tool industry is slow, but definite. The average business for the entire industry is about 35 per cent of capacity, with some fifteen or twenty firms doing considerably better than this. During December about half the machine tool builders had an increase in business of 20 per cent or more. Contrary to usual business experience, the first weeks in January brought a fair volume of business to many tool manufacturers. A few concerns state that business reached a normal level and would be quite satisfactory if it continued at the same rate throughout the year.

One New England manufacturer building a standard line operates at 75 per cent capacity, and another building special machinery runs to capacity and has orders on hand for the next three months; but in many cases the shops are still running on a limited schedule, although stocks are being reduced so that the time is approaching when a resumption of more active manufacturing will become necessary.

One shaper manufacturer finds that his total business for last year averaged about 50 per cent of normal, and a manufacturer of grinding machines sold a larger number in 1922 than in the best year previous to the war. This manufacturer states that if the number of machines sold in 1912 is represented by 100, the sales in 1917 were 300; 1918, 300; 1920, 200; 1921, 95; and 1922, 120. As prices are from 90 to 95 per cent higher than before the war, this means that the actual volume of business in dollars and cents in 1922 was more than double the business of ten years ago. Multiple-spindle drilling machines have been in fair demand for the last two months, both in the sensitive and in the bigger types; and while conditions as recorded may not be as favorable in the case of all machine tool builders, it is generally believed that the latter part of 1923 will see practically a normal business in this field.

Small Tools and Accessories

The small tool business is improving more rapidly than the machine tool business. One of the largest tap manufacturers operates at 60 per cent capacity, and in the Middle West the small tool business is reported to average from 75 to 80 per cent of what might be considered normal. The general practice of taking inventories at the beginning of the year has been responsible for some decrease in orders in this field; but on the other hand, February and March usually bring an increased volume of business. The demand for hacksaws is active, and several manufacturers of this product are running to capacity. Prices for hacksaws, however, are entirely too low, being only about 10 per cent above the pre-war price, which is out of all proportion to the increased cost of materials and labor. The business in hacksaw and cutting-off machinery is not yet anywhere nearly normal, but it is considerably better than a year ago.

The grinding wheel industry operates at about 60 per cent capacity, with prices that are considered satisfactory. The pressed-steel and stamping business runs to capacity in all cases when catering to the automobile field, and to from 50 to 60 per cent capacity when devoted to a general line of business. An important development is taking place in this field in that castings are in many instances being replaced by pressed-steel members, as the latter are lighter, cheaper, and stronger than castings. Gradually, the general substitution of pressed steel for castings, whenever this can be done, will bring a great deal of business to the shops engaged in this line.

Chain manufacturers are active, as would be expected with business flourishing in the automobile field. The demand for bicycle chains is also good, and industrial chain users are placing more orders than formerly. Some of the die-casting shops are operating to capacity, and others have a business far in excess of a year ago. The demand for machinists' precision measuring tools is much better, and micrometer makers do a business of about 50 per cent normal. Magnetic chucks are in greater demand than for nearly three years. Multiple drill heads have a fair sale, and the demand for broaches taxes at least the smaller broach-makers to capacity.

The Automobile Industry

All past records in automobile production were surpassed in 1922. At present, the automobile industry continues to produce in excess of any previous figures for this time of the year, and some of the leading companies are operating nearly at capacity, which ordinarily happens only during the late spring and early summer months. The manufacturers are confronted with transportation, raw material, and labor problems, but so far there has been no noticeable decline in factory operations on this account.

The Iron and Steel Industry

Perhaps the most hopeful sign for the machine tool industry is the activity in the iron and steel field, which always must precede an active demand for machine tools. The decrease in steel production that was expected before the end of the past year did not set in, and there has been no decline in the production of either pig iron, billets, bars, shapes, or plates. Taking steel alone as a criterion, some industrial forecasters see signs of a boom year. This is probably too optimistic a view, but stable conditions are aided by the fact that as the volume of business increases, prices are largely kept in check by the conservative price policies of the larger steel corporations, and unless unforeseen conditions arise, prices will probably continue at their present level for a considerable period. Nevertheless, it is considered wise to place orders for future needs right now, for even though prices remain stable, there may be difficulties about deliveries if the present increase in demand continues.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

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Reed-Prentice Planer-type Surface Grinding Machine

A PLANER-TYPE surface grinding machine capable of handling work up to 19¾ inches wide, 15 feet long, and 10 inches high above the magnetic chucks with which the table is provided has been brought out by the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass. From the accompanying illustrations it will be seen that the bed, table, and housings of the machine are the same as in the regular Whitcomb 36-inch heavy-duty planer built by this company. The driving mechanism for the table is also of the standard construction. The cross-rail is of special design, and has mounted on it a Blanchard vertical grinding head, which is driven by a 25-horsepower self-contained motor and equipped with a 20-inch grinding wheel. The machine is primarily designed for grinding cast-iron channels, but it may also be used for many other classes of work, either steel or cast iron.

The handwheel near the bottom of the housing on the front side of the machine is for raising and lowering the cross-rail, to position the grinding wheel properly to suit different heights of work. Accurate vertical movements of the head are obtained by revolving the upper handwheel located on the cross-rail, at the front of the machine. The work is held by means of six magnetic chucks, which have previously been referred to. Each of these chucks has a magnetic surface of 14⅛ by 19¾ inches. There is a cast-iron spacer placed between each chuck, so that the work is supported against the thrust of the wheel for its entire length. Side guides and other spacers are mounted on the cast-iron spacers between the chucks, and at one end of the table a bracket is provided to brace the work against end movement. These parts are necessary to hold the work in place in the event that the supply of electric current to the chucks should be accidentally shut off while the grinding wheel is traveling over the work.

The machine is equipped with a two-speed countershaft for driving the table, the two speeds providing for taking roughing and finishing cuts. The roughing cuts are taken at a table speed of 30 feet per minute, on both the forward and return strokes of the table, while the finishing cuts may be taken at a table speed suited to the requirements.

Angle-irons are fastened around the sides and ends of the table for its entire length and width to support sheet-metal guards. These guards protect the operator from injury and prevent the cutting compound from running on

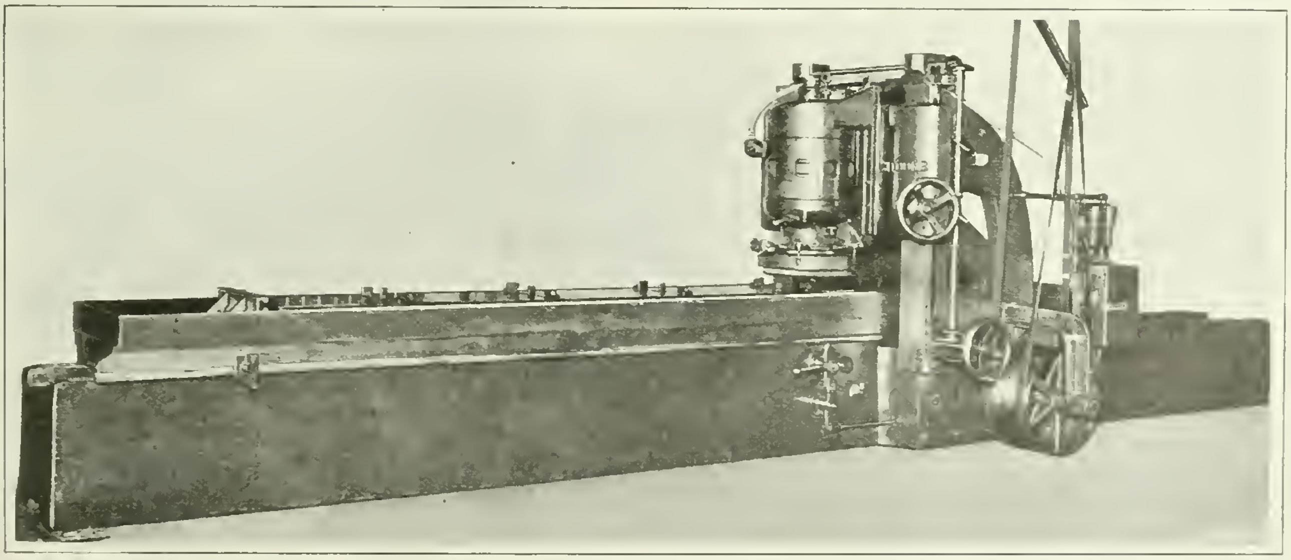


Fig. 1. Reed-Prentice Surface Grinding Machine of the Planer Type for grinding Work up to 15 Feet in Length

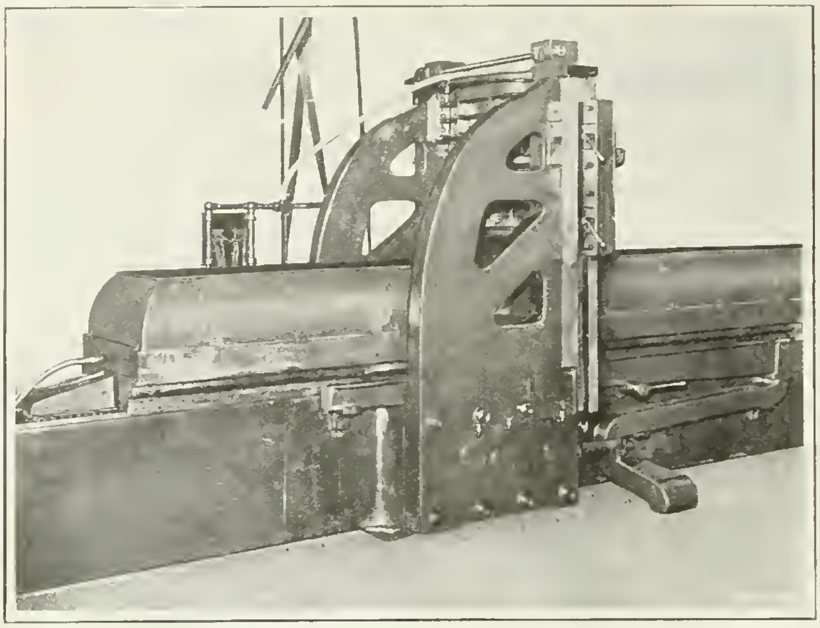


Fig. 2. Rear View of the Planer-type Grinding Machine, showing Method of conveying the Cutting Compound back to the Supply Tank

the floor or into the various mechanisms of the machine. The guards were removed from the table at the time the photograph, Fig. 1, was taken, in order to give a better view of the grinding head and the magnetic chucks. On the rear side of the machine, which is illustrated in Fig. 2, there is a spout through which the cutting compound leaves the table and flows through metal troughs to receiving and supply tanks beneath the floor. The cutting compound is delivered to the wheel by a pump in the supply tank, through two 1-inch pipes, one of which conveys the compound to the inside of the grinding wheel and the other to the outside.

CINCINNATI-ACME UNIVERSAL TURRET LATHE

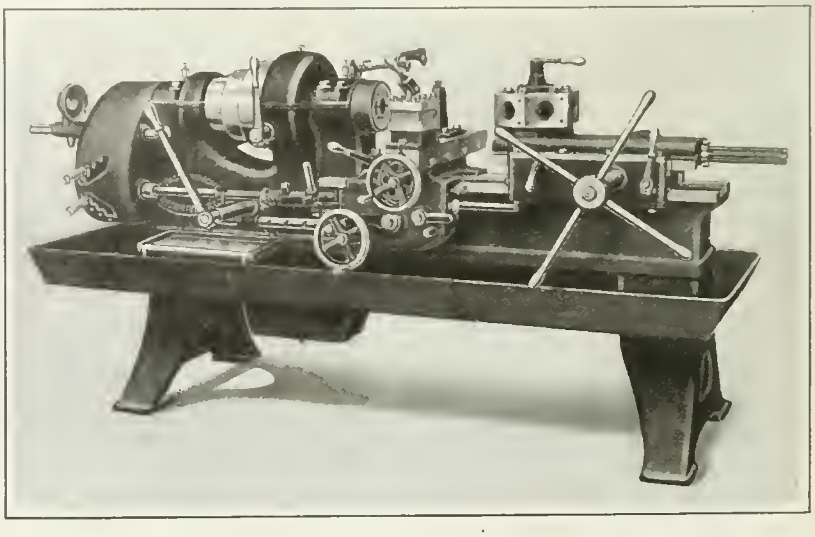
The No. 1 universal hexagon turret lathe here illustrated is an addition to the line of turret machinery manufactured by the Acme Machine Tool Co., Cincinnati, Ohio. The illustration shows this machine with a cone head, but it may also be furnished with an all-geared head. The bar capacity is for work up to 1½ by 9 inches, and the chucking capacity for work up to 18 inches. The head is cast solid with the bed, so as to obtain maximum rigidity and correct alignment of the spindle with the ways of the bed. The driving cone has three steps, and with this type of drive there is a friction single back-gear. The all-geared head provides twelve spindle speeds ranging from 18 to 318 revolutions per minute; these changes are obtained by operating two levers at the front of the headstock. The sliding and mating gears are made of chrome-nickel steel and are heat-treated.

The stopping and reversing lever is placed on the top of the geared headstock, and controls the operation of a friction clutch on the initial driving shaft. A hand-hole in the top cover gives easy access for adjusting the friction clutch. Change from one speed to another in one continuous movement of either of the speed-change levers is effected by a patented gear-shifting device. When the lever has reached the point where the gears are out of mesh, the driving pulley is automatically disengaged from the friction clutch, and re-engaged after the gears are again completely in mesh. This feature enables the gears to be shifted from one speed to another while revolving simply from their own momentum, thus eliminating shock and excessive clashing.

The automatic chuck is forged from the solid on the end of the spindle so as to insure rigidity and obtain minimum overhang from the front spindle bearing. The work is gripped or released instantly and, in conjunction with the stock feed, may be fed forward without stopping the machine, by giving a movement to the long lever at the front of the head. A stepped wedge automatically compensates for variations in the size of the work. An extra capacity chuck may be furnished for holding short work of large diameter.

The side carriage clears the chuck and can be moved out of the way to permit the use of short tools on the hexagon turret. Six independent stops are provided on the side carriage for the longitudinal movement. The square turret on the cross-slide is positioned by means of a hardened lock-bolt located directly beneath the cutting tool; the turret is unclamped and the lock-bolt withdrawn by a vertical movement of the lever on top of the turret. The six tool holes in the hexagon turret are fitted with binder bushings, and stock can be passed through them so as to allow the use of short stiff tools in turning long work. The hexagon turret is indexed automatically by the backward movement of the turret-slide, and is locked in the different positions by means of a bolt at the front end of the slide. Independent automatic stops are supplied for each turret face, and the abutment for the stops can be shifted to allow a slight extra movement of the turret. The stops are also arranged to trip the power feed. The side carriage and turret are provided with separate feed-shafts so that each may be operated independently of the other. The feeds to the side carriage can be reversed by operating the knob on the side of the apron.

A two-horsepower constant-speed motor running at 1200 revolutions per minute is required for the geared-head machine, and it is recommended that the motor be mounted on the rear side of the head-end leg. For the cone-head machine, a two-horsepower variable-speed motor running at from 500 to 1500 revolutions per minute is preferable. This motor is placed on a pedestal at the rear of the head and belted to the cone pulley. A taper attachment for turning tapers up to 3 inches per foot in lengths of 8 inches, and a chasing attachment for cutting threads from 3 to 72 pitch,



Cincinnati-Acme Universal Hexagon Turret Lathe built in Cone and Geared-head Types may also be supplied. Some of the principal specifications of this machine are as follows: Swing over bed, 18 inches; swing over cross-slide, 8¾ inches; maximum distance from nose of spindle to turret face, 23 inches; transverse travel of cross-slide, 8 inches; longitudinal travel of cross-slide, 17 inches; and approximate weight, 3150 pounds.

SHORE RECORDING SCLEROSCOPE AND PNEUMATIC PEDAL

In the Model C-1 scleroscope made by the Shore Instrument & Mfg. Co., Van Wyck Ave. and Carll St., Jamaica, N. Y., which was described in December, 1921, MACHINERY, the hardness of the metal part being tested is determined by noting the height to which the hammer rebounds, relative to a vertical graduated scale. An improved instrument provided with a dial, known as the Model D recorder is now also being manufactured by this company. In the new instrument, instead of the indication being momentary, the dial hand remains fixed an indefinite length of time or until the next test is made. The mechanism consists of the usual drop-hammer, the function of which, by virtue of its accumulated energy of motion, is to overcome the penetrative resistance of the metal under test. This absorbs more or less of its striking energy, which is always constant, but that which is not absorbed, as most noticeable with the harder metals, reacts on the hammer itself, and causes it to rebound to a height proportional to the hardness of the metal.

The hammer also differs from that of the earlier models in that it is longer, heavier, and drops and rebounds a comparatively shorter distance. A sensitive one-way ball clutch and pilot sleeve normally holds the hammer in its upper starting position, but when released, the pilot sleeve falls with the hammer, so that the slightest rebound to a height above the starting position, even though it is less than 0.001 inch, is instantly fixed by the clutch. Following this cycle, the clutch is raised to its starting position, carrying the hammer with it in its now somewhat elevated position, due to being locked on the rebound. When the hammer arrives at its starting position, it engages and actuates a rack and pinion and hair-spring dial mechanism, which indicates the amount of the hammer rebound, and consequently the hardness of the specimen. The hardness values obtained with this instrument agree, of course, with those indicated by the vertical scale of the older one.

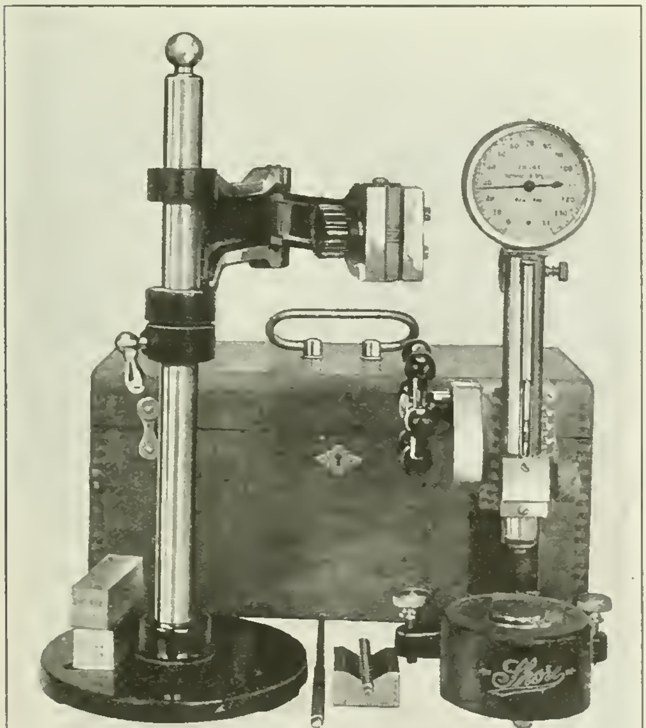


Fig. 1. Shore Scleroscope with Dial for recording the Hardness of Parts tested

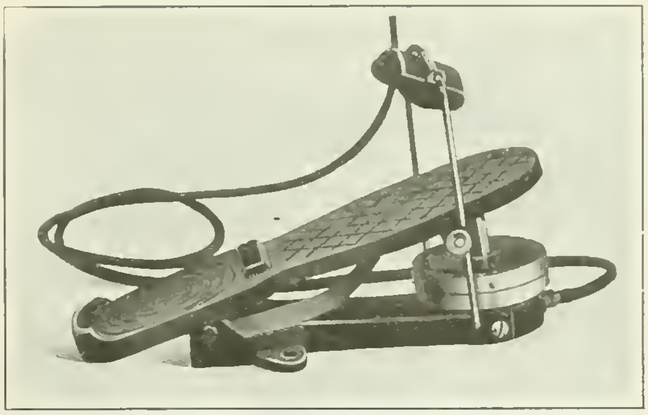


Fig. 2. Pneumatic Pedal which provides for operating the Model C-1 Scleroscope by Foot

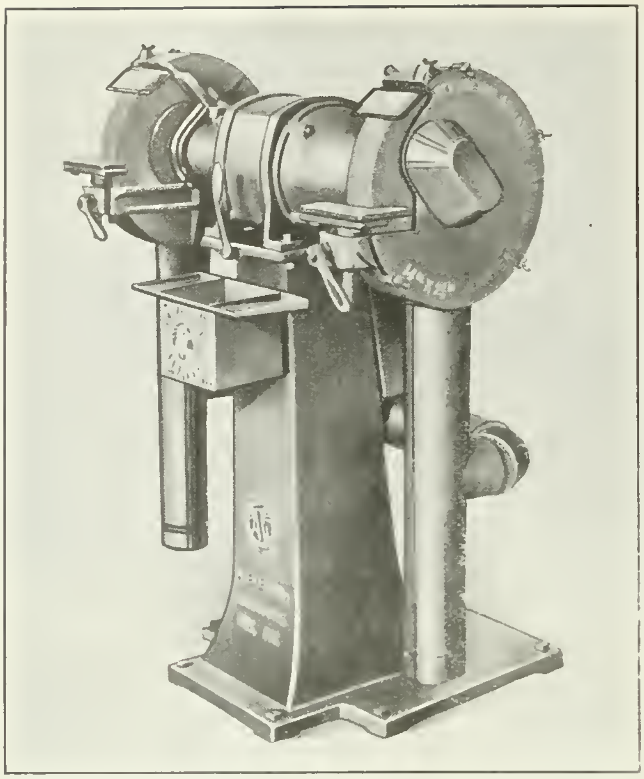
In many instances it has been found desirable to operate the Model C-1 scleroscope by foot, and to permit of such operation, the Shore Instrument & Mfg. Co. is also bringing out a pneumatic pedal known as the "Sico." This device is illustrated in Fig. 2. It is provided with an adjustable knuckle part for the top of the foot, which not only keeps the foot in place, but also permits the operator to press the pedal up and down at will, even though a spring normally actuates the up stroke. This feature serves to exercise all the foot muscles, and eliminates fatigue or cramps when the demands on the operator are prolonged. The required suction and compression is obtained by the use of a para rubber diaphragm, which is so mounted that there is practically no wear. A rubber tube is connected to the nipple of the air chamber and to the air nipple of the scleroscope.

C. A. W. ELECTRIC GRINDERS

One of a line of motor-driven grinders which is being introduced to the trade by the Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio, is shown in the accompanying illustration. These grinders have a chrome-nickel shaft supported in Timken taper roller bearings, which may be adjusted to compensate for wear, a feature which is said to give exceptionally long life to the rotating parts. They are made in various sizes of from ½ to 15 horsepower, in speeds of 1800 and 3600 revolutions per minute, and for electric current of any phase or voltage. The machine may be mounted on a floor pedestal as illustrated, on a bench pedestal, or on a post bracket.

The motor is especially designed for hard service, having a rotor and stator of the alternating-current type, assembled by electric welding without the use of bolts, rivets, or solder. Forced ventilation is provided through dirt-proof openings, to assure cool operation at heavy overloads. The motor is controlled through a positive quick-acting switch which cannot be opened except when the current is off, and is therefore fool-proof. The switch handle can be operated by the elbow when both hands are in use. On the bench and floor types, the control mechanism, switch, and fuse cabinets are mounted on the back of the pedestal where they do not interfere with the operation of the grinder. A patented lock holds the shaft in position when wheels are being changed, and because of this design, one man can change wheels quickly without assistance.

Eye-shields of heavy glass, set in aluminum, are furnished as accessories, for ready attachment to either guard. They are adjustable, and furnish protection to the operator's eyes so that he does not need to wear goggles. The floor pedestal

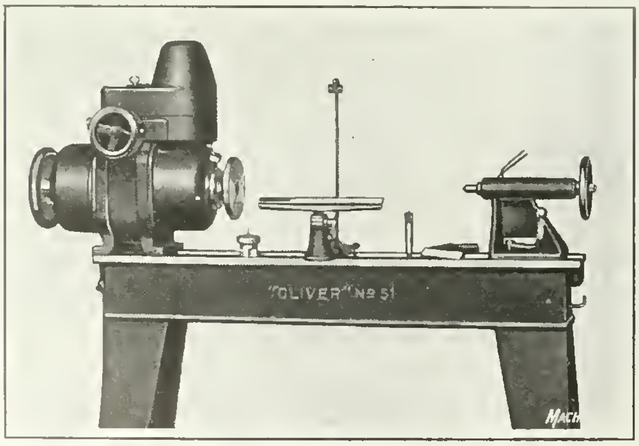


One of a Line of C. A. W. Motor-driven Grinders

has been designed with the comfort of the operator in mind. It is braced at the rear and provided with a toe notch in which the operator may brace himself. Guards for 10-inch and smaller wheels are removable but are not adjustable. However, patented guards for 14-inch wheels are adjustable so that both the rest and the top lip of the guard keep the same relation to the wheel as the latter becomes worn. The guards are supplied with an opening to facilitate connection to an exhaust system, and they can be fixed in any position to permit the grinding of long rods, etc.

OLIVER MOTOR-HEAD SPEED LATHE

A No. 51 motor-driven wood-turning speed lathe built by the Oliver Machinery Co., Grand Rapids, Mich., was described in August, 1918, MACHINERY at the time that it was placed on the market. This machine was designed for operation on alternating current at four different speeds, which were controlled through a handwheel on the front head-leg of the bed. The same company is now bringing out an additional No. 51 speed lathe, which is here illustrated. The new machine is provided with a variable-speed motor which gives speeds of 600 to 3600 revolutions per minute. The motor runs on single-, two-, or three-phase alternating current.

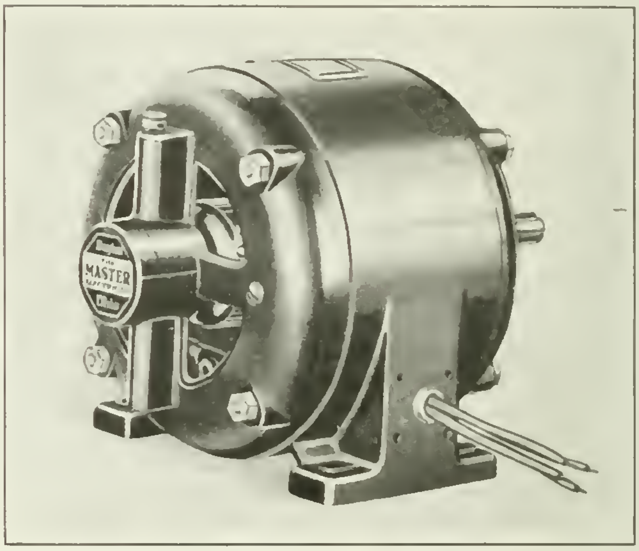


Oliver Wood-turning Lathe equipped with a Variable-speed Motor

The entire controlling mechanism is self-contained in the motor, there being no field rheostats, regulators, or relays. A push-button switch and handwheel control are regularly furnished, and through them the speed of the motor may be varied at will while it is in operation. The motor is equipped with ball bearings and a patented combined handwheel and faceplate. As a handwheel, it may be used to revolve the work or to stop the motor more quickly.

MASTER ELECTRIC MOTOR

An addition has been made to the line of electric motors built by the Master Electric Co., 448 First St., Dayton, Ohio. The new design is built in sizes of from 1/3 to 1½ horsepower. A point of interest concerning this motor is that the frame dimensions of the commutator end are identical with those of the end from which the shaft projects, the result being a very symmetrical design. This motor has interchangeable frames for the alternating- and direct-current types. Other features of design include a compact short-circuiting device, removable self-aligning bearings, and a dual wick oiling system. A feature of the repulsion-induction motor is an exceptionally high starting torque, with low current consumption. The motor is designed to start heavy overloads with so slight a drop in line voltage that there is practically no flickering of lights. The motor is also said to operate high overloads under adverse voltage conditions.

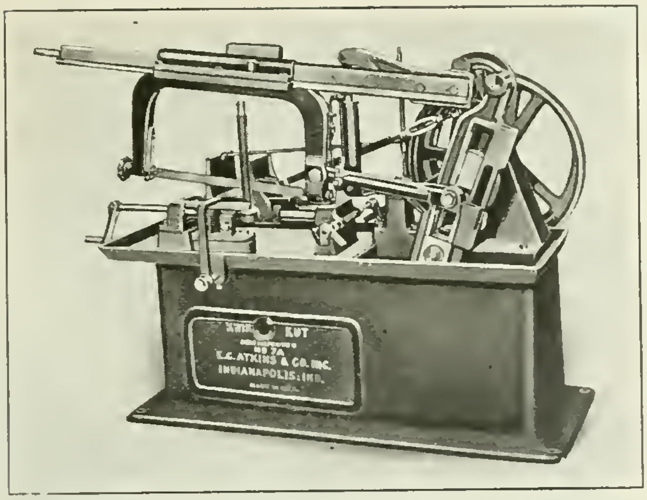


Master Alternating- or Direct-current Motor built in Sizes of from 1/3 to 1 1/2 Horsepower

ATKINS METAL-CUTTING MACHINE

The speed of operation has been practically doubled in the improved No. 7-A "Kwik-Kut" sawing machine recently placed on the market by E. C. Atkins & Co., Indianapolis, Ind. In the improved machine a speed of 100 strokes per minute is considered practicable, whereas the speed was formerly from 50 to 60 strokes per minute. The stroke is adjusted automatically to the size of the material in the vise. The saw frame travels on a T-bar and is kept in adjustment by means of screws, so that it will always travel in a straight line. The blade-holder has a gage that indicates whether or not the blade is adjusted properly relative to the vise. The blade guide rides on top of the blade, and prevents it from running sidewise while a cut is being taken.

The machine has a cabinet base which contains a compound settling tank, reservoir, and pump. The general construction of the entire machine is heavier than before, and



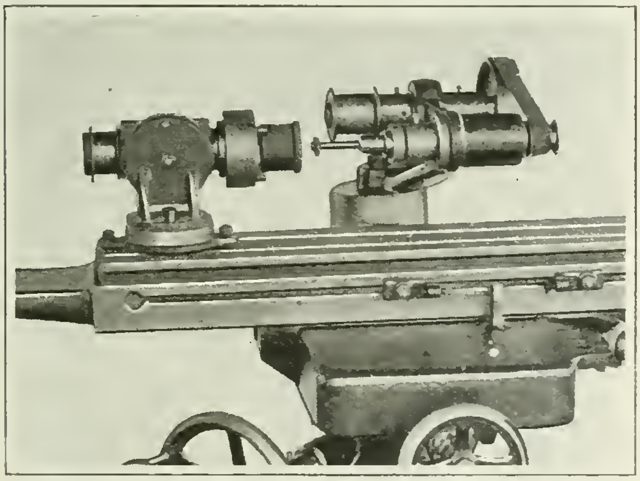
Atkins No. 7-A "Kwik-kut" Metal-cutting Machine

oil-cups are placed wherever a large amount of oil is required. The feed is controlled by a hydraulic dashpot, by means of which a greater or lesser feed can be secured by simply turning a by-pass cock. When desired, the by-pass cock can be set for a constant feed. The dashpot also acts as a cushion for the raising device, with the result that the blade is lowered into the cut without jar.

WOODS INTERNAL GRINDING HEAD

To meet the demand for an inexpensive internal grinding equipment where the amount of grinding to be performed does not warrant the purchase of a single-purpose machine, the Woods Engineering Co., Alliance, Ohio, has placed on the market a grinding head that can be used in conjunction with either the No. 2 or the 2½ universal tool and cutter grinders built by that concern. The illustration shows this head applied to the No. 2 machine. The regular work-head is employed for holding the work either in a chuck or on a faceplate.

This internal attachment replaces the regular grinding head of the machine, and the change from one head to the other can be accomplished in five minutes. The shaft, which is driven by the main belt of the machine, is mounted in ball bearings and carries a large pulley for driving the grinding spindle. The latter is mounted in ball bearings, with provision for adjusting for wear. Different lengths and diameters of stubs can be applied to the spindle nose to suit the work in hand. Adjustments may be made to maintain the proper tension on the belt that drives the grinding spindle.



Woods Internal Grinding Head mounted on Tool and Cutter Grinder

REED OPPOSED-SPINDLE DRILLING MACHINE

Drilling holes at close center distances can frequently be done to better advantage by drilling from opposite sides of the work than by drilling them on the same side by the use of an attachment. The first of these two principles has been adopted in designing the machine illustrated in Figs. 1 and 2, which is a recent development of the Francis Reed Co., 43 Hammond St., Worcester, Mass.

A special feature of this machine is the minimizing of drill breakage through the use of coil springs *A*, Fig. 2, which act in conjunction with leverage links. An adjusting means provides for regulating the pressure of these springs. The machine spindles are advanced and withdrawn from the work by operating lever *B*, Fig. 1, a crank, and links. Lever *B* reaches the stop *C* just before the points of the drills break through the work, thus allowing the compressed springs *A* to supply the power for gradually finish-drilling the holes. The spindle heads are adjustable to suit the drill length, and any length can be used. A vertical adjustment provides for varying the center distance between holes.

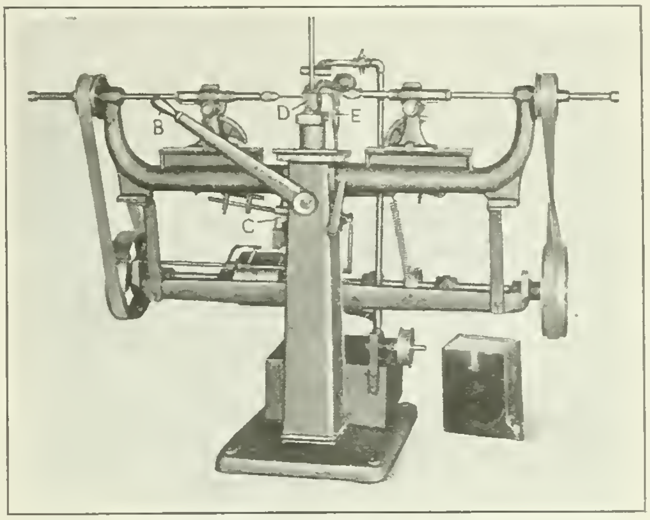


Fig. 1. Reed Drilling Machine with Opposed Spindles for drilling Work from Opposite Sides

Work-holder *D*, on the machine illustrated in Fig. 1, is intended for holding ½- and ⅝-inch round stock, a completed example being shown lying on the top of the pedestal. However, special work-holders can be devised to hold a large variety of parts. Work-holder *D* is cam-operated in conjunction with the feed-lever *B*, and held by means of a weight. On the completion of a drilling operation, lever *B*

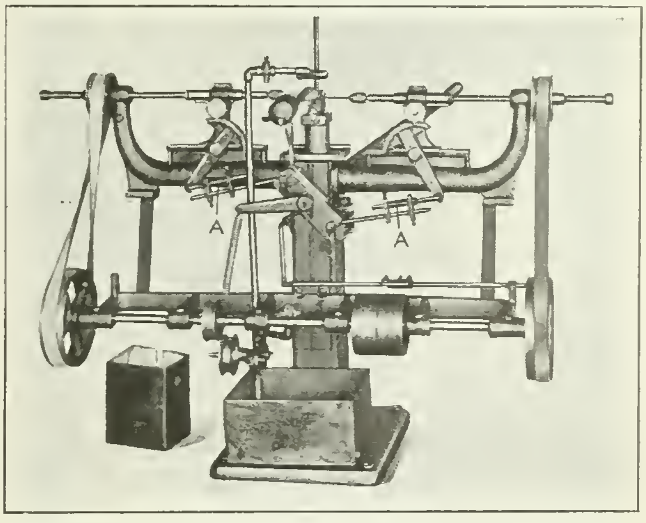
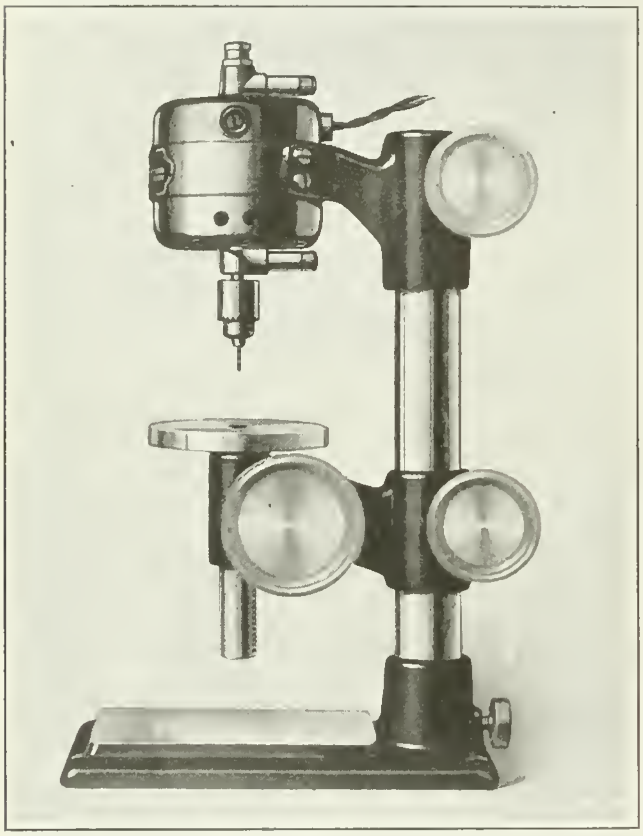


Fig. 2. Rear View of Machine illustrated in Fig. 1, showing the Compression Springs used to break the Drills through the Work

is lifted, raising the clamping lever through cam *E*, and opening the jig to allow the operator to quickly remove the finished work and insert a new piece. One hand is employed to feed the drills and the other to handle the work. The machine is furnished with an oil-supplying equipment, the tank on the floor being placed around the work-holder to catch the liquid and return it to the tank after use. A production increase of one hundred per cent over old methods is claimed for this machine.

"DUMORE" SENSITIVE BENCH DRILL

A new sensitive bench drill which has recently been added to the line of "Dumore" products manufactured by the Wisconsin Electric Co., 2556 16th St., Racine, Wis., is shown in the accompanying illustration. This drill is equipped with a dynamically balanced "Dumore" universal motor which runs on either alternating or direct current. A ball thrust bearing takes up all end play, and wick grease-cups insure lubrication of the bearings. The spindle is furnished with a No. 0 Jacobs chuck which has a capacity up to ⅛ inch. Quick-acting locking devices make the raising or lowering of the motor and the work-table a simple operation. The motor can be easily detached from the column when it is desired to use the drill as a portable hand tool. Six different spindle speeds are obtainable by means of a foot-controlled rheostat.



"Dumore" Sensitive Bench Drill for Holes up to ⅛ Inch Diameter

The table is raised and lowered through a rack and pinion by turning a handwheel. The gear ratio of this mechanism is figured to balance the weight of the table and make the equipment so sensitive that small drills can be used without danger of breaking them. A gage set by means of a thumbscrew is provided to end the feeding of the drill when a hole has been drilled to the desired depth. The table is 3½ inches in diameter, and has the center located 3 inches from the column, which permits drilling to the center of a 6-inch circle. The table is bored and reamed at the center to suit the shanks of fixtures which form part of the regular equipment. These fixtures include cone, cup, and radius centers and a V-block. The radius center is milled to facilitate drilling rings and similar pieces. The over-all height of this drill is 16 inches.

BATH INTERNAL THREAD MICROMETER

An internal thread micrometer which has been developed by John Bath & Co., Inc., 8 Grafton St., Worcester, Mass., is shown in Fig. 1. This micrometer measures the exact size of a threaded hole and is read in the same manner as a micrometer caliper. It has four projecting jaws that seat firmly in inclined dovetail slots in cylindrical jaws which are actuated by means of a micrometer screw. The measuring jaws are relieved to decrease the weight and are held back against the handle by a large threaded flange which acts as a pilot and facilitates the catching of the thread in the work when the micrometer is being screwed into place. This threaded pilot is ground several thousandths inch under the nominal size, and has four notches for removing chips.

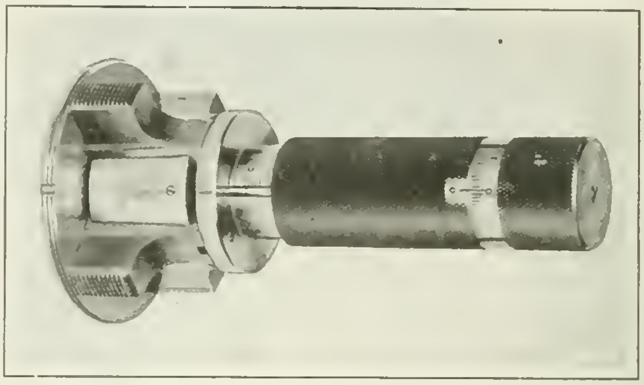


Fig. 1. Bath Internal Thread Micrometer with Threaded Pilot

The micrometer is ground cylindrical at its minimum size so that when it is expanded in the work to the normal size, the jaws make line contact in the threaded hole. In using the micrometer, it is contracted a few thousandths of an inch under the normal size, screwed into position, and expanded until the measuring jaws contact with the threaded hole. The reading is then taken by means of the graduated dial, after which the micrometer is again contracted and removed. The micrometer can be used to measure a thread for maximum and minimum sizes—the limits being decided upon by the user anywhere within a limit capacity of 0.020 inch. An 8-inch micrometer, which is shown in Fig. 2, illustrates the possibility of making the micrometer in large sizes. It is exceptionally light for a gage of this size.

The master reference ring shown in Fig. 3 is furnished for checking the micrometer when wear occurs on the

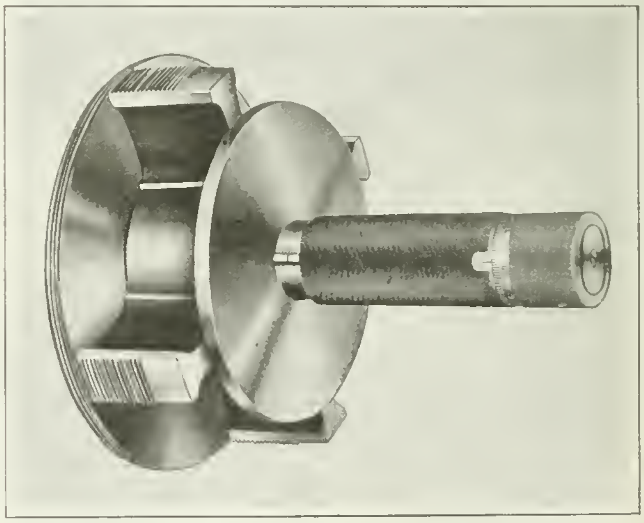


Fig. 2. Internal Thread Micrometer of Large Size

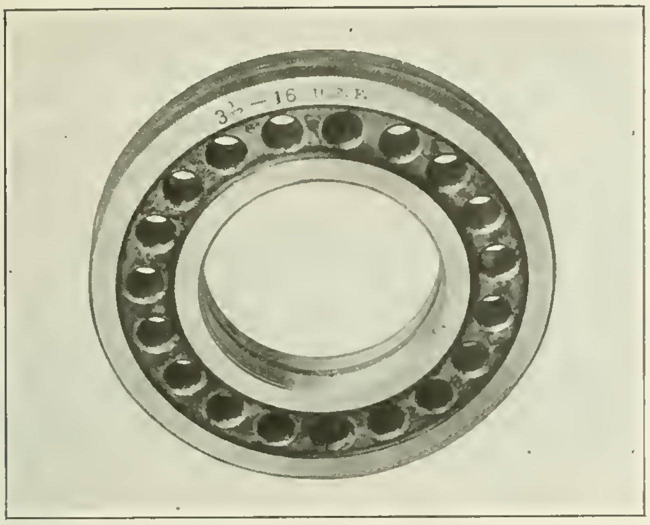
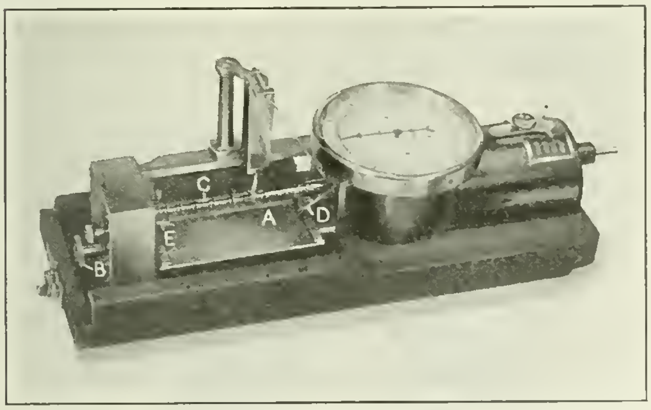


Fig. 3. Master Reference Ring for checking the Internal Thread Micrometer

measuring jaws. There is provision for setting the reading dial at zero when the micrometer is set to size by the master reference ring. The advantage of this internal thread micrometer is that it can be reground until worn out and it can always be kept up to size by referring to the master reference ring. New jaws may also be fitted by the maker.

O-Z HAND TACHOGRAPH

The number of revolutions per minute of rotating members is graphically recorded on a moving strip of paper in the "O-Z" hand tachograph shown in the accompanying illustration. This instrument is being placed on the market by O. Zernickow, 15 Park Row, New York City, for recording any speed between 30 and 24,000 revolutions per minute. The paper is fed across surface *A* by means of two rollers which are driven by a clock mechanism, the latter being wound by turning knob *B*. The upper roller *C* has a series of disks which contact with an ink roller and draw parallel longitudinal lines on the paper strip. The speed of the revolving member being investigated is indicated by a line drawn by pen *D* in a vertical direction relative to the direction in which the paper strip travels. This pen is set in motion by a pin projecting from the tachograph housing, and levers. The speed is indicated on the dial during the test. Pen *E* marks the time in seconds or one-fifth seconds.



O-Z Hand Tachograph for recording graphically Speeds in Revolutions per Minute

The entire width of the paper strip is available to pen *D* for the different ranges of the tachograph, these ranges being controlled by the thumb-slide. This enables clear registration of even very small fluctuations in speed. The inking and printing rollers can be easily removed for cleaning and reconditioning. The weight of this instrument is two pounds. The recording mechanism may also be adapted to any type of O-Z tachometer.

PANGBORN PROTECTIVE HOOD AND APRON

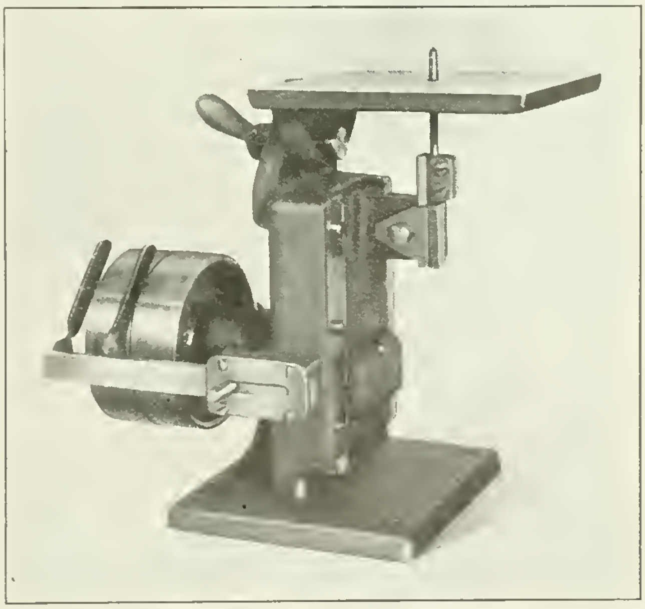
When steel shot and grit are used in sand-blasting, as is quite common in foundries, there is greater wear on the hood and clothing of the operator than when sand is used, owing to the fact that the metal abrasive particles have two and one-half times the specific gravity of sand particles, and strike a blow in the same proportion without disintegration. To meet the demand for greater protection when using metal abrasive, the Pangborn Corporation, Hagerstown, Md., has placed on the market a "Shotpruf" apron and hood.

The apron has straps which pass around the neck of the operator, and spring clips which attach it to his legs. The clips do not bind the legs, and provide for quickly donning or removing it. The front of the apron is made of chrome leather. The hood, which is shown in the accompanying illustration, also has a chrome-leather front and crown which effectually resists wear. A finely woven wire screen, which can easily be replaced, protects the eyes of the operator and at the same time permits clear vision. The hood is made with an adjustable band that fits any size head.

Pangborn "Shotpruf" Hood

ANDERSON BENCH FILING MACHINE

A filing machine of the bench type, which has been designed for use in machining all kinds of dies, forming tools, and upright cutters, is now being placed on the market by Hugold Anderson, 201 Eddy St., Providence, R. I. From the accompanying illustration it will be seen that the machine

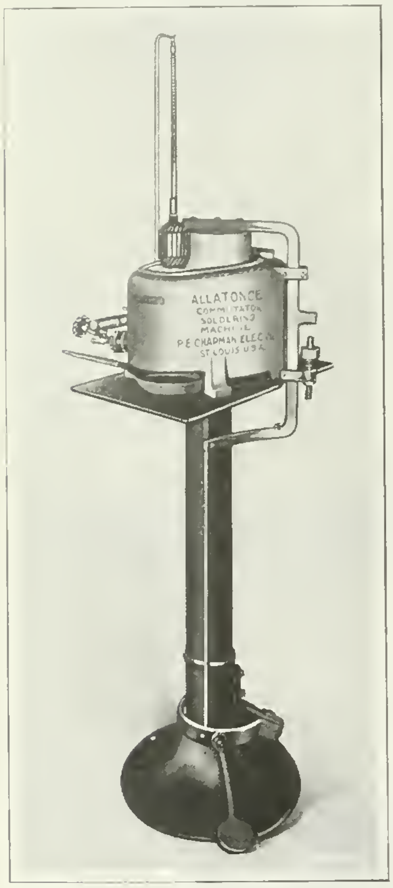


Anderson Bench Machine for filing Dies, Forming Tools, etc.

is equipped with a tilting table. This table may be swiveled up to 30 degrees both ways relative to a perpendicular, and when tilted to the maximum, the 7/16-inch hole at the center provides sufficient clearance for a ¼-inch file. This is of importance in filing narrow strips of sheet metal.

The slide is provided with a gib for taking up wear, and is so arranged that the working parts will be adequately protected from filing dust. The file-holder is made to receive ¼-inch standard machine files, and is adjustable. The belt-shifter, for changing the belt from the tight to the loose pulley and vice versa, has a spring locking arrangement. A perforated oil bushing with which the loose pulley is supplied permits of running this pulley for months without oiling. The stroke of the slide is 1½ inches; the size of the table 7 inches square; and the over-all height of the equipment, 10 inches. The proper speed of operation is from 350 to 400 revolutions per minute of the driving shaft. This machine may also be equipped with a saw frame.

CHAPMAN SOLDERING MACHINE



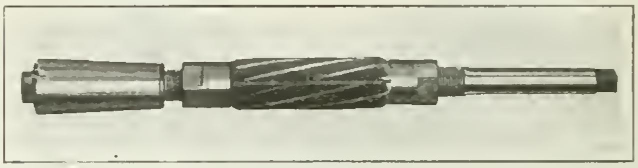
Chapman Soldering Machine

Commutators, rotors, containers, or other parts that require considerable soldering, may be soldered simultaneously at all joints by means of the "Allatonce" soldering machine here illustrated. This machine is a recent product of the P. E. Chapman Electrical Works, Tenth and Walnut Sts., St. Louis, Mo. It eliminates the necessity of using the slow and tedious soldering iron. The device that holds the part to be soldered also protects any desired portion of the work from contact with the solder. The latter is automatically cleaned of dross, and there is no dripping. Raising of the solder to the height of the joints to be soldered is effected by depressing the treadle at the foot of the pedestal. The burners can be adjusted for using either natural or artificial gas. A jacket protects the operator from the heat of the fire, and there is no chance of hot solder splashing on his hand. An armored thermometer, 18 inches long, is provided, which is graduated to 1000 degrees F., and 535 degrees C. The machine is built in two sizes.

HANLON & WILSON EXPANSION SPIRAL REAMER

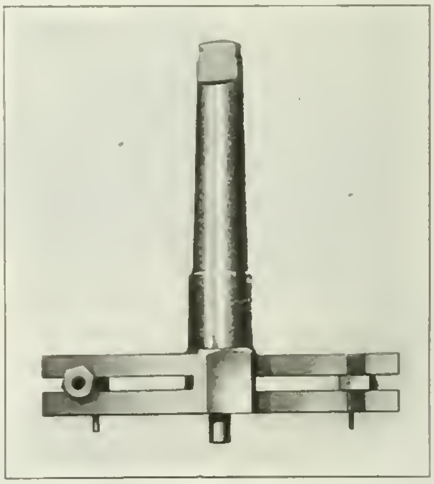
An expansion spiral reamer made up of segments containing spiral cutting edges is being introduced to the trade by Hanlon & Wilson, 321-323 Pennwood Ave., Wilkinsburg, Pa. From the illustration it will be seen that the reamer has a central spindle or arbor which is threaded for that portion of its length that is covered by the cutting segments and the means provided for holding them to the tool. This spindle has slots tapered at the bottom to form a cone relative to the axis of the spindle, and in these slots are keys or wedges the inner surface of which is tapered to correspond with the bottom of the slots, while the outer surface forms part of a cylinder. The cutting segments form a complete cylinder when assembled, except for the portions removed when cutting them from the solid cylinder in their manufacture.

The inner bore of the segments is straight and is backed centrally by a key. The segments are interlocked at their ends with the keys so as to insure proper relation with them at all times. An intermediate washer placed between the segments and the adjusting units prevents injury to the units when making adjustments. Variation in the diameter of the reamer is accomplished by moving the cutting sections along the spindle by means of the adjusting nuts. This actuates the keys in the tapered slots and expands or contracts the segments, according to the direction in which the nuts are revolved. The reamer is particularly adapted to machining holes containing oil-grooves or cavities. The minimum and maximum diameters regularly manufactured are ¾ and 1½ inches, respectively, and the range of expansion is 1/16 inch.



Hanlon & Wilson Expansion Spiral Reamer

KOCH DRILLING MACHINE CUTTER

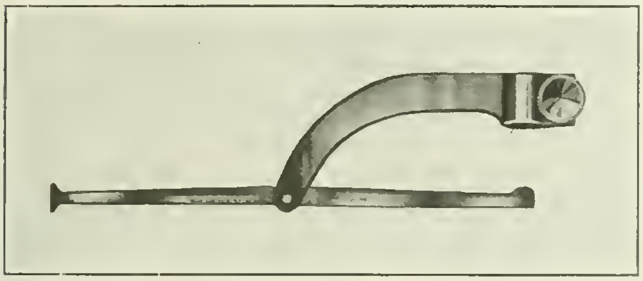


"Jiffy" Cutter for cutting Holes in Fiber and Metal Sheets

To provide an efficient means of cutting holes in fiber sheets, metal plates, and similar work, Paul W. Koch & Co., 19 S. Wells St., Chicago, Ill., are placing on the market the device here illustrated. This is known as the "Jiffy" cutter, and is similar to the hand tool, made by this firm, except that it is provided with a shank to fit a drilling machine spindle. The knives are easily adjustable to and from the shank and are renewable. Standard knives are intended for cutting metal plates up to 3/16 inch in thickness, but special knives may be supplied for cutting metal up to 1¼ inches thick. The tool may be used at a speed up to 100 revolutions per minute on fiber, and up to 50 revolutions per minute on metal. It is made in two sizes, one for cutting holes from 1¼ to 3 inches in diameter, and the other for cutting holes from 1½ to 6 inches.

BROWN & SHARPE INDICATOR ATTACHMENT

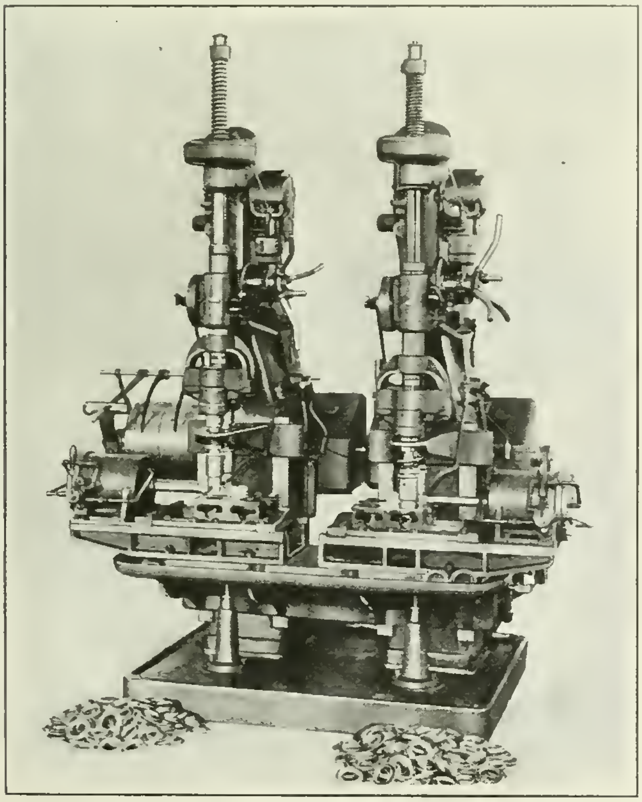
An attachment designated as No. 729 has been added to the line of precision tools made by the Brown & Sharpe Mfg. Co., Providence, R. I., in order to increase the usefulness of the dial indicator made by this company. The new attachment adapts the indicator for testing internal and other surfaces that cannot be easily reached by means of the straight spindle with which the indicator is regularly supplied. The arm of the attachment is a bronze casting, which can be easily assembled and makes direct contact between the test bar and the dial plunger. Adjustments are unnecessary, and so there is no chance for inaccuracies. The test bar is made of steel, ground, accurately balanced, and held firmly in place by a pin driven through the arm.



Attachment for the B. & S. Dial Indicator

BARNES HEAVY-DUTY GANG DRILLING MACHINE

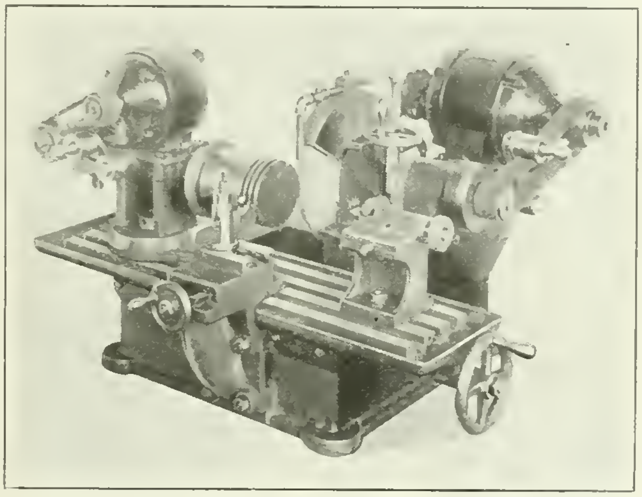
A two-spindle 22-inch heavy-duty gang drilling machine of the self-oiling and all-geared type manufactured by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill., is shown in the accompanying illustration equipped with duplex jigs having air chucks, and two-spindle auxiliary heads on each main spindle, the machine being thus arranged for tapping pressed-steel fittings for steel barrels. There are special geared thread-leading feeds to suit the pitch of the taps used in this work. Each auxiliary head carries two Rickert-Shafer collapsing taps of 2-inch pipe size. The main spindles are provided with coil springs at the top, which automatically and instantly return them upon tripping the collapsing taps. The two-position air jigs on the table enable the operator to reload the two spare positions while two pieces in the positions beneath the auxiliary spindle are being tapped. Brackets provide for resetting the chasers on the upward thrust of the spindles. Small coil springs just under the collapsing taps remove the shock at the moment of resetting. The production from this unit per operator is approximately 700 pieces per hour. The machine without the special equipment is a standard product of the company.



Barnes Two-spindle Gang Drilling Machine equipped for Tapping

FRANKLIN TURNING AND GRINDING MACHINE

A machine equipped with a grinding head at the rear and a tool carriage at the front is being placed on the market by the Franklin Machine & Tool Co., 61 Franklin St., Springfield, Mass., for turning and grinding automobile pistons, wrist-pins, valves, reseating cutters, etc. As will be seen from the illustration, the work and grinding heads are driven by individual motors. The work-head motor is of 1/4 horsepower capacity, and is mounted on a graduated swiveling base. A regular lathe spindle construction is provided for holding faceplates, draw-in collets, piston adapters, and lathe chucks. The head may be set at any angle for turning and grinding tapers, boring, and internal grinding. The turning tool is clamped in a toolpost set in a cross-slide which is operated by a feed-screw. The wheel-head motor is of 1/2 horsepower capacity, and is also mounted on a cross-slide. The handwheel at the right of the wheel guard is graduated to enable the operator to grind work to ten-thousandths of an inch. The grinding wheel is 10 inches in diameter. A belt-tightener is supplied.

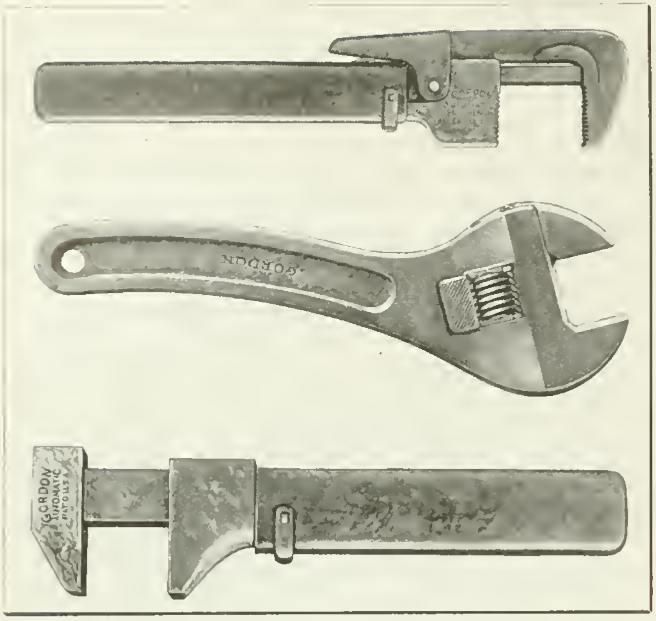


Franklin T-G Model Turning and Grinding Machine

GORDON AUTOMATIC WRENCHES

A line of wrenches, the distinguishing feature of which is their automatic adjustment, has been brought out by the Automatic Wrench Co. of America, 450 Palisade Ave., West New York, N. J. This line of wrenches, as shown in the accompanying illustration, includes pipe wrenches, open-end wrenches, and wrenches similar to the familiar monkey-wrench type. All the different types can be operated by one hand. In the case of the wrench shown at the bottom of the illustration, a slight pressure of the thumb on the movable jaw instantly adjusts the wrench to the size of the nut or bolt head. To release the grip, a slight pressure on a spring in the handle is all that is necessary. The head and shank are one solid piece of metal, and the lower jaw is also made from one piece.

The pipe wrench is also so designed that it can be operated by one hand in any position. To fit it to a pipe, all that is necessary is to push the adjustable jaw forward with the thumb, until the size required is reached. When the wrench is to be released, a slight pressure on a spring in the



Three Types of Gordon Automatic Wrenches

handle acts in the same manner as described for the regular type of wrench. A valuable feature of the pipe wrench is that the top jaw can be brought back at an angle, by pressing the lower part, so that a firmer grip can be obtained.

The open-end wrench is so designed that adjustment to the size of the nut or bolt head is instantly made by a slight pressure of the thumb on the adjustment jaw, and the final tightening is obtained by giving the thumb-screw in the head of the wrench a slight turn with the thumb. The release is obtained instantly by a slight downward pressure on the knurled surface directly beneath the thumb-screw. All these wrenches are made from drop-forged 15-25 point carbon steel, casehardened, and have a rustproof finish.

* * *

NEW MACHINERY AND TOOLS NOTES

Combination Drilling Machine Table and Vise: Modern Machine Tool Co., 601 Water St., Jackson, Mich. A larger size of the combination table and vise for drilling machines described in September, 1919, MACHINERY when it was being manufactured by the Sprague-Hayes Mfg. Co., Detroit, Mich. The manufacture of the device was taken over by the Modern Machine Tool Co., as mentioned in June, 1922, MACHINERY. The vise previously described was a 16-inch size, whereas the new product is a 19-inch size, intended for use on 20-, 21- and 24-inch drilling machines. The jaws open to 10 inches. The weight is about 200 pounds.

Electric Riveting Machine: Kobert Machine Co., Inc., 50 Church St., New York City. A redesigned dual-head electric riveting machine in which a copper electrode and a steel heading set are placed side by side at the front of the machine. Heating of a rivet is accomplished by passing a current through it while it rests on the horn and is held down by the copper electrode. When the rivet has been heated sufficiently, the head of the machine is moved laterally 1¼ inches to bring the steel heading set over the work, after which the rivet head is formed under pressure. The machine is motor-driven, and controlled by a foot-pedal. The rivets are heated after being assembled in the holes of the work. By this method, the placing of hot rivets in reamed holes is avoided.

Heat-treating Gas Furnace: Fitzgerald Forging & Heat-treating Co., 576 St. James Ave., Springfield, Mass. A gas furnace known as the "Midget Universal," which is intended for use in the general heat-treating of both high-speed and carbon tool steels. The heating chamber is 6½ inches wide, 7 inches high and 9 inches long. There is also a space at the front of the furnace where tools may be preheated to approximately 1500 degrees F. before they are passed into the final chamber. Only twenty minutes is required to heat the furnace to a temperature suitable for treating high-speed steel, and a fuel consumption of only 275 cubic feet of gas is required per hour to maintain a temperature of 2400 degrees F.

1898—1923

A reception in which the entire organization of MACHINERY took part was tendered to Matthew J. O'Neill, general manager, on January 20, which was his twenty-fifth anniversary with the Industrial Press. An illustrated history of the business, covering a quarter century, signed by everyone present, and a massive silver vase, appropriately inscribed, were presented to Mr. O'Neill on that occasion.

The Industrial Press, now in its thirty-fourth year, originally owned and published four technical journals which were sold after the publication of MACHINERY was begun, and the entire efforts of the organization were concentrated on that journal and on the development of an extensive book business in the same field.

MACHINERY, now in its twenty-ninth year, is one of the few American technical journals which have continued from the beginning, for that term of years, under the same ownership and management. The development of the business during recent years is due primarily to Mr. O'Neill's ability, enthusiasm and energy.

* * *

HYDRAULIC AND ELECTRIC VARIABLE-SPEED DRIVES COMPARED

In a paper presented before the annual meeting of the American Society of Mechanical Engineers, Walter Ferris, vice-president of the Oilgear Co., Milwaukee, Wis., made a comparison between the hydraulic variable-speed drive and the electric variable-speed drive. In order to point out several advantages of the hydraulic drive, Mr. Ferris described an Oilgear drive as applied to a seven-foot boring mill.

This drive runs continuously, no friction clutch or other means of shutting down the drive being used. The service is severe and practically continuous on the day run. The over-all mechanical efficiency of this variable-speed drive at various strokes of the pump and corresponding speeds of the motor is shown by the curve in Fig. 2. The unit transmits from 10 to 15 horsepower, and with a maximum efficiency at full stroke of about 87 per cent, maintains a 70 per cent efficiency down to quarter-stroke.

According to Mr. Ferris, the advantages of this drive over an electric drive are as follows:

1. A more perfect control of the speed, permitting the operator to revolve the machine table in either direction at very slow speeds while chucking the work. The operator will frequently run his table 2 revolutions per minute, using a wrench on each clamping bolt as it comes past until the chucking is completed. If the work consists of boring a

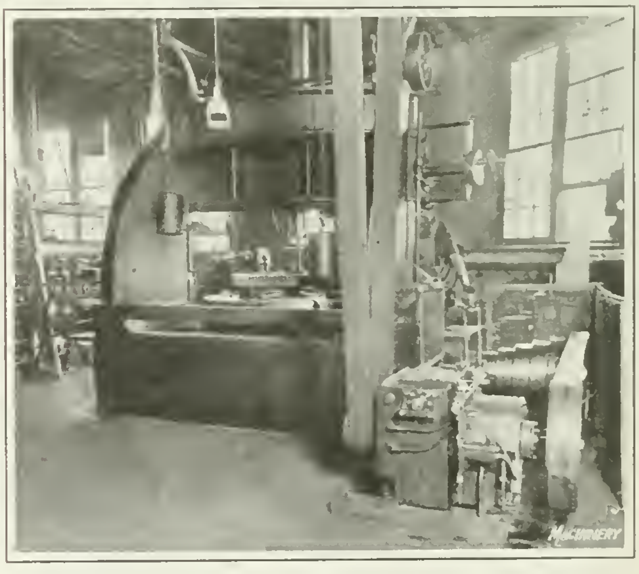


Fig. 1. Boring Mill with Hydraulic Variable-speed Drive

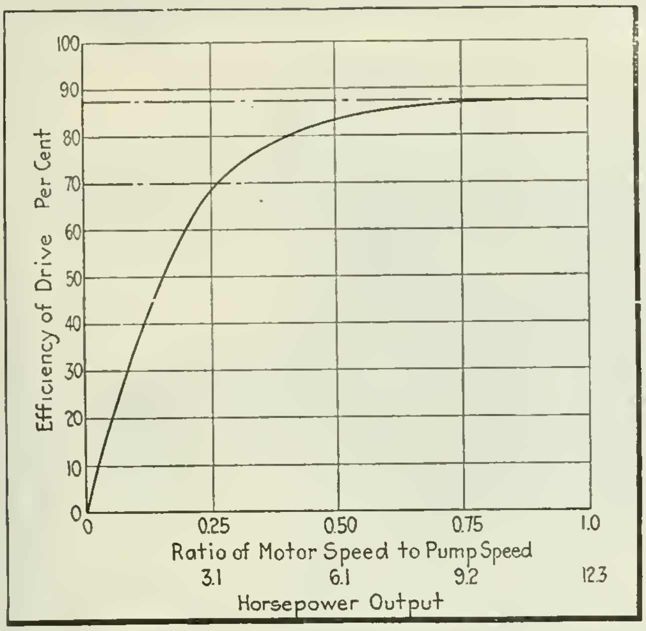


Fig. 2. Mechanical Efficiency of Hydraulic Variable-speed Drive for Boring Mill

small hole, he quickly speeds up the table to 48 revolutions per minute by merely turning the control handle of the drive.

2. No coasting when the power is shut off; the drive can be stopped from a full speed of 48 revolutions per minute in two and one-half seconds. In six seconds the table can be brought up to maximum speed in either direction. These figures include the time required to accelerate the large cone pulley of which the flywheel effect is greater than that of the table and all gearing.

3. No peak loads drawn from the line, and no heating of the hydraulic drive. When the boring mill is rapidly accelerated or stopped, as described in the preceding paragraph, the maximum accelerating torque is communicated to the hydraulic motor as soon as the hydraulic pump is a short distance off center and working at a very short stroke with small power consumption. As the pump stroke increases, with a corresponding increase of the driving speed, the power increases toward the maximum, but the draft of power during the acceleration is never in excess of the maximum running load. The mill may be started, stopped, and reversed as often as desired, without heating the hydraulic drive.

4. Low maintenance and a minimum of attention required. This particular drive has had no attention whatever for periods of from three to six months at a time. The machine operator claimed that an electric drive would have required some attention at least once a week in the way of replacing fuses, soldering connections, etc.

* * *

PRACTICAL RESEARCH

By ARTHUR L. COLLINS

When one thinks of a laboratory, the natural conception is of a place where theorists work on purely scientific problems. The patience of the scientific investigator has won him many laurels, but has not gained him the support of the man in the shop who depends on the skill and speed of his hands and rule-of-thumb methods to meet any demands for increased production that may arise.

There are many factories where a works laboratory would not be tolerated. A common expression of factory executives is, "Oh, if we had the money we might install a laboratory, but we are getting along all right now, so what's the use?" This is the attitude taken by many executives, and they will probably stick to it until they are either replaced by more progressive leaders, or their firms are forced out of business by more wide-awake competitors.

Rule-of-thumb methods of manufacturing are still adhered to in many plants, in spite of the great number of trade associations and organizations established for the mutual benefit of those engaged in practically every line of endeavor. There has been a decided awakening, however, on the part of the majority of American business men. The great amount of good to be derived from the association of men engaged in the same lines of business is becoming more clearly recognized. Men are now coming together to discuss their problems, and are telling what used to be considered trade secrets. They are looking at such things in a broader way than heretofore, and have come to realize that their own business is often benefited by a competitor's success.

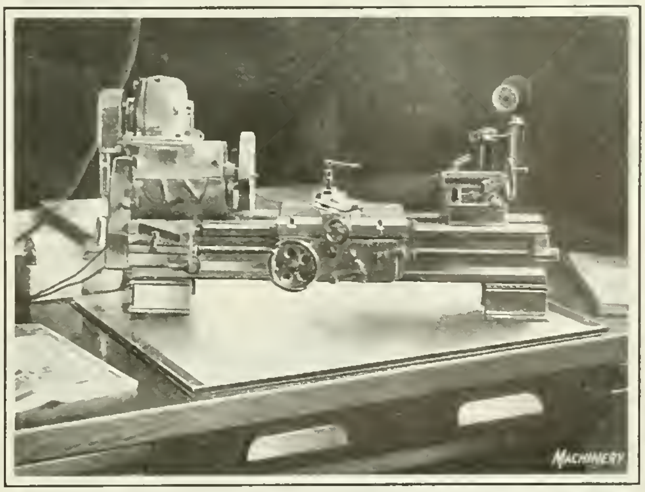
The great research laboratories of such corporations as the Eastman Kodak Co., the General Electric Co., the United States Steel Corporation, etc., have been of such inestimable value that smaller companies have been led to follow their example. The president of a large steel company recently made the statement that the science of today is the practice of tomorrow. The truth of this has been demonstrated many times, and has led to the expenditure of vast sums in purely scientific experimentations. What is considered the science of yesterday is available for the business man of today, if he will but use it. One of the best ways to do this is to establish a works laboratory and place it in charge of a scientifically trained man. Briefly stated, the functions of such a works laboratory are to apply scientific principles to the manufacture of the firm's product, so as to raise the standard of quality and still keep the cost at a minimum.

If placed in charge of the proper man, the laboratory should be the best paying department of a business. We have not as yet attained 100 per cent efficiency in any mechanical process and we probably never will, but it is the aim to eliminate as much waste as possible, and this aim must be more earnestly striven for by most American firms. Foreign manufacturers with low labor costs can compete favorably with us even with our intensive production, and it is therefore necessary to keep production costs at a minimum.

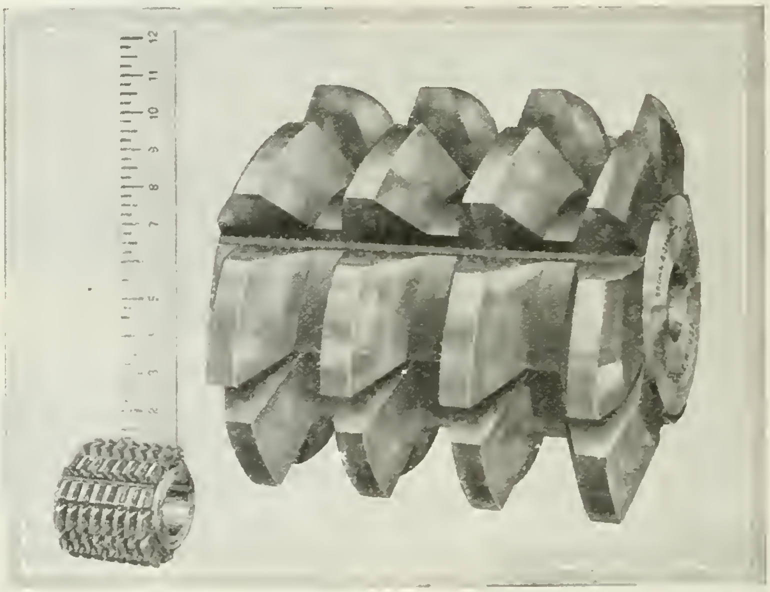
* * *

WORKING MODEL OF A LATHE

The lathe model shown in the accompanying illustration is a miniature of a Type S geared-head motor-driven lathe built by the Sebastian Lathe Co., Cincinnati, Ohio, which has a swing of 15 inches and a bed length of 6 feet. The model, which is built to one-third scale, performs all the functions of the full-sized machine. An idea of its size can be obtained by comparing it with the telephone and other objects on the desk on which the lathe rests. The model is built 90 per cent from aluminum, and weighs about 60 pounds.



Model of Sebastian Geared-head Quick-change Lathe



This sizeable Brown & Sharpe Ground Hob is the largest of a complete set we recently made for a well-known gear manufacturer.

Three Features of

BROWN & SHARPE GROUND HOBS

Accuracy of Form

Grinding the teeth on the form corrects all hardening distortions and allows a Ground Hob to be used from one end to the other, there being no errors in form to limit its use.

Duplication of Accuracy

As grinding is a positive means of controlling the tooth form, any Brown & Sharpe Ground Hob may be accurately duplicated when necessary. Gear Manufacturers can duplicate the accuracy of these Ground Hobs in their finished gears—thereby securing the uniformity and precision required in high-grade gears.

Increased Production

The correction of all hardening distortions by grinding the hob teeth on their form prevents any one tooth or group of teeth from doing the major part of the work. The freer cutting action which comes from each tooth doing its share results in increased production and longer service between resharpenings.

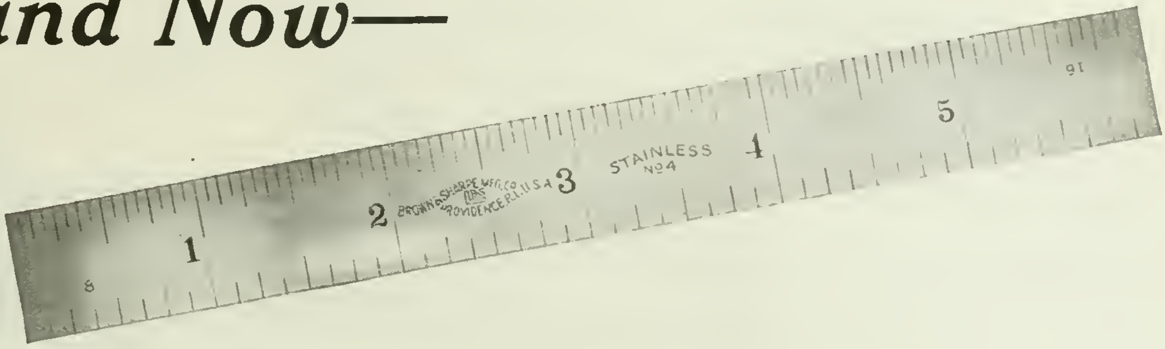
Consider the three features of Brown & Sharpe Ground Hobs—Higher Accuracy, Greater Uniformity and Increased Production—in reference to your own gear-cutting requirements.

Write today for the list of Brown & Sharpe Ground Hobs carried in stock.

BROWN & SHARPE MFG. CO.

Providence, R. I., U. S. A.

and Now—



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Rustproof—will not stain or discolor, but will always retain its bright finish—clean cut graduations in 8ths, 16ths, 32nds and 64ths, of the characteristic Brown & Sharpe accuracy.

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Ask for No. 350—You'll like it.

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Providence, R. I., U. S. A.

POWER FOR CUTTING METALS

The results obtained in a ten-year investigation made by the Kempsmith Mfg. Co., Milwaukee, Wis., into the subject of the power required for cutting metals on milling and drilling machines, lathes and planers, were discussed in a paper presented by Fred A. Parsons before the annual meeting of the American Society of Mechanical Engineers. In his summary Mr. Parsons stated that in taking slabbing or face-milling cuts, the power economy increases (1) as the number of revolutions per minute of the cutter is decreased, but only if this increases the chip thickness, as in machines having the feed rate independent of the spindle speed; (2) as the feed per revolution of the cutter is increased; (3) as the number of teeth in the cutter are decreased, but only if the number of revolutions per minute remains constant, thus increasing the chip thickness; and (4) as the front rake is increased.

Also, for spiral and slabbing cutters the power economy increases (1) as the cutter diameter is decreased, and (2) as the depth of cut is increased. For face milling cutters the power economy increases (1) as the cutter diameter is increased; (2) as the width of cut is decreased; (3) as the corner radius or chamfer is decreased; and (4) as the depth of cut is increased, but only when the blades have a rounded or chamfered corner.

With lathes, planers, etc., the power economy increases (1) as the feed per revolution or per stroke is increased; (2) as the round on the tool point is decreased; (3) as the angle of the tool face with the direction of the feed is decreased; (4) as the cutting rake is increased; and (5) as the depth is increased, but only if the end of the tool is rounded.

For drills, counterbores, etc., the power economy increases (1) as the feed per revolution is increased; (2) as the number of flutes or cutting edges is decreased; (3) as the spiral angle or cutting rake is increased; and (4) as the drill is ground with a smaller included angle of point.

While this summary points the way to a greater power economy, Mr. Parsons states that the possibilities must in many cases be subordinated to practical considerations. On a milling machine, for instance, too slow a cutter speed, too few teeth in the cutter, and too high a feed, though desirable for cutting efficiency will cause hammering, and usually the work and jigs will not stand this, even if the machine would. In certain cases this can be overcome by using helical milling cutters with a large angle of the teeth, but not always.

In certain other important details, also, a given set-up may fail in operation, even though the computed power is well within the cutting capacity of the machine. Almost any machine may be caused to chatter, or may chatter on certain speeds and feeds, even though the cut is fully within the capacity of the machine—in fact, often because the cut is too light or the cutters too sharp to put an initial strain on the supporting structure and take out the slack. More often it is due to synchronized vibrations, which are difficult to avoid for all conditions. Of two spindle speeds, both may be equally efficient in the transmission of power and have equal belt-horsepower capacity, yet the gear leverages and bearing and shaft stresses by which one is obtained may be excellent, while for the other they may be very poor, causing unsatisfactory cuts, chatter, and failure.

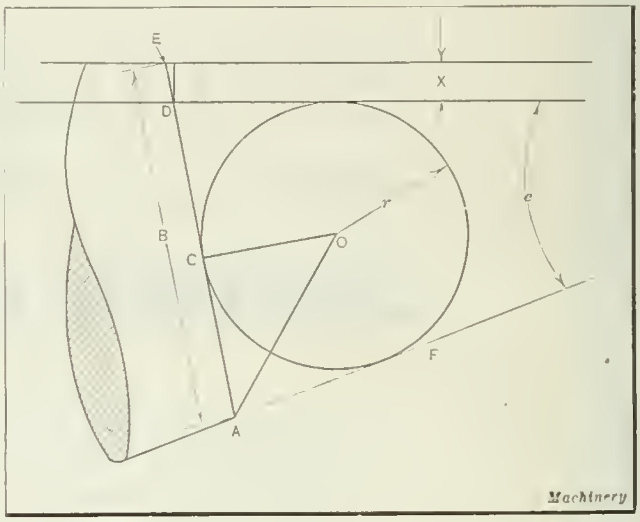
As another instance of practical limitations (though this applies only to spiral milling cutters) it might be supposed that more teeth in the cutter would give equal power economy with greater production per unit of time, provided the feed was increased to give the same average thickness of chip, because more chips would be cut per minute by the greater number of teeth. However, not only is there danger of chip interference, but if it be considered that the number of revolutions per minute for a given cutter is limited for any given material, and that the feed per revolution is limited in most cases by the finish required—which is generally accepted as being determined for spiral milling cutters by revolution marks and not by tooth marks—it will be seen that a point is soon reached where the only way left to increase the average chip thickness and obtain greater economy is to reduce the number of teeth. The only limit in this direction is, as before mentioned, the hammering action of the cutter. As the cut approaches the limit of the power capacity of the machine, the advantage of few teeth in the spiral milling cutter becomes very marked in its effect upon production.

* * *

MEASURING DIAMETER AT SMALL END OF TAPER PLUG GAGE

By C. N. PICKWORTH

A method of measuring the diameter at the small end of a taper plug gage was described on page 194 of November MACHINERY. The writer believes that the following method is somewhat simpler and more direct. Referring to the accompanying diagram, e = angle of taper, r = radius of disk, and X = the difference between the measurement taken over the plug gage and the measurement taken over the disk when the top edge of the gage is parallel with the surface plate.



Method of measuring Diameter at Small End of Taper Plug Gage

In the diagram, angle CAO = angle $OAF = \dfrac{90 - (e \div 2)}{2}$

Hence

$$AC = r \cot\left(\frac{90-(e \div 2)}{2}\right)$$

and

$$AD = 2r \cot\left(\frac{90-(e \div 2)}{2}\right)$$

Then

$$DE = X \sec (e \div 2)$$
$$AD + DE = B$$

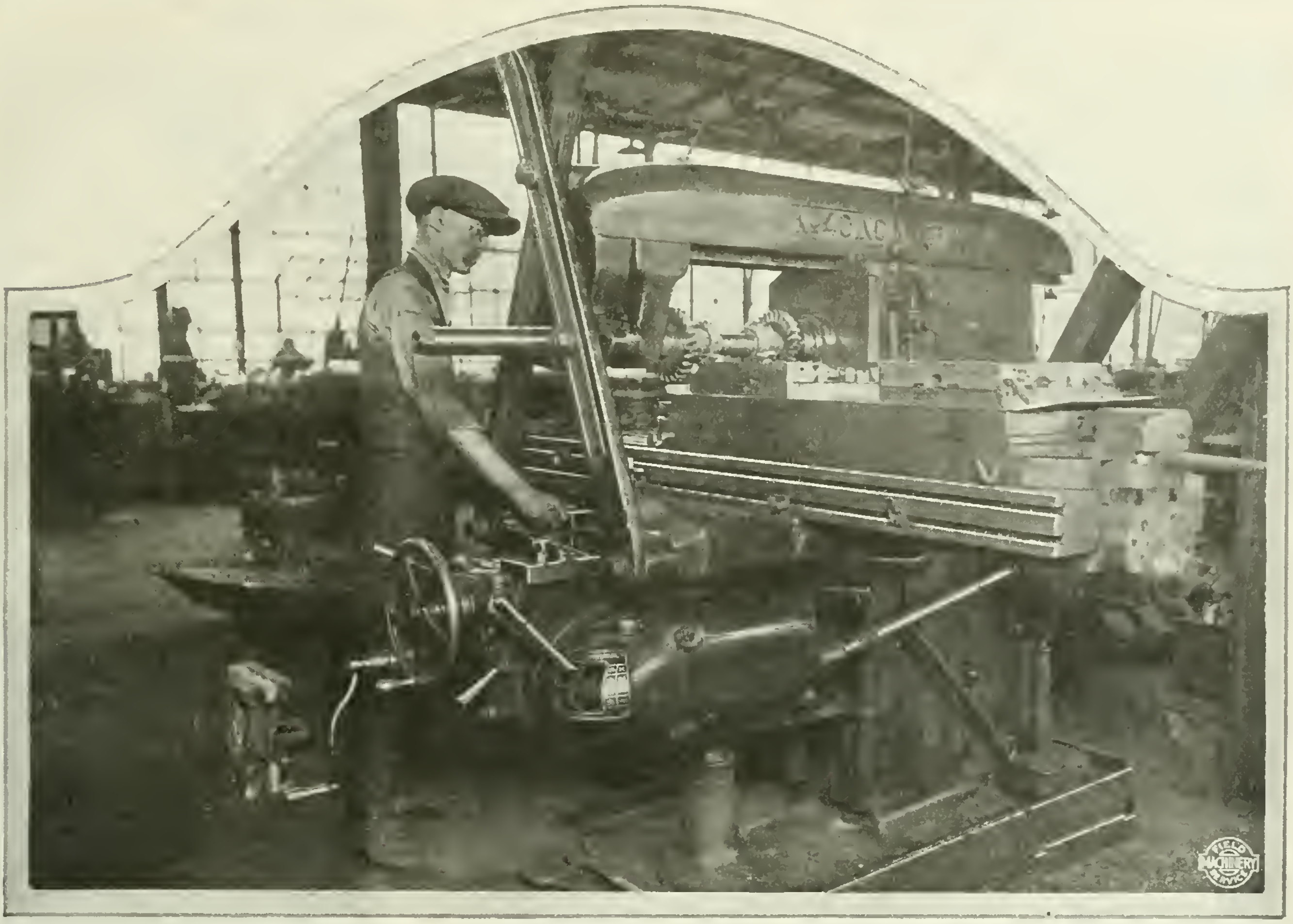
and

$$B = 2r \cot\left(\frac{90-(e \div 2)}{2}\right) + X \sec (e \div 2)$$

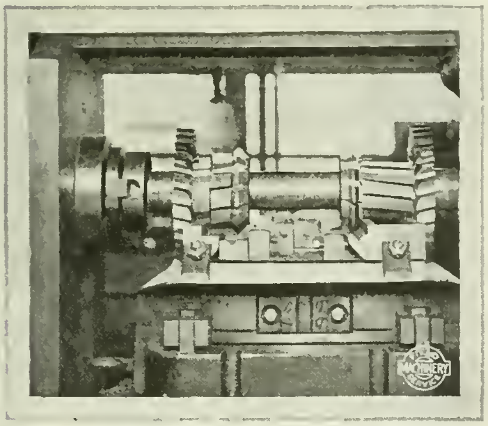
* * *

CORRECTION

In the article appearing on page 393 of January MACHINERY, "Improvised Attachment for Bevel Gear Cutting," it is stated that the attachments described are used on a Gould & Eberhardt spur gear cutting machine. This is an error, because the illustrations show a "Newark" gear cutting machine, built by the Newark Gear Cutting Machine Co., Newark, N. J.



The *Right* Way To Do This Job



A powerful drive is provided for the large gang of cutters by the flanged spindle with a 14 taper spindle hole. The self aligning Rectangular Overarm in conjunction with the outer arbor supports give the rigidity necessary to obtain the accuracy and finish required.

One of these cast-iron lathe bed carriages is finished all over to limits of .001″, ready for scraping, every 41 minutes.

Cincinnati No. 4 Plain High Power features made this time possible.

For each operation two pieces of work are mounted, one at each end of a 16″ x 36″ Index Base, held on the machine table.

Operator loads while milling. Dog controlled power quick traverse and feed practically eliminate non-productive time.

Cincinnati No. 4 and No. 5 High Power Millers possess every milling convenience. A special booklet has been prepared for your use. Send for it.

The CINCINNATI MILLING MACHINE COMPANY
CINCINNATI, OHIO

CINCINNATI MILLERS

PERSONALS

G. M. Horton, who has been general manager of the Cisco Machine Tool Co., Cincinnati, Ohio, since its incorporation, has resigned.

Marvin E. Monk has been made director of sales for the U. S. Ball Bearing Mfg. Co. of Chicago, Ill., manufacturer and distributor of ball bearings. Mr. Monk has for some time past been assistant sales manager of the company.

Arthur H. Keetch, sales representative of the Warner & Swasey Co., Cleveland, Ohio, for the Buffalo territory, with headquarters in the Iroquois Bldg., Buffalo, N. Y., has been appointed district sales manager for the Buffalo and Pittsburg districts.

Ralph L. Glaser, who for several years has been the Connecticut sales representative of the Warner & Swasey Co., Cleveland, Ohio, has been appointed New England district manager, with headquarters in the Oliver Bldg., Boston, Mass. Mr. Glaser succeeds H. L. Kinsley, who recently passed away after being with the Warner & Swasey Co. for seventeen years.

Joseph R. Sheppard, who for a number of years was hydraulic engineer in charge of the hydraulic machinery department of R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa., and who has acted as consulting engineer for the Espen-Lucas Machine Works for the last two years, has again resumed full charge of the engineering department for hydraulic machinery of R. D. Wood & Co.

J. E. Yorkston, who for the last fifteen years has been engineer in charge of the drafting department of the General Electric Co., Schenectady, N. Y., has been promoted to the position of consulting mechanical engineer. In his new capacity Mr. Yorkston will assist the designing engineers of the company in connection with important mechanical problems, and will also serve as a consulting authority in all matters pertaining to drafting practice.

C. W. Couch and **Frank DeWitt** have opened sales offices in the Plymouth Bldg., Cleveland, Ohio. They will represent the following companies: The Cuyahoga Steel & Wire Co., the Columbus Works Co., the Muncie Cap & Set Screw Co., and the Perry-Fay Co. Mr. Couch has been connected with the Western Automatic Machine-Screw Co. and the Perry-Fay Co. for the last twelve years. Mr. DeWitt has been connected with the Ross Mfg. Co. for the last six years as treasurer and general manager.

Fitch S. Bosworth has been appointed manager of the Chicago office of the Chain Belt Co., Milwaukee, Wis. Mr. Bosworth has been in charge of the St. Louis office for the last three years, and has specialized on chain and conveying engineering problems. **Raymond X. Raymond**, who has been connected for several years with the export sales department in Milwaukee, will be associated with Mr. Bosworth in the Chicago office. **Thomas F. Scannell**, formerly of the Chicago office, has been placed in charge of the St. Louis office. This company manufactures Rex chain conveying machinery, traveling water screens, and concrete mixers.

Jacques Fenwick, of the firm of Fenwick Freres & Co., of Paris, who has been in the United States for the last three months, studying industrial conditions and visiting builders of machine tools and small tools, sails for France, February 3, on the *George Washington*. Mr. Fenwick, during his visit here, made an extended trip through the country, visiting practically all the important industrial centers and spending a great deal of time in American shops and factories. He was much impressed with America, and commented on the cordial reception that he received everywhere. He also stated that he found American manufacturers always willing to cooperate with the foreign dealer in developing any possible foreign trade, although present conditions unfortunately make it very difficult to take advantage of this spirit of cooperation.

OBITUARIES

Wallace P. Hurley, for the last twelve years a member of the sales organization of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., died at New Hope, Pa., November 28, of sleeping sickness. Mr. Hurley was a graduate of Purdue University, class of 1906. In 1910 he left a position as instructor in the electrical engineering course at the Carnegie Institute of Technology to work for the Westinghouse Electric & Mfg. Co. as a correspondent in the illuminating section of the supply department, and later became manager of that department. In August, 1918, Mr. Hurley left to take a commission in the Searchlight Division of the Signal Corps of the United States Army. At the end of the war he returned to the Westinghouse Company and was assigned to the New York sales office, where he represented the company among a number of the larger central stations. He held this position at the time of his death. Mr. Hurley was a member of the American Institute of Electrical Engineers and of the Illuminating Engineering Society.

A. B. LANDIS

A. B. Landis died December 20 from heart failure, at the age of sixty-nine. Mr. Landis was one of seven children. He learned his trade as a machinist in the shops of Frank F., and Ezra F. Landis of Lancaster, Pa. In 1874 he became a partner of his brother, under the firm name of F. F. & A. B. Landis. This firm was engaged in the manufacture of small stationary engines and portable steam engines. In 1878 the business was sold to the Geiser Mfg. Co., of Waynesboro, Pa. Mr. Landis remained with this concern in charge of the tool department for a number of years, during which time he developed many new tools, and was largely instrumental in introducing interchangeable manufacturing methods in the plant. While he was connected with this company he developed the first Landis grinding machine.

In 1890 he again entered into partnership with his brother Frank F. Landis under the firm name of Landis Bros., to engage in the manufacture of cylindrical grinding machines. The plant was destroyed by fire on April 27, 1897, but within twenty-four hours a stock company had been formed under the name of the Landis Tool Co., and a new plant was quickly built. Mr. Landis was connected with this company until 1910 as mechanical engineer and superintendent.

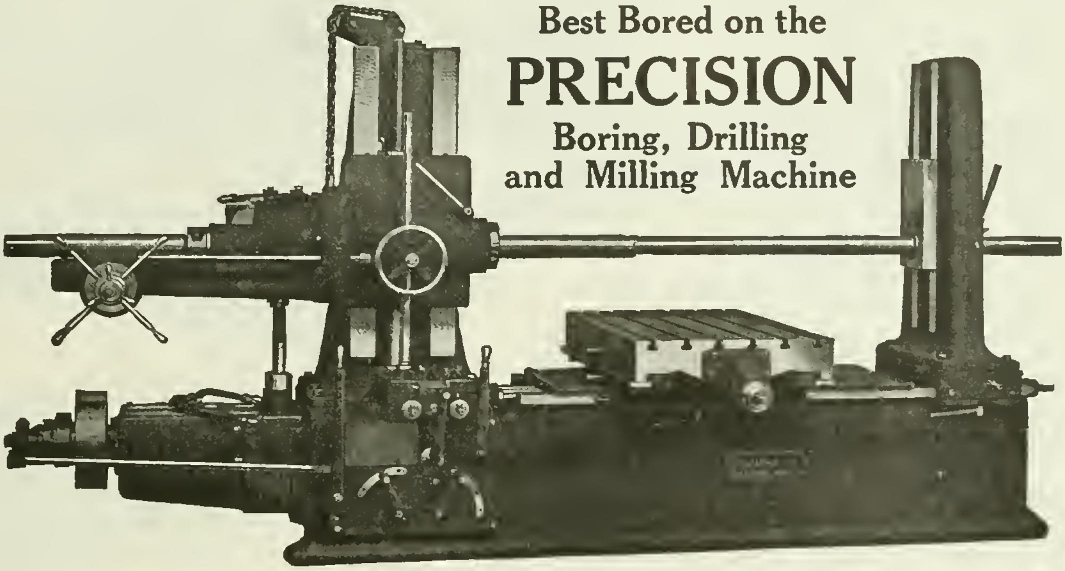
The possibilities of his grinding machine were quickly recognized by the trade, and the new company expanded rapidly to its present capacity. In 1903 the Landis Machine Co. was organized to manufacture the Landis threading machine, which was originally developed by Mr. Landis.

In the fall of 1910 Mr. Landis severed his connection with both the Landis Tool Co. and the Landis Machine Co., taking up his residence at Chestnut Hill, Philadelphia, where he opened an engineering laboratory for the development of many inventions, chief among which was a mechanical speed-change mechanism for automobiles, machine tools, etc. In the fall of 1919 he organized th firm of A. B. Landis & Sons to engage in commercial grinding and the development of mechanical ideas. He was actively connected with this business up to the time of his death.

* * *

It is reported that in various parts of Germany barter is replacing the use of money; for instance, the Weimar Board governing the agricultural schools of Triptis and Marksujl has fixed the tuition for the winter term in rye instead of money, and the Saxon Thuringian Power Co., at Auma has announced that it will gladly receive, instead of cash, ten eggs, three pounds of wheat flour, or twenty-five pounds of potatoes for each kilowatt hour of electricity consumed.

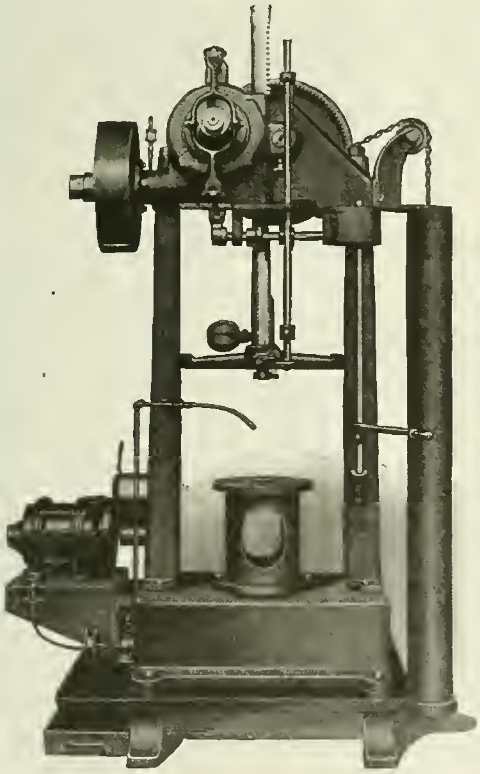
HOLES



Best Bored on the

PRECISION

Boring, Drilling
and Milling Machine



Best Bushed
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**LUCAS
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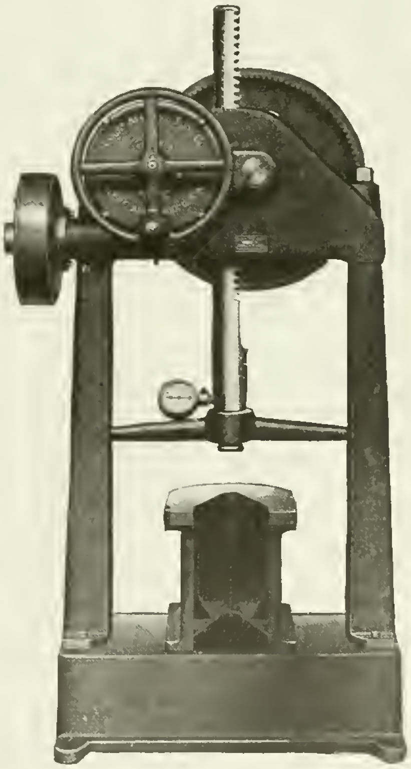


LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokio, Japan.

TRADE NOTES

Barbour, Love & Woodward, Inc., dealers in machine tools and machine shop equipment, have removed their offices from 45 W. 18th St. to the Grand Central Terminal Bldg., New York City.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., announces that F. Rodger Imhoff, formerly sales manager and consulting engineer of the company, is no longer connected with the organization.

Foster Machine Co., Elkhart, Ind., manufacturer of turret lathes and screw machines, has established an office in New York City at 30 Church St., Room 332. E. H. Warner, formerly with the Fairbanks Co., will be in charge.

Riley & Foster, manufacturers' agents, with headquarters in Baltimore, Md., and Richmond, Va., have been appointed southern representatives for the Dolman Mfg. Co., Inc., Springfield Mass., manufacturer of the Dolman screwdriver.

Cling-Surface Co., Buffalo, N. Y., announces that it can now supply Cling-Surface belt preservative in heavy, medium, and light consistency or in bars. This extension of the line adapts the product to all kinds of plant conditions.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., manufacturer of pneumatic and electric tools, has appointed Blake C. Hooper of Minnesota Supply Co., Pioneer Bldg., St. Paul, Minn., as special railroad agent in the Northwest for the sale of the "Thor" line of tools.

Consolidated Tool Works, Inc., 296 Broadway, New York City, is represented in Illinois, Wisconsin, Minnesota, Indiana, Iowa, Missouri, Nebraska, Kansas, Michigan, North Dakota, South Dakota, Ohio, and Louisville, Ky., by Jules N. Winsten, formerly of the Bancroft Corporation, Worcester, Mass.

Master Electric Co., Dayton, Ohio, presented life insurance policies as a Christmas gift to all its employes, ranging from $500 up to $2000. The smaller policies will be increased each succeeding year until a limit of $2000 is reached, with all premiums paid as long as the employe remains with the company.

Wayne Tank & Pump Co., Fort Wayne, Ind., recently celebrated its thirtieth birthday by moving the executive offices into a new administration building. A new light-metal tank plant has also just been completed, and the painting, crating, and shipping departments have been enlarged.

Oxweld Acetylene Co., Newark, N. J., has recently moved its western department from 1077 Mission St., San Francisco, Cal., to larger quarters at 1050 Mission St. The western department of the company also maintains offices at Los Angeles, Portland, Seattle, Salt Lake City, and El Paso. Leo Romney is manager.

General Electric Co., Schenectady, N. Y., has allotted $37,500 to the University of Illinois, to continue an investigation relating to the fatigue of metals. The company is particularly interested in this subject because of the need of a metal that will withstand the strain of vibration to which metal is subjected in steam turbines.

Anglo-American Industrial Diamond Co., Inc., 14 W. 40th St., New York City, announces that J. S. Rose and H. R. Spandel have been appointed managers of the company, which will market in the United States the industrial diamonds of the Anglo-American Industrial Diamond Co., of London, England. The new corporation will handle industrial diamonds (bort) of all qualities and kinds.

Cleveland Stone Co., 1836 Euclid Ave., Cleveland, Ohio, has purchased the plant and equipment of the Sterling Grinding Wheel Co., Tiffin, Ohio, and expects immediately to enter the field of artificial abrasives. The Cleveland Stone Co., already a well-known producer of natural abrasives, has added a staff of service men and ceramic engineers to its organization, preparatory to entering the artificial abrasive field.

Van Norman Machine Tool Co., Springfield, Mass., builder of milling machines, internal grinders, ball raceway grinders, and bench lathes, announces that the Detroit sales office of the company is now managed (effective January 1,) by R. A. Griswold, who in the past represented the Rivett Lathe & Grinder Co. in Detroit, Mich., and in other sections of the country, and was with B. C. Ames Co., Waltham, Mass., as field representative.

Metal & Thermit Corporation, 120 Broadway, New York City, has recently equipped its Jersey City welding shop for making welds on lighter sections by means of the oxy-acetylene and electric processes, this service being in addition to the present facilities of the shop for undertaking thermit welding repairs. The policy of equipping the welding shops with oxy-acetylene and electric welding facilities will later be extended to the other welding plants of the company.

Gibb Instrument Co., Bay City, Mich., manufacturer of "Zeus" welders, has taken over, under exclusive license, the manufacture and sale of the automatic and semi-automatic patented electric arc welding machines developed and heretofore manufactured by the **Fred Pabst Co.**, of Milwaukee, Wis., and has contracted to act as selling agent for the Pabst line of patented covered electrodes. The Fred Pabst Co. has spent over two years in the development of this line of equipment.

Timken Roller Bearing Service & Sales Co., Canton, Ohio, has been formed in order to add the final link in the chain of complete control that the Timken Roller Bearing Co. exercises over its product from the raw material to the sale and maintenance of the finished bearing. The new company will bring the service work for Timken bearings directly under the supervision of the Timken Roller Bearing Co. Thirty-two direct factory branches are maintained in as many of the leading cities of the United States and Canada. In addition, authorized distributors will be located in smaller cities.

Onondaga Trading Co., Inc., Syracuse, N. Y., moved its office about February 1 to Fourth, North, and Free Sts., where a large addition has been built to the sterilizing and washing plant. The new building in which the office is located is of modern concrete and steel construction. The total floor space of the plant has been increased from 8000 to 20,000 square feet, and the capacity from 4000 to 20,000 pounds per day. This concern specializes in the grading, washing, sterilizing and baling of wipers for use in industries where waste is often utilized. Seventeen grades are produced and sold under different brand names.

Morse Chain Co., Ithaca, N. Y., has found it necessary to construct a new factory in Detroit, Mich., owing to the increasing demand for silent chain front-end drives. The company has previously operated a factory in Detroit in a leased building. The plant at Ithaca will be continued as at present. The new factory consists of a one-story building, of reinforced concrete construction, providing a total manufacturing area of 60,000 square feet, in addition to quarters for the sales and engineering offices. Provision has been made for expansion to a floor area four times that of the old plant. The Detroit factory will manufacture all the sprockets and adjustments used in Morse front-end drives.

* * *

HERRINGBONE GEAR STANDARDS

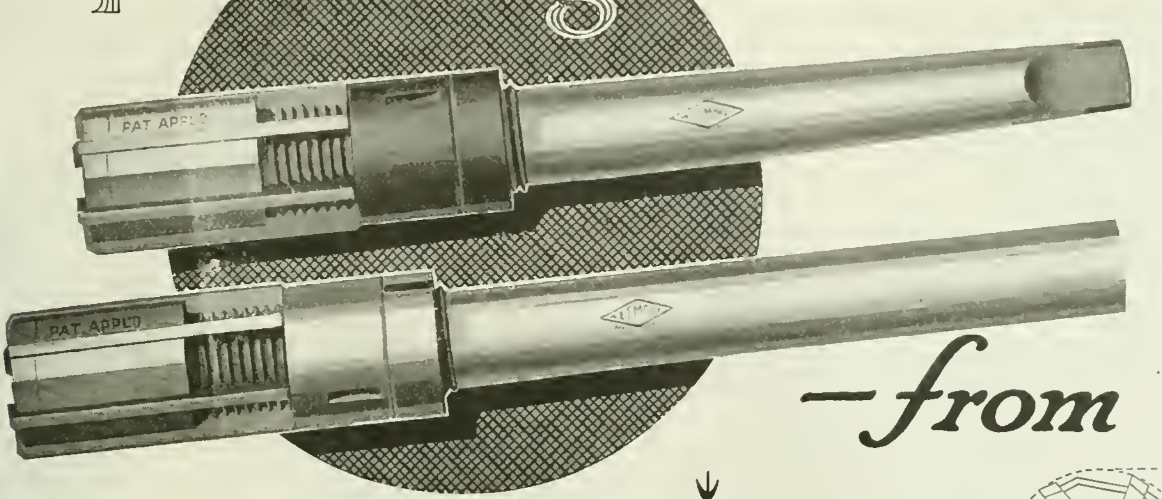
Standards for herringbone gears intended for commercial use have been prepared by the Sectional Committee on the Standardization of Gears, and presented for final approval to the American Gear Manufacturers' Association and the American Society of Mechanical Engineers, joint sponsors in the preparation of standards for gears. With respect to the tooth form, the herringbone gear standards deal with the pressure angle, addendum, dedendum, clearance, whole depth, helical angle, and dimensions to be added for the enlargement of pinions.

In considering the gear blank, standards are given for the following dimensions: Pitch diameter, outside diameter, minimum width of active face, and width and depth of groove at center of blank for gears cut with hobs at right angles to the axis of the gear, with single threaded hobs set at the proper angle with the axis of the gear, and by planing or shaping. A formula is also given for determining the horsepower rating for pitch line velocities up to 2000 feet per minute. Four tables and various other formulas are included in these standards. They are presented in full in the February number of *Mechanical Engineering*, published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

* * *

The United States Civil Service Commission has an opening for a mechanical engineer to take charge of the design, construction, and repair of the instruments used in the field and office by the Coast and Geodetic Survey and to do other related work. Applicants for this position should apply for Form 1312, stating title of the examination desired (mechanical engineer—precision instruments), to the Civil Service Commission, Washington, D. C. Applications must be filed with the Civil Service Commission prior to the hour of closing business on February 20.

Expanding Reamers



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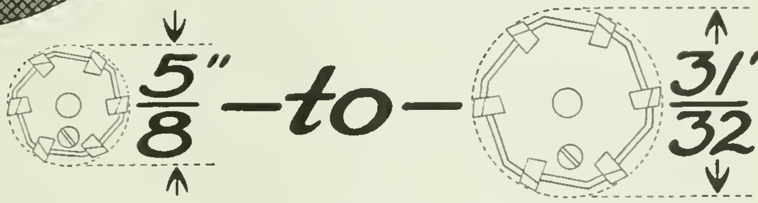


Blades for all Wetmore Reamers

Wetmore Blades are scientifically ground to the exact bevel best suited for working various metals—steel, cast iron, bronze, etc. Best high-speed steel, ground to thickness, length and on seat. Tested for hardness and toughness. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron or bronze.

Free Handbook!

Write on your business letterhead for complimentary copy of the Wetmore Reamer Reference Book. An authoritative work on latest designs of Expanding Reamers. Sent to you *free, postpaid*—without obligation to you.

Guaranteed Accuracy

RANGING in size by thirty-seconds from 5/8" to 31/32" inclusive—straight or taper shank—these Wetmore Expanding Small Machine Reamers fill a distinct need in plants where extreme accuracy and production speed are important.

In expanding these small reamers, there are no unnecessary screws to be loosened. Expansion is taken care of by a cone nut and lock nut at rear of blades. The straight blades are held securely by a special, exclusive method. These Wetmore "little fellows" set a new standard of quality, accuracy and durability. Try them and see.

There are other Wetmore Reamers, too—in designs and sizes for every need. Here are some of the important Wetmore advantages:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring of the reamer while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

There are several other Wetmore features you should know. Write today for our handbook-catalog which describes and illustrates the Wetmore Reamers that are becoming standard equipment in so many large plants.

Wetmore Reamer Company

60-64 27th St., Milwaukee, Wisconsin

Manufacturers of Expanding Reamers and Cylinder Reaming Sets, Arbors, Blades and Thread Gauges

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

COMING EVENTS

February 8-9 (note change of date from February 15-16)—Sectional meeting of the American Society for Steel Treating, City Club, Chicago, Ill. National secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

February 14-16—Convention of the American Institute of Electrical Engineers at the Engineering Societies' Bldg., 29 W. 39th St., New York City.

February 17-22—Exposition of inventions and patents to be held at the Grand Central Palace, New York City, under the auspices of the Universal Patent Exposition Corporation. World's Tower Bldg., 110 W. 40th St., New York City.

February 19-21—Annual meeting of the American Institute of Mining and Metallurgical Engineers at the Engineering Societies' Bldg., 29 W. 39th St., New York City.

February 27—Joint meeting of the Engineers Club of Philadelphia and the Philadelphia sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers at the Engineers Club, 1317 Spruce St., Philadelphia, Pa.

March 18-24—Second general meeting of the International Chamber of Commerce in Rome, Italy. Lacey C. Zapf, secretary American Section, Mills Bldg., Washington, D. C.

April 9-14—Paper Industries Exposition to be held at the Grand Central Palace, New York City. Charles F. Roth and Fred W. Payne, managers, Grand Central Palace.

April 18-20—Spring convention of the Society of Industrial Engineers, at Hotel Gibson, Cincinnati, Ohio. Further information can be obtained from the business manager of the society, 327 S. La Salle St., Chicago, Ill.

April 25-27—Tenth National Foreign Trade Convention in New Orleans, La. O. K. Davis, 1 Hanover Square, New York City, secretary.

April 28-May 3—Twenty-seventh annual convention and seventeenth annual foundry machine and equipment exhibit of the American Foundrymen's Association at Cleveland, Ohio. C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill., secretary.

May 3-5—Semi-annual meeting of the American Electro-chemical Society at Hotel Commodore, New York City. Secretary, Colin G. Fink, 327 S. La Salle St., Chicago, Ill.

May 15-18—Annual convention of the National Association of Purchasing Agents at Cleveland, Ohio. Secretary, O. H. R. Heydon, 19 Park Place, New York City.

June 25-29—Annual convention of the American Institute of Electrical Engineers at Swampscott, Mass. For further information, address the secretary's office, 29 W. 39th St., New York City.

June 25-29—Twenty-sixth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa., secretary.

NEW BOOKS AND PAMPHLETS

The Working of Steel. By Fred H. Colvin and K. A. Juthe, 245 pages, 6 by 9 inches; 135 illustrations. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City.

This is the second edition of the authors' book on the annealing, heat-treating, and hardening of carbon and alloy steels. It deals with the elements of the processes used in steel making, the composition and properties of steel, alloy steels, steels used in the Liberty engine and their application to the automotive industry, the forging of steel, annealing, casehardening, hardening of carbon and high-speed steel, furnaces, and pyrometers.

Cost Accounting Procedure. By William B. Castenholz. 335 pages, 6 by 9 inches; 70 diagrams and illustrations. Published by the La Salle University Press, Chicago, Ill.

In this book the author not only covers the underlying principles of cost accounting and their application, but also describes actual methods of keeping cost accounts. The book is particularly intended for cost accounting in manufacturing plants, and covers material costs, store records, pay-roll records, labor reports, direct labor costs, factory overhead, machine burden, factory overhead distribution, foundry cost accounting, wage systems, operation of a cost department, installation of a cost system, and many other subjects equally important in the financial management of an industrial undertaking.

Rapid Arithmetic. By T. O'Conor Sloane. 190 pages, 5 by 7½ inches. Published by D. Van Nostrand Co., 8 Warren St., New York City. Price, $1.50.

This book on arithmetic is intended to supplement the ordinary text-book. It is more general in nature than most text books on this subject, and may be said to be popular in its appeal. Quick and special methods in arithmetical calculation are given, together with a collection of puzzles and curiosities of numbers. Several variant methods are included for performing addition, subtraction, multiplication, and division. These processes are followed by fractions, decimals, interest, discount, and percentage, powers of numbers, exponents, squaring the circle, and miscellaneous material.

Mechanical World Year Book for 1923. 348 pages, 4 by 6¼ inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 1s 6d.

This is the thirty-sixth year of publication of this little handbook for mechanical engineers. Of the new matter to be found in the present edition, attention is directed to the section that is devoted to fan work; this section contains material on ventilation, conditioning of air, humidification, airways, pressure losses in duct work, drying, dust and fume removing, cupola blast, mechanical draft, etc. The section on safe loads and deflection of beams has been rewritten and new illustrations have been added. The notes on belting have also been expanded, and revisions have been made in various other sections. Among the new tables is one giving the lengths of diagonals of certain sections, and a revised table of gages. Many new illustrations have been introduced. One of the valuable features of the book is the classified buyers' directory, which is published in English, French, Russian and Spanish.

The Fundamental Principles of Purchasing. By H. D. Murphy. 83 pages, 4¾ by 7¼ inches. Published by the Purchasing Agent Co., Inc., 19 Park Place, New York City. Price, $1.50.

Ten years ago practically nothing had been written on the science of industrial purchasing. This was due to the fact that there did not exist at that time organized methods in industrial buying. However, a marked change has taken place in the past decade, and today it is becoming recognized that efficient buying is governed by certain definite principles, the same as selling and other industrial activities. The fundamental principles that make for success in buying are outlined in this book. The author is purchasing agent of the American Radio & Research Corporation, and his training and experience have been drawn upon in the preparation of the work. It contains eleven chapters, headed as follows: Preparation; What the Purchasing Agent Should Do; the Knowledge of Materials; the Knowledge of Methods; the Knowledge of Men; Picking the Source of Supply; an Order is An Order; Organization; the Order and the Law; What the Purchasing Agent Should Read; The Position Higher Up.

Hendricks' Commercial Register of the United States. 2482 pages, 8½ by 11½ inches. Published by S. E. Hendricks Co., Inc., 70 Fifth Ave., New York City. Price, $15.

The thirty-first (1923) edition of Hendricks' Annual Commercial Register contains 150 pages more than the 1922 edition, and 125,000 changes and additions were made in bringing out the new edition. This register covers completely the electrical, engineering, machinery, building, manufacturing, chemical, and all other allied industries, giving lists of manufacturers useful to both buyers and sellers. Over 18,000 products are separately classified, with the name and address of every manufacturer or producer, together with trade names or brands. This classification makes reference easy on account of the system used for indexing and cross-indexing. Many of the old classifications have been revised and regrouped, and the recent radio trade has been thoroughly classified. The names of all manufacturers included in the register, in addition to being listed under the products manufactured or handled, are also included in an alphabetical section. An alphabetical list of trade names is also given with the name and address of the manufacturer. Purchasing agents and sales managers, and others interested in the buying and selling of the products covered by the register, will find the work of great value in their business.

NEW CATALOGUES AND CIRCULARS

Sanford Motor Truck Co., Syracuse, N. Y. Bulletin containing specifications of the Sanford six-cylinder motor truck known as the "Greyhound."

Louis Allis Co., Milwaukee, Wis. Bulletin 406, outlining the distinguishing features of the L-A heavy-duty motor, and describing the details of construction. Complete information is given on the various types.

Botwinik Bros., 21 Sylvan Ave., New Haven, Conn., dealers in machinery and mill supplies, with branch offices at 28-42 Drouve St., Bridgeport, Conn., is distributing a calendar for 1923 to the trade.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Circular illustrating and giving specifications for the "Thor" pneumatic safety rivet buster, which is capable of cutting off and backing out rivets of all sizes.

Midwest Steel & Supply Co., Inc., 28 W. 44th St., New York City. Folder entitled "Steel Sections for Overhead Shafting and Anchorage Problems," illustrating and describing the company's products, which comprise box rails and steel stringers.

Whiting Corporation, Harvey, Ill. Bulletin 159 (superseding No. 141), dealing with the operation and the maintenance of Whiting electric cranes. Lists of repair parts are given, together with halftone illustrations of the different parts, numbered so that they may be easily ordered.

Elecdrive Mfg. Co., Inc., Syracuse, N. Y. Catalogue describing the construction and operation of the Elecdrive universal wrench, drill, stud, and screwdriver, which is equipped with off-set spindles, permitting operation in close quarters. The dimensions and prices of the different sizes are included.

Geneva Metal Wheel Co., Geneva, Ohio. Catalogue 16, illustrating and describing the Geneva steel wheels suitable for all kinds of portable outfits that do not run on rails, with the exception of automobiles. Among the types of wheels shown are industrial truck wheels for light and heavy duty.

Consolidated Tool Works, Inc., 296 Broadway, New York City. Catalogue D, illustrating and describing the company's pilot brand tools, including hacksaw frames, bit braces, planes, hand drills, breast drills, spring calipers and dividers, adjustable tap wrenches, tool- and tap-holders, self-reading micrometers, and screwdriving sets.

Edgar T. Wards Sons Co., Boston, Mass. Catalogue giving dimensions, prices, and other data of cold-rolled or cold-drawn steel, sheet steel, spring steel, steel tubing, and various brands of tool steel. General information is also included, as for example, automobile specifications for steel, metric equivalent tables, data on standard gages, and weight tables.

Alexander Milburn & Co., 1416 W. Baltimore St., Baltimore, Md. Miniature catalogue covering the Milburn line of welding and cutting equipment, which includes acetylene welding generators, compressing plants, oxy-acetylene plants, welding and cutting torches, oxygen, hydrogen, and acetylene regulators for welding or cutting, gages, welding rods, preheaters, etc. Copies will be sent upon request.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets, Nos. 9, 11, 12, 23, 24, 29, 32 and 83 FE, illustrating and describing installations of ball-bearings in mine car-wheel mountings, grinding or polishing heads, toolpost high-speed grinding spindles, machine tool change-speed gearing, equalizing wood saws, variable feed-change speed gear-box and table elevating mechanism of boring mills, worm-drive shaft mounting, and swing saws.

Cincinnati Planer Co., Cincinnati, Ohio. Catalogue entitled "Planer Operations," containing a large number of illustrations of actual installations of Cincinnati planers, indicating the capacity of these machines and the classes of work which they are particularly adapted to handle. A brief description of each job is included. The catalogue also contains a list of concerns using two or more of these planers and a partial list of railroads using Cincinnati planers.

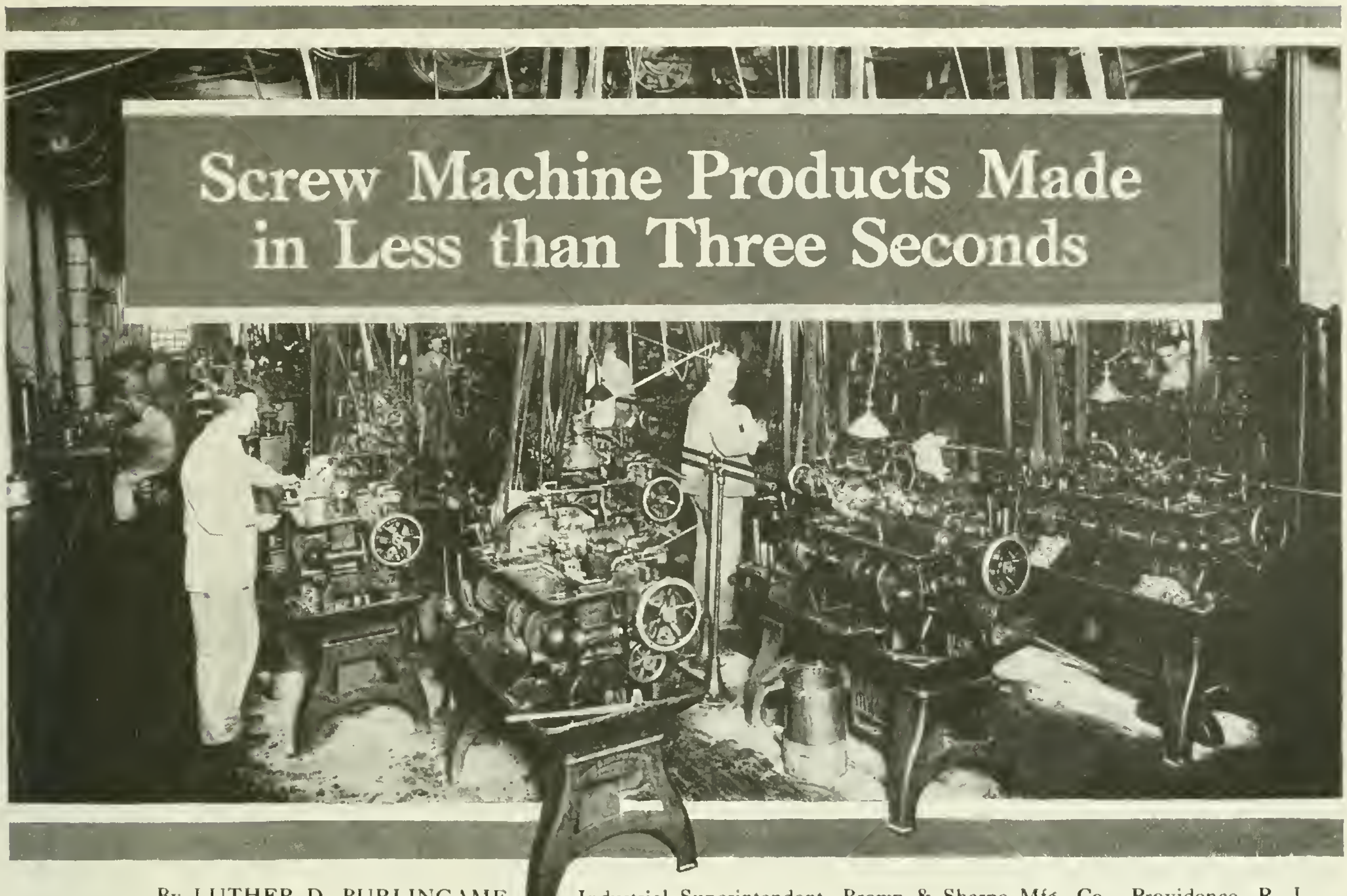
Wisconsin Electric Co., 2556 Sixteenth St., Racine, Wis. Circulars illustrating and describing "Dumore" portable grinders and drills. The circulars are illustrated with views showing applications of these tools on various classes of work. The portable drills are made in three models, 1-BD, 2-BD, and 2-AD, having capacities for drilling holes ¼ and ⅛ inch in diameter in steel, and are intended particularly for light production work requiring speed and accuracy, and for general repair and emergency work.

W. A. Jones Foundry & Machine Co., 4409 W. Roosevelt Road, Chicago, Ill. Catalogue 26, containing information relative to Jones spur gear speed reducers. This catalogue comprises a complete treatise on speed reduction drives, and is intended for consulting engineers, superintendents, chief engineers, master mechanics, and any one who specifies mechanical drives for factories, mills, mines, or plants. It contains technical information, complete descriptive matter, and illustrations of typical drives. One section of the catalogue shows pictorially installations of reducer drives in many large industrial plants. Dimensions, weights, and horsepower ratings for complete speed reduction sets are also given.

Norton Co., Worcester, Mass. Treatise on grinding, comprising 387 pages, 5 by 7½ inches, bound in green cloth. This a book dealing with the wheels, machines, and methods employed in modern grinding practice, and containing information as to the production and application of abrasives, grinding wheels, and grinding machines. The book has been compiled by members of the executive and technical staffs of the Norton Co., and covers the practice of grinding in a comprehensive manner. An idea of the subjects dealt with can best be given by reference to the chapter heads, as follows: Definition and Field of Grinding; Abrasives; Manufacture of Grinding Wheels; Selection of Grinding Wheels; "Hand" and Semi-precision Grinding; Tool and Cutter Grinding; Machines for Precision Grinding; the Cylindrical Grinding Machine; Efficient Production of Cylindrical Work; Steadyrests; Crankshaft Grinding; Roll Grinding; Form Grinding; Cam Grinding; Plain Surface Grinding; Internal Grinding; Miscellaneous Applications of Grinding; Polishing and Lapping; Devices for Truing and Dressing Grinding Wheels; Care and Safe Use of Grinding Wheels; Operation of Grinding Wheels in Machine Grinding. The price of the book is $1.

MARCH MACHINERY 1923

Screw Machine Products Made in Less than Three Seconds



By LUTHER D. BURLINGAME, Industrial Superintendent, Brown & Sharpe Mfg. Co., Providence, R. I.

Examples Showing how Rapid Production is Obtained by Careful Tooling and Machine Timing

IN these days of split-second stop-watches, it is apparent how much depends on saving time to the fraction of a second; in some cases the difference between success and faiure may depend upon that fraction of a second. When many duplicate pieces of work are to be produced, a small saving in time on each piece may amount to a surprisingly large saving in the total, and when the time required to make a given piece is short, such a saving is relatively larger in proportion to the total time, thus representing a greater percentage of saving. This saving results in a lower wage cost per piece produced as well as a reduced overhead charge against the piece, and may mean the placing of an order for a rush job which would otherwise be lost.

In cases where the limitations of the machine and not the requirements of the work determine the time required to produce a part, means for performing operations simultaneously, for reducing idle movements, and for speeding up, may point the way to increased production. The cam system used on automatic screw machines permits operations to overlap each other and each tool can have the highest possible rate of feed and be set for the minimum length of travel required for a particular job. These conditions give maximum efficiency to the machine, and consequently lead to increased production.

Examples of saving in time by the use of a high-speed machine are most noticeable in working brass, aluminum, and other soft metals, but time savings can also be effected when cutting steel, if the diameter is small. Even when a high speed machine is not used, methods can be applied in handling jobs on regular automatic screw machines of the cutting-off, turret-forming, and full-automatic types. These methods consist of (a) using multiple lobes on the cam, (b) using more than one set of tools in the turret, and (c) producing more than one piece in a single cycle of operations. This article will describe some of these special methods, as applied to regular machines, and then deal with a high-speed machine, which, in addition to having the spindle operate at a speed suitable for soft metals, has also the possibility of taking advantage of the special methods pointed out, to make an additional saving.

Forming and Cutting off Parts in Less than Three Seconds

Three seconds is the minimum time for completing the cycle of operations on the regular line of No. 00 automatic screw machines made by the Brown & Sharpe Mfg. Co., including the No. 00 automatic cutting-off machine. It might be inferred from this statement that three seconds is the shortest time in which a piece of work can be produced, but the three examples shown at *A*, *B*, and *C* in Fig. 1, are completed, respectively, in 1 1/3, 2½, and 2 seconds on the cutting-off machine, and show the possibilities of production in an even shorter time than three seconds.

Example *A* is made of machinery steel, 5/32 inch in diameter. The short production time of 1 1/3 seconds is made possible by using three sets of lobes on the cam, thus completing three pieces at each revolution of the camshaft. The gearing is timed for one camshaft revolution per four seconds, so that each piece is produced in one-third this time. The operations are (a) cutting off, using a tool on the front slide; (b) forming, using a tool on the back slide; and (c) feeding the stock to the stop. The piece is not cut off until after feeding the stock forward for the

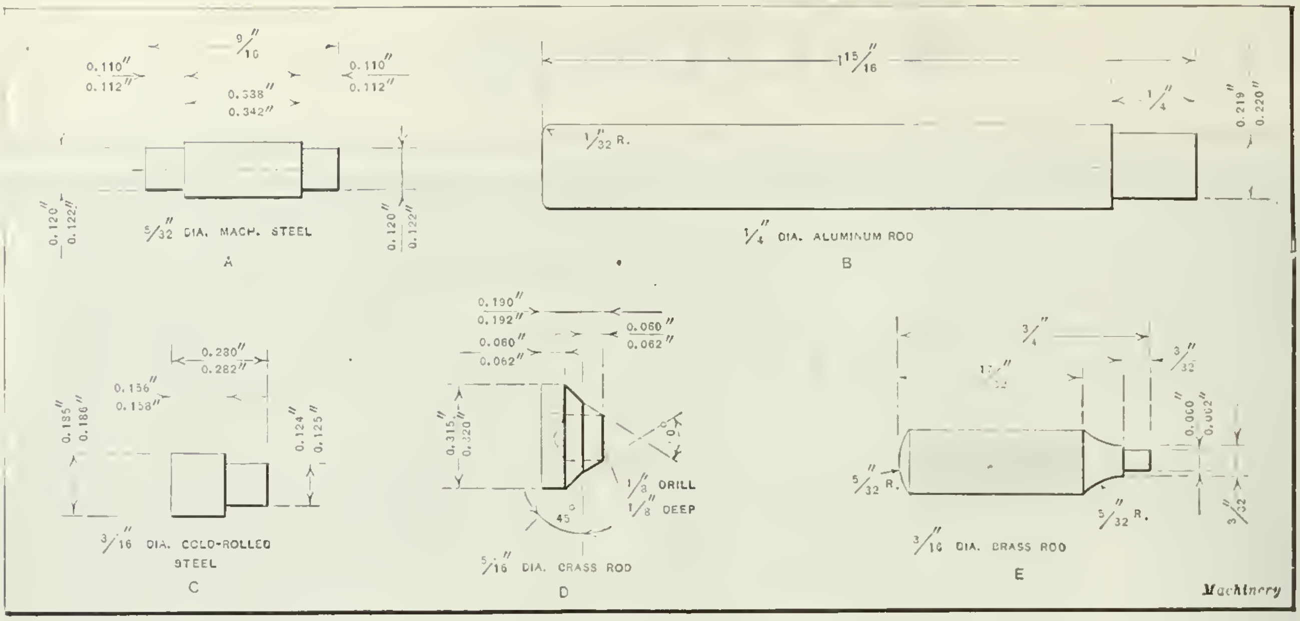


Fig. 1. Examples of Work produced in from One and One-third to Three Seconds in Automatic Cutting-off and Turret Forming Machines

next piece, so that three pieces are operated on simultaneously. While one is being cut off, the rear end of the next and the front end of the third are formed. The surface speed of the work is 98 feet per minute, and the net production is 2420 pieces per hour. This allows 10 per cent for changing stock and for contingencies; the same allowance is made in the net production on all examples given.

Example *B* is made from a ¼-inch aluminum rod, and, as in the first example, only cross-slide tools are required. Because the material is softer than that from which example *A* is made, it is possible to revolve the part at a higher surface speed, but the greater amount of stock removed and the time required to handle so long a piece necessitate a somewhat longer time for the cycle of operations. In this case the machine is timed for five seconds, and two lobes are provided on the cam, making the production time 2½ seconds for each piece and the net production 1280 pieces per hour. Details concerning this job are given on the estimate sheet, Fig. 3.

Example *C*, Fig. 1, is made of cold-rolled steel, 3/16 inch in diameter, the machine being timed for producing one piece in two seconds, even though the part is held to such close limits as 0.001 inch. This rate of production requires a surface speed of 118 feet per minute for forming. Two sets of lobes are used on the cam, and the gearing gives one revolution of the camshaft every four seconds. One piece is completed in 80 revolutions of the spindle, the net production being 2400 pieces per hour. In both this case and the preceding one, the cutting-off step is simultaneous with the forming step; however, a third piece is not operated on, as in the first example. The formed diameter of example *B* is also held to a limit of 0.001 inch.

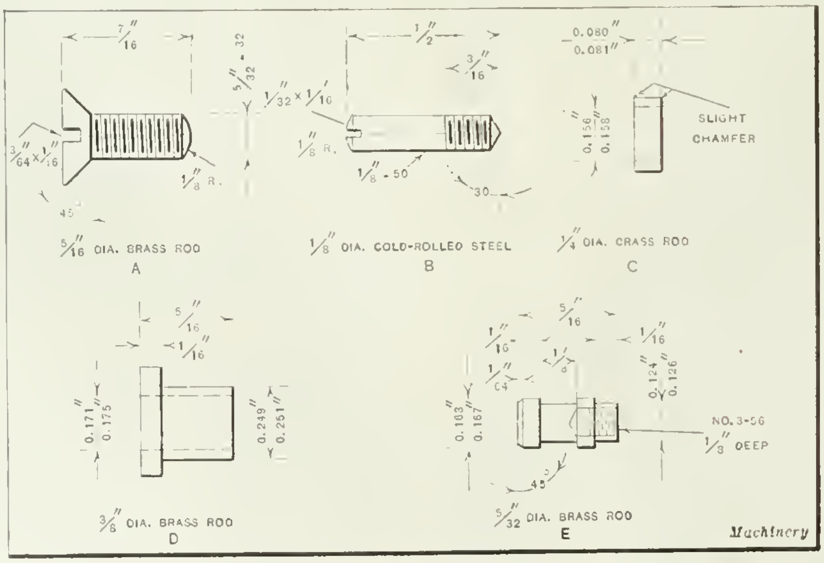


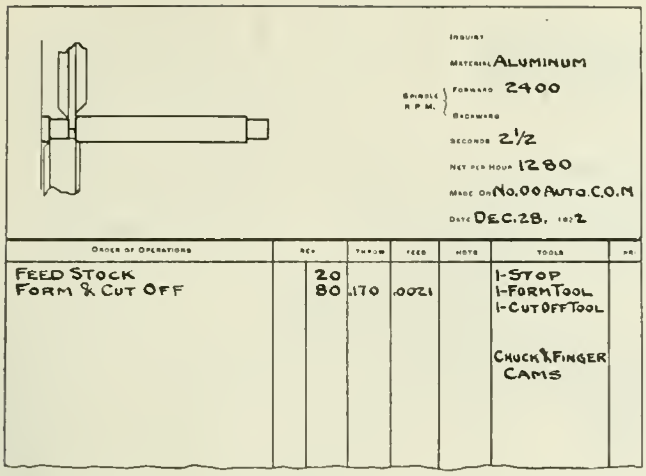
Fig. 2. Two Examples produced on a Regular Type Automatic Screw Machine, and on a High-speed Machine

Two Examples Requiring Turret Tools

Two brass pieces requiring the use of turret tools are illustrated at *D* and *E*. Reversal of the spindle is not necessary in machining these parts, and so a turret forming machine is adapted for this work. One of the pieces is given a short straight knurl, and drilled, while the other is given a diamond knurl. Each piece is completed in three seconds. Only two turret tools are required for example *D*, so by providing three sets of tools in the turret it is merely necessary to index this member one-third revolution to each revolution of the camshaft. These turret positions are used for stock stops and drills. The forming is done by a tool on the front slide, which produces two shoulders at angles of 45 and 30 degrees with the horizontal, and the knurling is done by a tool carried in a top knurl-holder; this is possible because of the short portion that is knurled. The cutting off is done by a tool in the back slide.

Indexing of the turret and drilling are coincident with the forming operation, and the first part of the cutting-off operation is coincident with the knurling. The operations are: (a) Feed stock to stop; (b) index turret; (c) form with tool on front slide; (d) drill; (e) knurl; (f) cut off; and (g) index turret. A total of 120 spindle revolutions are made in completing one piece, and the net production obtained on this job is 1080 pieces per hour.

As example *E* has a longer knurled portion, the knurl must be carried in the turret. However, indexing of the turret is avoided in this operation by using the front cross-slide as a stop in feeding the stock, and doing the forming and cutting off by means of tools held on the back cross-slide. Another advantage of this set-up is that only one knurling tool is required. The different steps in this operation are: (a) Feed stock to the front cross-slide;



Inquiry

Material ALUMINUM

Spindle R.P.M. Forward 2400

Backward

Seconds 2½

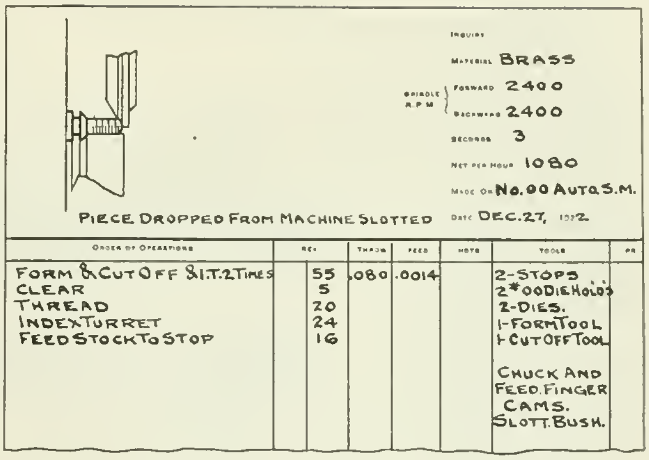
Net per Hour 1280

Made on No. 00 Auto. C.O.M

Date DEC. 28, 1922

Order of Operations	Rev.	Throw	Feed	Note	Tools	Pr.
FEED STOCK	20				1-STOP	
FORM & CUT OFF	80	.170	.0021		1-FORM TOOL 1-CUT OFF TOOL CHUCK & FINGER CAMS	

Fig. 3. Estimate Sheet which gives Data concerning the Operation on Part B, Fig. 1



PIECE DROPPED FROM MACHINE SLOTTED

Inquiry

Material BRASS

Spindle R.P.M. Forward 2400

Backward 2400

Seconds 3

Net per Hour 1080

Made on No. 00 Auto. S.M.

Date DEC. 27, 1922

Order of Operations	Rev.	Throw	Feed	Note	Tools	Pr.
FORM & CUT OFF & I.T. 2 TIMES	55	.080	.0014		2-STOPS	
CLEAR	5				2 #00 DIE HOLDS	
THREAD	20				2-DIES.	
INDEX TURRET	24				1-FORM TOOL	
FEED STOCK TO STOP	16				1-CUT OFF TOOL CHUCK AND FEED FINGER CAMS. SLOTT. BUSH.	

Fig. 4. Specifications Relative to the Machining of the Brass Screw A, Fig. 2

(b) knurl; (c) form; and (d) cut off. The net production is 1080 pieces per hour.

Two Threaded Parts

A brass screw made from 5/16-inch stock, formed, threaded, and slotted in three seconds is illustrated at *A*, Fig. 2. While such a screw could be produced on a machine on which there was no provision for reversing the spindle, as for instance, on the B. & S. No. 00 turret forming machine, using an opening die-head, it can be made to better advantage and with a cheaper tooling equipment on the full automatic type of screw machine in which the spindle does reverse. The use of the slotting attachment makes it possible to slot the screw-head simultaneously with the other operations. Only two turret positions are required for this job, one for the stop and one for the die, and so the machine is set up with duplicate sets of tools in the turret, and the turret is indexed half way around to each revolution of the cam. The reason for not using three sets of tools is that the indexing of the turret is done while the forming, cutting-off and slotting steps are in process, so that no further time could be saved by providing another set of turret tools. The slotting requires about three seconds. Each screw is completed in 120 revolutions of the spindle, the net production being 1080 pieces per hour. Details of this job are given on the estimate sheet Fig. 4

Another example of work that is suited to the full-automatic machine is the steel screw *B*, Fig. 2, which is produced from 1¼-inch cold-rolled steel in three seconds. The cutting off is done at a maximum speed of 78 feet per minute, with the spindle running backward at 2400 revolutions per minute, and the threading is done at a surface speed of 29 feet per minute, with the spindle running forward at 927 revolutions per minute. As with part *A*, two sets of turret tools are used. The operations are: (a) Feed to stop; (b) index turret; (c) thread; (d) clear; (e) cut off; and (f) index turret. The examples given in the foregoing are produced on machines of regular types provided with ordinary tool equipment. Additional time can often be saved on work to be done in large quantities by providing special equipment or tools, such as a revolving drilling attachment which will give a drilling speed equivalent to the sum of the spindle and drilling attachment speeds.

Design of a High-speed Automatic Screw Machine

The B. & S. No. 19 automatic screw machine has a maximum spindle speed of 5000 revolutions per minute, and is especially adapted to high-speed work. On this machine it is possible to complete the cycle of operations in two seconds. In order to insure satisfactory results at such a high speed, the spindle bearings are lubricated and cooled by means of a forced circulation of oil, which is passed through a jacket surrounding the outside of the bearings to cool them, while a sufficient supply is introduced to the bearings for lubricating purposes. In addition to this provision for keeping the bearings cool and well oiled, the strain of driving is entirely removed from the bearings by mounting the driving pulleys on sleeves that are supported independently of the spindle in such a manner that no strain is transmitted to the spindle. The pulleys run on roller bearings; the friction clutches are made of extra width and have phosphor-bronze rings that engage hardened steel surfaces; and the end thrust of the spindle, clutch ring, chuck-operating sleeve, and feed-tube, are taken by ball bearings.

On this machine the turret design is such that each tool is moved independently

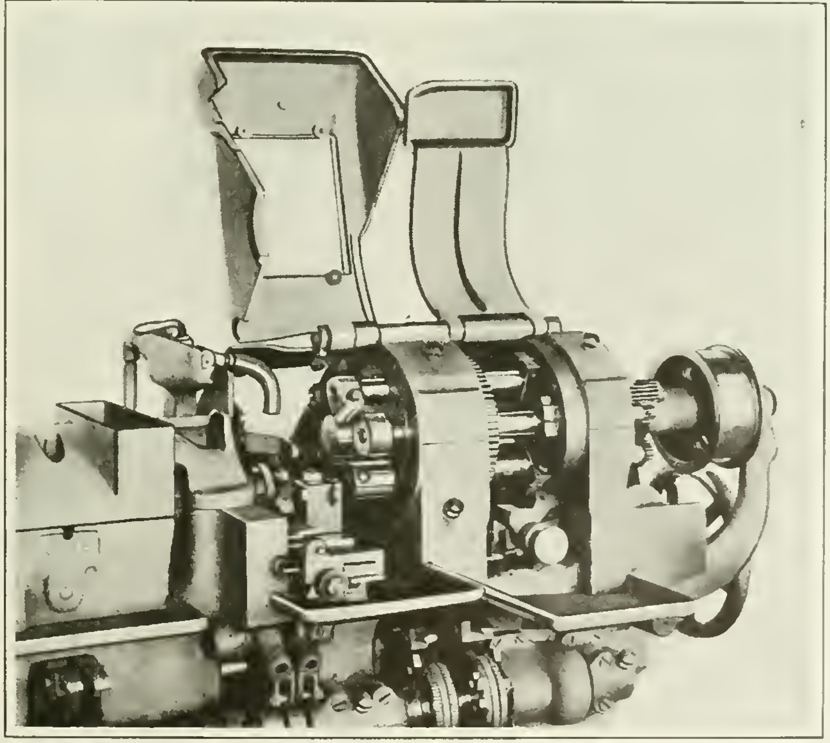


Fig. 5. Turret Mechanism of High-speed Machine equipped with Sliding Tool-spindles

toward and away from the work without having to move the heavy turret. The turret unit is shown in Fig. 5. To limit still further the moving of parts to those that are as light as possible and that may be operated rapidly, an auxiliary or supplementary slide is provided, which is disconnected from the main slide during part of the operation, as will be explained later. The time required for feeding the stock and indexing the turret is one-third of a second.

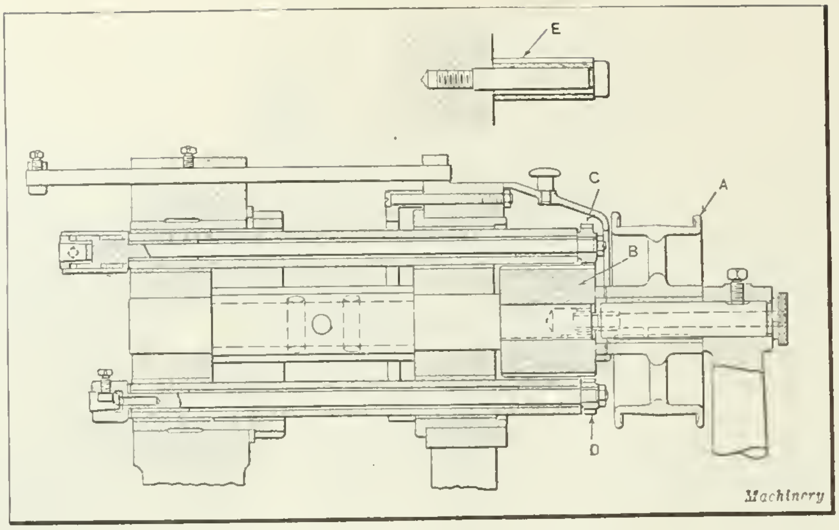


Fig. 6. Driving Mechanism for the Tool-spindles

The operating mechanism of the auxiliary slide is illustrated diagrammatically in Fig. 9. The turret *A* carries the tool-spindles, and these are engaged by block *B* as they are successively indexed into the operating position. The main slide *C* carries the auxiliary slide *D*, the former being mounted on the bed of the machine. A crank *E*, which is also mounted on the main slide, is connected to the auxiliary slide through a two-part connecting-rod *F*. A latch holds the two connecting-rod parts together except during the quick-return and quick-advance motions, which are effected by revolving the crank disk *E*. The latch is disengaged by passing over cam *G*, thus breaking the connection with the auxiliary slide for the quick-return and the quick-advance movement up to the point of cutting. By this arrangement only the lightest parts are moved during this part of the operation.

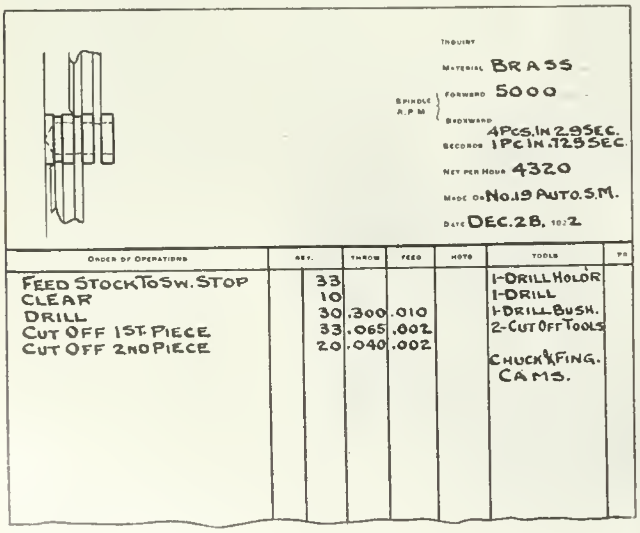
Instead of having the main spindle reverse on this machine, a second speed in the forward direction of 1450 revolutions per minute is provided. Thus, withdrawing of the tap or die-head after a threading operation can be accomplished by utilizing the differential speed between the main spindle and the revolving tap or die-holder carried in the turret. The turret tools are driven from pulley *A*, Fig. 6, through gear *B*, and either of pinions *C* and *D*. When it is desired to revolve a tool-spindle in the same direction as the main spindle so as to obtain a differential speed, direct connection is made to the tool-spindle through gear *B* and pinion *C*. However, when it is desired to reverse the direction of a tool-spindle so as to obtain the sum of the two speeds, as for instance, in drilling, the smaller pinion *D* is used, which is connected with gear *B* through the intermediate pinion *E* shown in the view at the top of the illustration.

In tapping or threading operations, the tap or die runs at a speed of 2500 revolutions per minute, in the same direction as the main spindle, thus giving a cutting speed of 2500 revolutions per minute, but when the tap or die is run off the work, the main spindle revolves at 1450 revolutions per minute, and as the tool-spindle runs at the same speed as before, the difference in speeds gives 1050 revolutions per minute as the backing-off speed. In drilling, the drill spindle revolves in the opposite direction to the main spindle at a speed of 3350 revolutions per minute, and so the drilling speed is the sum of the maximum main spindle and the drill spindle speeds or 8350 revolutions per minute.

A swinging stock stop which operates in unison with the chuck permits a full set of six working tools to be carried in the turret, and eliminates the usual extra indexing of the turret for the stock stop. Provision is made for stopping the machine when the supply of stock is exhausted, the chuck being left open so that a new piece can be inserted. The work is inserted from the machine end of the wire stand, which can be swung out of line with the spindle to permit of this, after which it is swung back and locked in position. Because of the advantages of a high-speed spindle, light moving parts, and revolving turret tools, this machine is well suited to work which allows of rapid cutting and especially to drilled work or that on which long turning operations are required; it is also suited to work for which idle movements of the machine parts take up a considerable proportion of the total time.

Examples of Work Produced on the High-speed Automatic Screw Machine

Examples of work produced in less than three seconds with a B. & S. No. 19 automatic screw machine are shown at *C*, *D*, and *E* in Fig. 2. Part *C* is a brass ring produced from solid stock with the corners chamfered. The machine



Inquiry

Material BRASS

Spindle R.P.M. Forward 5000

Backward

Seconds 4 PCS. IN 2.9 SEC. 1 PC IN .725 SEC.

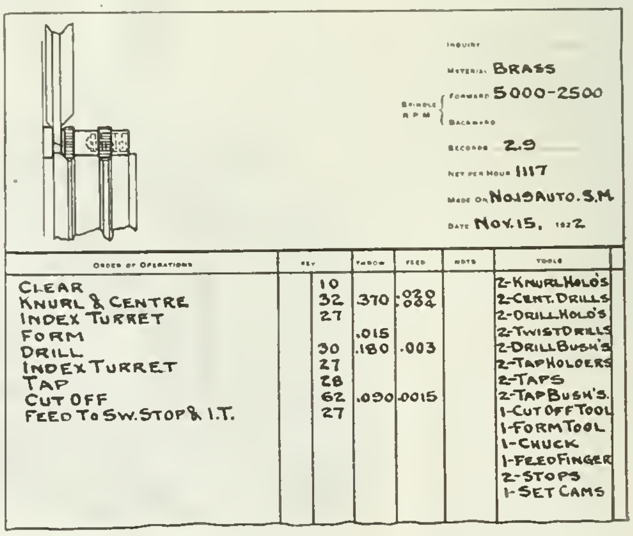
Net per Hour 4320

Made on No. 19 AUTO. S.M.

Date DEC. 28, 1922

Order of Operations	Rev.	Throw	Feed	Note	Tools	Pr.
FEED STOCK TO SW. STOP	33				1-DRILL HOLDR	
CLEAR	10				1-DRILL	
DRILL	30	.300	.010		1-DRILL BUSH.	
CUT OFF 1ST PIECE	33	.065	.002		2-CUT OFF TOOLS	
CUT OFF 2ND PIECE	20	.040	.002		CHUCK & FING. CAMS.	

Fig. 7. Estimate Sheet giving Data Relative to Part C, Fig. 2



Inquiry

Material BRASS

Spindle R.P.M. Forward 5000-2500

Backward

Seconds 2.9

Net per Hour 1117

Made on No. 19 AUTO. S.M.

Date NOV. 15, 1922

Order of Operations	Rev.	Throw	Feed	Note	Tools
CLEAR	10				2-KNURL HOLD'S
KNURL & CENTRE	32	.370	.020 .004		2-CENT. DRILLS
INDEX TURRET	27				2-DRILL HOLD'S
FORM		.015			2-TWIST DRILLS
DRILL	30	.180	.003		2-DRILL BUSH'S
INDEX TURRET	27				2-TAP HOLDERS
TAP	28				2-TAPS
CUT OFF	62	.090	.0015		2-TAP BUSH'S.
FEED TO SW. STOP & I.T.	27				1-CUT OFF TOOL
					1-FORM TOOL
					1-CHUCK
					1-FEED FINGER
					2-STOPS
					1-SET CAMS

Fig. 8. Order of Operations and Tooling Equipment for Part E, Fig. 2

time per piece is less than three-quarters of a second. The reason that this can be done in so short a time is that two pieces are produced simultaneously, the cutting-off tool for the first piece being set enough ahead of that for the second so that when the first piece drops, the second one is still supported sufficiently to carry the cut. In this case two sets of lobes are provided on the cam, four pieces being produced at each complete revolution of the camshaft, the timing of the machine being 2.9 seconds. The tooling and order of operations for this piece are shown on the estimate sheet in Fig. 7.

The part illustrated at *D*, Fig. 2, is a brass shouldered bushing turned from $\frac{3}{8}$-inch stock, which is the maximum size that can be handled in the machine. The time required for completing this piece is $1\frac{3}{4}$ seconds. This is a case where a material saving of time as well as reduction in the wear and tear on the machine can be effected by using the swing stock stop. Because of this type of stop, it is not necessary to index the turret on this job, the only operation requiring a turret tool being drilling. This method allows the drill to start practically as soon as the stock is fed, without the delay that would be caused if it were necessary to wait for the turret to index to the next position. Two sets of lobes are used on the cam, and the gears give one revolution of the camshaft in 3.5 seconds. The operations are: (a) Drill; (b) form (these two operations being performed simultaneously); (c) cut off; and (d) feed stock. The spindle makes 143 revolutions during the machining of each bushing, and the production is 1840 pieces per hour.

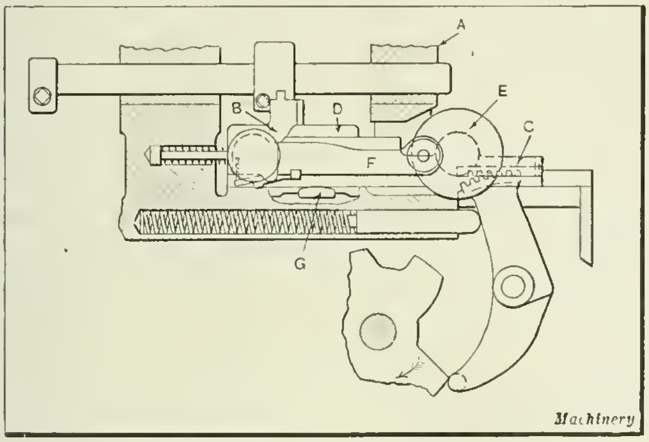


Fig. 9. Operating Mechanism of the Auxiliary Slide carried on the Main Slide

The knurled and tapped brass piece *E* is produced in 2.9 seconds. This piece requires but three turret positions for the tools, because of the swing stop for use in feeding the stock. Therefore, two sets of tools can be used in the turret, and the latter is indexed half way around to each revolution of the camshaft. Full specifications of the tooling equipment for this job are given in the estimate sheet in Fig. 8.

In a number of the examples given in this article a single workman operating several machines of either of the types described can produce from five hundred thousand to a million pieces in a week without working over-time. Examples could also be shown of work completed within three seconds time on machines of larger size, but naturally the greater percentage of such work is done to better advantage on small machines. Much work that requires more than three seconds for its completion on both large and small machines can have the time materially reduced by studying time-saving methods adapted to the particular job

* * *

The Mechanical Division of the American Railway Association has decided not to hold its regular convention for 1923. Instead, a special business session was held in Chicago early in the year.

MAKING WELDED STEEL TUBING—COMMENT

By R. POLIAKOFF

In February Machinery an article was published entitled "Making Welded Steel Tubing," in which the processes used by the Standard Welding Co. of Cleveland, Ohio, were described. The author does not say whether the flat stock used for rolling the tubes into shape is fed into the rolling machine hot or cold, but judging from the number of pairs of rolls shown in the machine in Fig. 1, and by the number of gradual deformations which the strip undergoes, as indicated, as well as taking into account the author's statement that the strip steel is fed into the machine from a coil, it may be concluded that the tubes are rolled cold.

The writer has had considerable experience with the manufacture of tubes of the kind described, having completely equipped one such plant and run it for some time; he knows also how some other plants of the same nature are equipped and run. In the plant of which he had charge there were rolling machines of two kinds, those in which the strip is rolled cold, and those in which the strip is rolled hot. On the basis of this experience, the conclusion was reached that when large production is the paramount object, the hot-rolling machine is the best: Its output, as compared with the cold-rolling machine is many times higher; it is simpler in construction—three or not more than four pairs of rolls being required instead of the seven pairs necessary in the cold-rolling machine; consequently, there is a smaller number of such rolls to be re-turned, reshaped, reground, etc. But that is not all. When a cold-rolling machine is used, the strips have to be dimensioned very accurately as to width; otherwise the joint of the tube, which has to be a butt joint, will not close at all if the strip is too narrow, or may become an overlapping joint if the strip is too wide. Again, if the strip is too wide, the edges may close at an angle, and extend outside of the circumference of the tube of the proposed diameter.

In the cold-rolling process the metal of the strip has to be of a special quality. When hot-rolled, the material can be of an inferior and therefore cheaper quality; less accuracy is required in the width of the strip as, being fed into the machine hot, that is, in a more pliable condition, it assumes more readily the required shape. As against the advantages mentioned, the necessity of heating the strips has to be considered—a furnace has to be provided, the best place for which is behind the rolling machine so that the strip can be fed into it directly from the furnace. This eliminates, on the other hand, the coil stand.

The speed of the welding machines, whether they are electric welders or whether the oxy-acetylene flame is used, is necessarily not very high, irrespective of whether the cold-rolling or hot-rolling method is used. In the hot-rolling method, it is possible to get, say, the whole weekly output of the plant ready for welding, and for the surface finishing machines in a day or two, depending on the sizes of the tubes to be produced and their quantity, and both the furnaces and the rolling machines can be stopped for the remainder of the week, and the workmen employed on the other machines. In other words, the number of men necessary for the hot-rolling process is less.

* * *

The scarcity of coal in Germany has increased the interest in the use of the tides for power purposes. Investigations have shown, however, that the cost of producing power in this way by any means yet known, is too high, compared with other power sources. The difference in the levels of the tides on the German coast are nowhere nearly as great as they are on the English coast, and what might be possible in certain parts of England is considered impracticable on the German shore.

Power Calculations for Bending Rolls

By A. L. ROBERTS

IN this article no claim for originality is made, but the method here outlined for calculating the strength and deflection of bending rolls and the power required to bend flat plates should be of assistance to beginners in adopting the proper sequence for calculating such problems.

In designing bending rolls, the first step is to determine the diameter of the rolls, considering both the strength and the deflection under full load. Referring to Fig. 1, if the top roll is supported by a flat plate resting on the two bottom rolls, and no pressure is applied, the points of support are a distance L apart, and no bending occurs. As pressure P is applied to the top roll, bending will occur in the plate which will result in the points of support changing as represented by span W. The amount of pressure required to bend the plate permanently to radius R is the maximum pressure and when the plate has been bent to this extent, the elastic limit of the material has been exceeded. This maximum pressure must be used in the calculations for strength, deflection, and horsepower requirements.

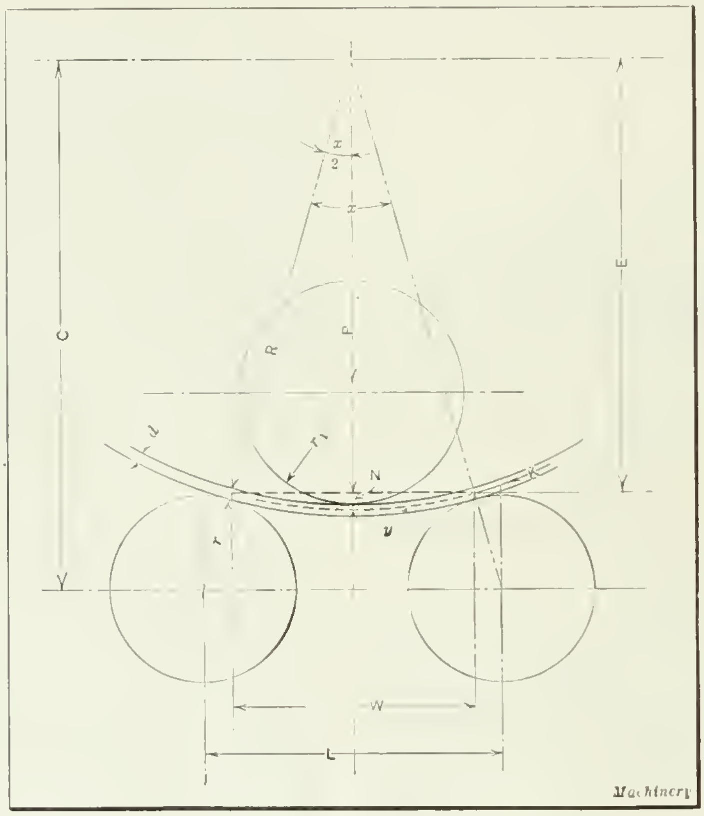


Fig. 1. Diagram illustrating Application of Forces on Bending Rolls

If the points of support were not changed by the application of pressure, as in a beam, the bending moment M would be equal to $PL \div 4$, L being the center distance of the bottom rolls in inches. If the width of the plate in inches be represented by b, the thickness in inches by d, and the safe stress in pounds per square inch by S, the resistance to bending equals $bd^2S \div 6$, and this value is equal to the bending moment; that is,

$$\frac{PL}{4} = \frac{bd^2S}{6} \text{ or } P = \frac{2bd^2S}{3L} \tag{1}$$

For the maximum value of P, the bending moment M is equal to $PW \div 4$, but since

$$W : L = R + \frac{d}{2} : R + d + r$$

$$W = \frac{L\ (R + d \div 2)}{R + d + r} \tag{2}$$

in which

R = inside radius to which plate is bent; and r = radius of bottom rolls.

Substituting this value of W for L in Formula (1) and transposing,

$$P = \frac{2bd^2S\ (R + d + r)}{3\ L\ (R + d \div 2)} \tag{3}$$

Calculations for Safe Working Stress

The maximum bending moment for the top roll can be calculated by the formula found on page 350 of MACHINERY'S HANDBOOK for a beam uniformly loaded for a part of its length. The bending moment will then be:

$$M. = \frac{PA}{S}\ (1 + 2k) \tag{4}$$

in which

P = load in pounds as found by Formula (3);

A = length in inches of roll from center to center of bearings; and

k = fraction of length of rolls at each end that is not loaded (see Fig. 2).

The value of k is obtained by dividing the distance from one edge of the plate to the center of the roll bearings by the center distance A of the bearings. When the width of the plate to be bent is approximately the same as the length of the body of the rolls, the value of k is so small that it has but little effect either on the bending moment or on the deflection. This value, however, has considerable effect when stresses and deflections are being calculated for a plate that is considerably less in width than the length of the body of the rolls.

The section modulus Z of the top roll equals $0.0982\ D_1^3$, D_1 being the diameter of the top roll in inches. The permissible working stress S, on the top roll is $M \div Z$. Referring to Figs. 3 and 1 the pressure on the top roll may be considered as the resultant of the two forces Q acting on the two bottom rolls, from which

$$Q = \frac{P}{2} \times \frac{R + d + r}{C} \tag{5}$$

and

$$C = R + d + r\left(\cos\frac{x}{2}\right) \tag{6}$$

In considering the strength of the bottom rolls, the same basic formulas as are used for the top roll are applied. The bending moment for the bottom roll will be

$$M = \frac{QA}{S}\ (1 + 2k) \tag{7}$$

The section modulus Z in this case equals $0.0982 D^3$, D being the diameter of the bottom rolls in inches. The safe working stress S in the bottom rolls is $M \div Z$.

Calculations for Deflection

The deflection f of the top roll due to load P is

$$f = \frac{PA^3}{384\,EI\,(1-2k)} \times (5-24\,k^2+16\,k^4) \qquad (8)$$

in which

E = modulus of elasticity = 29,000,000 for steel;

I = moment of inertia;

k = fraction of length of rolls at each end that is not loaded.

The deflection f_1 of the bottom rolls due to load Q, acting in the direction OQ, may be similarly expressed, thus,

$$f_1 = \frac{QA^3}{384\,EI\,(1-2k)} \times (5-24k^2+16k^4) \qquad (9)$$

Formulas (8) and (9) for deflection are from MACHINERY'S HANDBOOK, page 350.

The deflection of the top roll due to its own weight should also be computed, and since it acts in a coutrary direction to load P it should be subtracted from f. The value of f_1 as calculated by Formula (9), will give the deflection of the bottom rolls in the direction of the pressure resulting from load Q; that is, the angular deflection. Sometimes roller bearings are placed as supports, under the bottom rolls, and then all deflection of the bottom rolls can be disregarded. If, however, roller bearing supports are not used, the angular deflection should be reduced in the proportion of the distance C to $(R+d+r)$, and this will give the vertical component of this deflection parallel to the deflection of the top roll; that is, the deflection in a vertical direction.

The deflection of the bottom rolls due to their own weight must also be computed and this deflection added to the vertical deflection, since it acts in a downward direction. The total deflection F may be expressed by the formula

$$F = f - f_2 + f_1 \frac{C}{R+d+r} + f_3 \qquad (10)$$

in which

f = deflection of top roll due to load P;

f_1 = deflection of bottom rolls due to load Q;

f_2 = deflection of top roll due to its own weight; and

f_3 = deflection of bottom rolls due to their own weight.

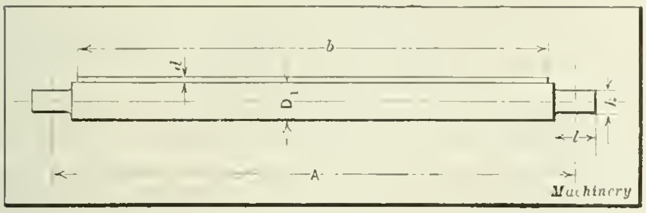


Fig. 2. Bending Roll and Dimensions used in the Calculations

It will generally be found for rolls of this kind, where wide plates are to be bent, that deflection is the governing factor. Sometimes the stress in the rolls will be comparatively low, since the diameter must be sufficient to maintain the deflection within reasonable limits. Both the top and bottom rolls may be enlarged slightly at the center to compensate for the deflection, and will thus have a slight taper toward each end.

Power Required for Driving the Rolls

The power to drive the rolls depends upon the speed of rolling. Ten feet per minute is good practice for medium sized rolls, but this rate is sometimes exceeded for small rolls and correspondingly reduced for rolls of large size. In Fig. 1 the pressure P acts through a distance N to bend the plate to radius R, while the forces K required to drive the plate through the rolls, is acting through arc y, the chord of which is W. Therefore $PN = Ky$ and

$$K = \frac{PN}{y} \qquad (11)$$

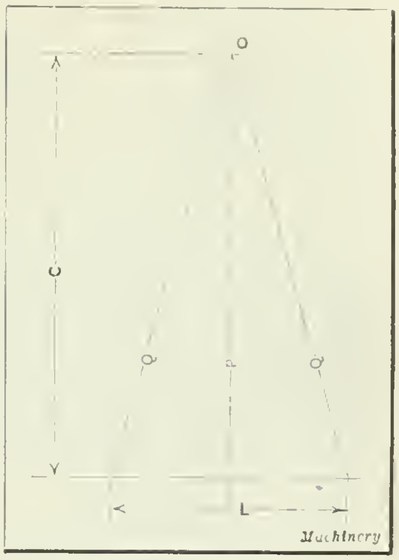


Fig. 3. Diagram used in investigating the Resultant Load on the Lower Rolls

It will be found that the power required for the actual bending of the plate is quite small in comparison with the friction load, the latter ranging from four to eight times the former. The horsepower formula for bending the plate without friction is

$$\text{H. P.} = \frac{Ks}{33{,}000} \qquad (12)$$

in which s represents the speed of the plate through the rolls in feet per minute.

In Fig. 1 the length of arc y, whose chord is W, can be calculated by first solving the angle x;

$$\text{Sin}\ \frac{x}{2} = \frac{W \div 2}{R + d \div 2} \qquad (13)$$

Then,

$$y = \frac{x}{360} \times 2\pi \left(R + \frac{d}{2}\right) \qquad (14)$$

The length of arc y can also be obtained by using a table of values for segments of circles, such as found on page 62 of MACHINERY'S HANDBOOK. Divide W by $\left(R+\frac{d}{2}\right)$ to obtain the chord for a segment of radius 1; then from the table select this value and the corresponding value for the arc, multiplying the latter value by $\left(R+\frac{d}{2}\right)$. This will give the length of arc y; its height N can also be readily found from this table or it can be calculated thus:

$$N = \left(R + \frac{d}{2}\right) - E \qquad (15)$$

$$E = \left(R + \frac{d}{2}\right) \cos \frac{x}{2} \qquad (16)$$

Fig. 4 is a diagram of a case where the plate to be bent is thin. When the thickness of the plate is small, Formula (3) for pressure P can be slightly simplified by omitting the plate thickness d, since it is but small in comparison with R and r. The formulas for bending a thin plate may then be stated thus:

$$W = \frac{LR}{R+r} \qquad (17)$$

and

$$P = \frac{2\,bd^2\,S\ (R+r)}{3\,LR} \qquad (18)$$

Application of Formulas Strength

A calculation to show the application of the formulas will now be made, the problem being to determine the size, strength, deflection and required horsepower for a set of rolls to bend a plate ¾ inch thick and 20 feet wide, to an inside diameter of 6 feet, at the regulation speed of 10 feet per minute. It is assumed that the diameter of the top roll is 18 inches, the diameter of the bottom rolls 15 inches, and that the bottom rolls are spaced 24 inches apart, center to center. Using the reference letters found in the accompanying diagrams and the assumed values for the problem, the data may be arranged in the following form:

$b = 20$ feet $= 240$ inches; $S =$ safe stress of material or 45,000 pounds per sq. in.
$d = 0.75$ inch; $A = 260$ inches;
$R = 36$ inches; $h = 10$ in. for top roll and 8 in. for bottom roll;
$r = 7.5$ in.; $D = 15$ in.; $l = 18$ in. for both rolls.
$r = 9$ in.; $D_1 = 18$ in.;
$L = 24$ inches;

$$k = \frac{(A - b) \div 2}{A} = \frac{10}{260} = 0.03846$$

The importance of factor k in the present example is slight; yet if the plate had been but ten feet wide instead of 20, k would then be $70 \div 260$ or 0.269, instead of 0.3846, and its effect in the calculation of the problem would then be considerable. While the factor k could here be entirely neglected without serious error, the formula should include the value, in order to cover all cases, especially as it is often necessary to calculate the thickness of a considerably narrower plate than the length of the rolls.

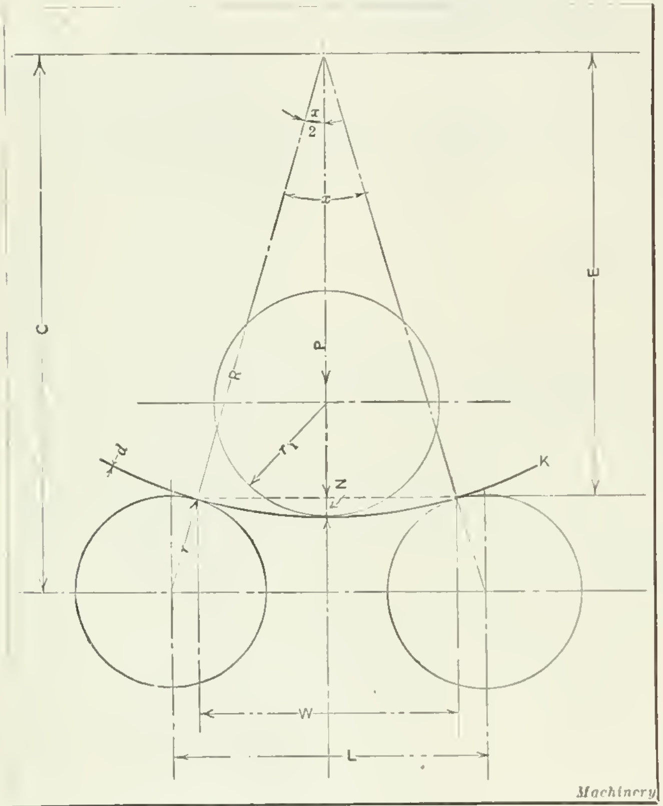


Fig. 4. Diagram for Use when the Plate is Comparatively Thin

Substituting in Formula (3):

$$P = \frac{2 \times 240 \times 0.75^2 \times 45{,}000 \times 44.25}{3 \times 24 \times 36.375} = 205{,}300 \text{ pounds}$$

From Formula (4)

$$M = \frac{205{,}300 \times 260}{8} \times 1.0769 = 7{,}185{,}300 \text{ inch-pounds}$$

$$Z = 0.0982 \times 18^3 = 572.7$$

The permissible working stress S in the top roll is

$$\frac{M}{Z} = \frac{7{,}185{,}300}{572.7} = 12{,}550 \text{ pounds per square inch}$$

This stress is a trifle too high, perhaps, but will be slightly reduced because of the necessity of enlarging the roll at the center to neutralize the deflection, as previously referred to. The effect of this enlargement will later be demonstrated in calculating this problem.

From Formula (2)

$$W = \frac{24 \times 36.375}{44.25} = 19.73 \text{ inches}$$

From Formula (13)

$$\sin\frac{x}{2} = \frac{9.865}{36.375} = 0.27120 \qquad \frac{x}{2} = 15 \text{ deg. } 44 \text{ min.}$$

$$\cos\frac{x}{2} = 0.96253$$

From Formula (6)

$$C = 44.25 \times 0.96253 = 42.6 \text{ inches}$$

From Formula (5)

$$Q = \frac{205{,}300}{2} \times \frac{44.25}{42.6} = 106{,}625 \text{ pounds}$$

From Formula (7) the bending moment for the bottom rolls is

$$M = \frac{106{,}625 \times 260}{8} \times 1.0769 = 3{,}731{,}800 \text{ pounds}$$

and

$$Z = 0.0982 \times 15^3 = 331.4$$

The safe or permissible working stress S in the bottom rolls is

$$\frac{M}{Z} = \frac{3{,}731{,}800}{331.4} = 11{,}260 \text{ pounds per square inch}$$

Application of Formulas—Deflection

From Formula (8) the deflection of the top roll is

$$f = \frac{205{,}300 \times 260^3}{384 \times 29{,}000{,}000 \times 5144 \times 0.9231} \times [5 - (24 \times 0.03846^2) + (16 \times 0.03846^4)]$$
$$= 0.0682 \times 4.9645 = 0.3385 \text{ inch}$$

In calculating the deflection of the top roll due to its own weight, the value of k is taken the same as when calculating the deflection due to load P. While this is not exactly correct, it is a sufficiently close approximation when the width of the plate being bent is nearly the same as the length of the body of the roll. It therefore results in the formulas for f and f_2 being composed of identical terms except those denoting, respectively, the load on the roll and its weight. The weight of the top roll is found to be 18,200 pounds and the resulting deflection is:

$$f_2 = \frac{18{,}200 \times 260^3}{384 \times 29{,}000{,}000 \times 5144 \times 0.9231} \times [5 - (24 \times 0.03846^2) + (16 \times 0.03846^4)]$$
$$= 0.006 \times 4.9645 = 0.030 \text{ inch}$$

The upward resultant deflection of the top roll can of course be computed in one operation, instead of two, by first subtracting the weight of the roll from the load P and using the remainder in the numerator of the fraction in Formula (8). It should be remembered, however, that if stresses and deflections are being calculated for a plate appreciably less in width than the length of the rolls, this condition does not apply, and in such cases the deflections of the top roll due to load P and to its own weight, must be computed separately.

In the present example we will assume that the bottom rolls have no roller bearing supports. The deflection of the bottom rolls due to load Q and acting in the direction OQ will then be, according to Formula (9):

$$f_1 = \frac{106{,}625 \times 260^3}{384 \times 29{,}000{,}000 \times 2481 \times 0.9231} \times [5 - (24 \times 0.03846^2) + (16 \times 0.03846^4)]$$
$$= 0.0735 \times 4.9645 = 0.3649 \text{ inch}$$

But for the deflection of the bottom rolls parallel to the lead P applied to the top roll, f_1 must be modified by multiplying it by the ratio of distance C to distance $(R + d + r)$, that is,

$$0.3649 \times \frac{42.6}{44.25} = 0.3513 \text{ inch}$$

The weight of one of the bottom rolls is 12,550 pouuds and the resulting downward deflection is:

$$f_3 = \frac{12{,}550 \times 260^3}{384 \times 29{,}000{,}000 \times 2481 \times 0.9231} \times$$

$$[5 - (24 \times 0.03846^2) + (16 \times 0.03846^4)]$$

$$= 0.0086 \times 4.9645 = 0.0429 \text{ inch}$$

The total deflection then is :

$$F = 0.3385 - 0.030 + 0.3513 + 0.429 = 0.7027 \text{ inch}$$

This deflection can be neutralized by increasing the diameter of the top roll about 0.31 inch in the center and the diameter of the bottom rolls about 0.39 inch. These two values are obtained by working the formulas for stress backward, as will be seen from the following: The new section modulus for the top roll will then be

$$Z = 0.0982 \times 18.31^3 = 602.8$$

and the safe working stress S for load P is

$$\frac{M}{Z} = 7{,}185{,}300 \div 602.8 = 11{,}919 \text{ pounds per square inch}$$

In a similar manner the stress in the bottom roll is reduced to 10 425 pounds per square inch.

Application of Formulas Horsepower

From Formula (16)

$$E = 36.375 \times 0.96253 = 35 \text{ inches}$$

From Formula (15)

$$X = 36.375 - 35 = 1.375 \text{ inches}$$

Dividing chord W by radius $\left(R + \frac{d}{2}\right)$ to obtain the chord for a segment of one inch radius, we obtain 0.5424, the corresponding arc being 0.549 inch. Multiplying the length of this arc by radius $\left(R + \frac{d}{2}\right)$

$$y = 0.549 \times 36.375 = 19.97 \text{ inches}$$

Then from Formula (11)

$$K = \frac{205{,}300 \times 1.375}{19.97} = 14.136 \text{ pounds}$$

The horsepower required for bending the plate, disregarding friction, may then be found from Formula (12), thus:

$$\text{H. P.} = \frac{14{,}136 \times 10}{33{,}000} = 4.28$$

The diameters of the top and bottom roll bearings are, from the conditions of the problem, 10 and 8 inches, respectively. The power required to take care of the frictional load is calculated as follows: By proportion, the bearing speed T of the rolls is first found.

For the top roll:

$$10 : T = 18 : 10$$

$$T = 5.56 \text{ feet per minute}$$

For the bottom rolls:

$$8 : T = 15 : 10$$

$$T = 5.34 \text{ feet per minute}$$

Multiplying these speeds by the load on the respective bearings and using a suitable friction coefficient, we have

$$102{,}650 \times 5.56 \times 2 \times 0.25 = 285{,}350 \text{ (approximately)}$$

$$53{,}312 \times 5.34 \times 4 \times 0.25 = 284{,}650 \text{ (approximately)}$$

$$\text{Total} = 570{,}000 \text{ foot-pounds.}$$

The horsepower required for the frictional load is

$$\frac{570{,}000}{33{,}000} = 17.27$$

and the total horsepower with friction, but without transmission losses, is 17.27 + 4.28, or 21.55 horsepower.

The assumed roll-bearing friction coefficient (0.25) used in the foregoing calculation may seem high, but it is adopted to cover all probable conditions. In a new machine after the journals have worn to a good bearing, the friction coefficient may be much less than that here employed. However, the bearings may become badly worn or scored due to imperfect lubrication and to the destructive effect of dirt and scale that becomes loosened from the plates during bending. For these reasons a coefficient of friction of from 0.20 to 0.25 should be used in the calculation.

The bottom rolls are the driven rolls. Their circumference is 3.927 feet and their surface speed 10 feet per minute. their rotative speed then is 10 ÷ 3.927 or 2.55 revolutions per minute. If a motor is used having a speed of 500 revolutions per minute, the ratio of speeds is 500 ÷ 2.55 or 196. It will probably require four gear reductions for this ratio. The first set of three gears driving the bottom rolls may be considered as having an efficiency of 80 per cent, and the other three reductions as having an efficiency of 90 per cent for each pair of gears and their shaft bearings. The total required horsepower will then be

$$\text{H. P.} = \frac{21.55}{0.80 \times 0.90^3} = 36.9$$

Conclusion

Assumptions have been made in the foregoing calculations covering the value for S and various values for friction coefficients. The value adopted for S (45,000 pounds per square inch), is well above the elastic limit for steel usually furnished in text-books as the result of tests, but this value is generally adopted by engineers and is apparently a safe value which will cover all conditions. The values indicated for the coefficient of friction may be modified, of course, under some conditions and may very easily become somewhat higher where the conditions are unfavorable, especially in an old and badly worn machine. For this reason it is good practice to adopt a motor with somewhat greater capacity than indicated by the calculations or at least one with considerable overload capacity.

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BUYING TOOL STEEL PERFORMANCE

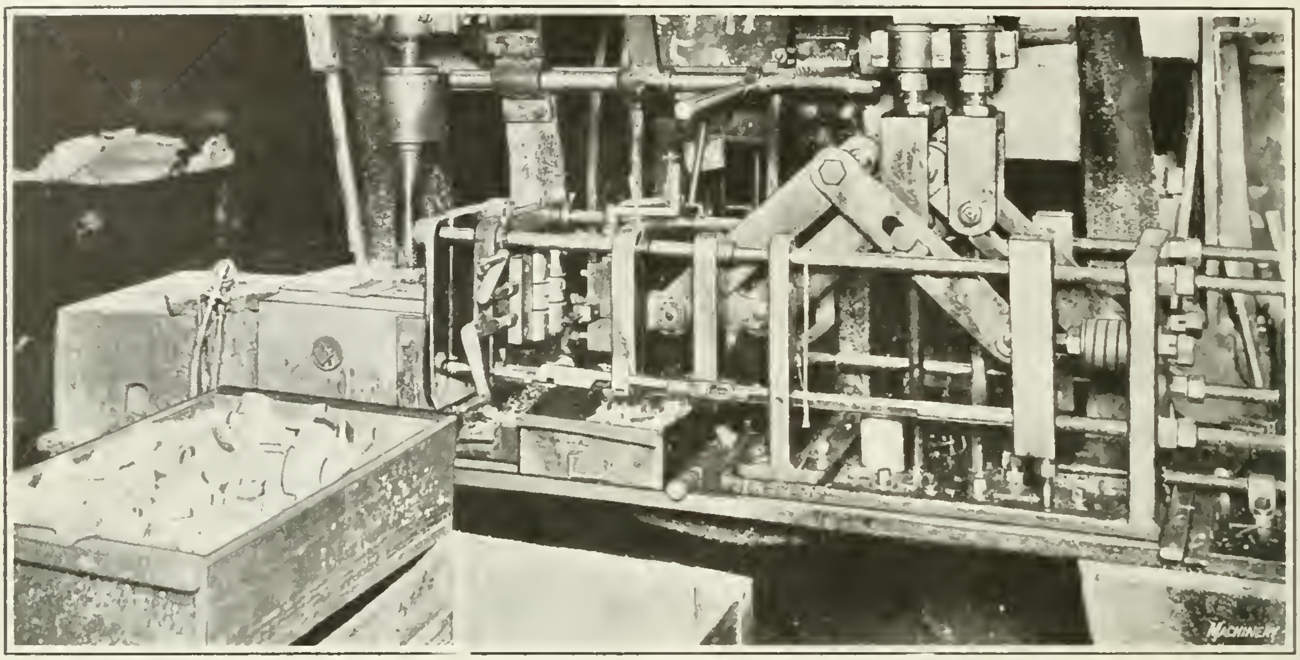
By R. POLIAKOFF

In January MACHINERY the article entitled "Buying Tool Steel Performance" states that, for the user of high-speed steel, performance and not chemical analysis is really the proper criterion. The question is left open however, of what performance requirements should be specified, and how they could be standardized.

Some time ago, the writer, recognizing the importance of performance specifications for high-speed steel versus chemical specification, undertook extensive experiments with different brands of such steel, all of European make—English, German, Austrian, Russian, and French. Special conferences were arranged both with the manufacturers' and the users' representatives, and the question of the method of manufacturing the steel was also investigated. The result was that a set of standard specifications for high-speed steel, based on performance, was finally evolved. These specifications have since been published by the writer in the Russian, German, British and American technical press, and are therefore available to those interested in the subject.

Though some revision of these specifications could, perhaps, be suggested, at the present time they are, to the best of my knowledge, the only practical attempt to solve the problem raised in the article in January MACHINERY. The writer will be glad to go further into the subject with those readers of MACHINERY who are interested in this matter.

Metals Used for Die-castings



Babbitts, Zinc-base Metals and Aluminum Alloys for Die-castings—Specifications Giving the Limits of Weight and Accuracy for Die-castings made from Different Metals

By A. G. CARMAN, Chief Metallurgist, Franklin Die-Casting Corporation, Syracuse, N. Y.

METALS suitable for die-castings must not attack the surface of the die, at the casting temperature, for this action would soon so change the form of the die depression that defective castings would be the result. It must be borne in mind that the advantage of the die-casting process is in the fact that a large number of castings can be produced from an expensive die before it has to be discarded on account of the quality of the casting produced.

The metal must have sufficient strength to withstand the strain of shrinkage from the casting temperature to the temperature at which it is removed from the die. This represents a range of from 200 to 600 degrees F., depending on the metal that is used. Shrinkage is especially noticeable in castings having large dimensions and thin sections, or in those that are formed by the use of large cores. The elongation and strength of a metal when it is cold are not always a criterion of what the same properties will be at a higher temperature. In the case of die-castings, we are particularly interested in these properties at high temperatures, for it is during this range of temperature that the shrinkage produces the strain on the metal. The strength of the metal must be sufficient to overcome the strain due to shrinkage, or a crack in the casting will be the result. In some castings where there is an opportunity for the metal to shrink without a corresponding strain, these qualities are not so important, and a metal with a greater shrinkage may be used.

The way in which the die is operated will sometimes overcome the tendency of the metal to crack in cooling. For instance, in cases where the large cores can be drawn very soon after the casting has been formed and before the metal has cooled sufficiently to cause strains, the tendency to rupture may be avoided. On the other hand, where the section is quite thick, the core cannot be drawn before the surface has become sufficiently hard to withstand the internal pressure of the molten metal, or the metal will be forced out from the interior and cause an imperfection in the casting.

The best way to determine these properties in an alloy is to actually use the metal in a die having large cores and rather thin sections. In performing this experiment, attention should be given to removing the casting from the die as rapidly as possible, for often a good casting can be made by this method, whereas working slowly and allowing it to remain longer in the die will result in a cracked casting.

General Requirements for Die-casting Metals

In connection with die-casting metals, too much cannot be said about the quality of the metal at the outset and the subsequent care prior to making the castings. In order to make good sound die-castings, it is necessary to have the metal clean, and as free from oxides, impurities, and occluded gases as possible. This means, especially with high melting point alloys, that at no time, either in the preparation of the alloy or in the heating of the metal prior to casting, should the metal become overheated or maintained at a high temperature for any length of time. At high temperature, metals rapidly absorb gases and become oxidized. When a metal has once become oxidized, it is very difficult, if not impossible, to overcome the damage done.

Surface cracks on castings, particularly where the section is thick, are often indications of porosity in the center. This porosity may be due to occluded gases, to air trapped in the metal during the casting process, or to lack of sufficient pressure to form a firm compact casting. The greater the quantity of occluded gases, which, of course, must be liberated upon solidification of the metal, the greater will be the tendency for the interior of the casting to be porous, even to the extent of not having sufficient strength to withstand the strains placed on it before it can be removed from the die.

Die-castings made under high pressure do not have a homogeneous structure, but, upon fracture, present a dense, fine-grained exterior and an interior of a coarser grain.

containing minute shrink holes where the section of the casting is thick. The fine-grained exterior is due to the pressure and to sudden cooling of the metal when it comes in contact with the inner surface of the die. This sudden cooling prevents the escape of gases occluded in the metal, and as the cooling of the casting progresses from the surface toward the interior, any shrinkage in the metal will draw from the center, leaving very small shrink holes of slightly varying size, depending upon the metal and the temperature at which it enters the die.

These shrink holes are particularly noticeable in castings having heavy sections that are made from metals with a high fusion point, and are not caused by trapping of air in the die, if precautions are taken to prevent it by properly gating and venting the die. However, small shrink holes in the interior of castings are not as detrimental as it would seem at first glance, for the exterior surface surrounding the weaker interior has a greatly increased strength, due to its dense fine grain. The treatment of the surface increases the strength, similar to the forging process.

The metals used in die-castings may be divided into three classes—the various babbitts, the zinc-base metals, and aluminum alloys.

LIMITS TO BE OBSERVED IN DESIGNING DIE-CASTINGS

Metal	Max. Weight of Casting, Pounds	Min. Wall Thickness[1], Inches	Min. Limits on Dimensions per Inch of Diameter or Length[2], Plus or Minus	Max. Number of External Threads per Inch[3]	Min. Diameter of Holes[4], Inches	Draft[5] Cores per Inch of Length and Diam.[6]	Draft[5] Walls per Inch
Aluminum	3	1/8	0.0025	20	3/32	0.015	0.005
Tin base	8	1/32	0.0005	34	1/32	0.0005	0.001
Lead base	10	1/32	0.001	24	1/32	0.0005	0.001
Zinc base	6	1/8	0.001	30	1/32	0.001	0.001

Machinery

[1] For small castings, the wall thickness of aluminum and zinc-base die-castings may be 1/16 inch.

[2] When the dimension involved is several inches, these limits may sometimes be reduced.

[3] When close fits are required in aluminum, the thread should be cast over-size and chased. Internal threads cannot be cast satisfactorily in aluminum, but can in some cases be cast in parts made from zinc-, tin-, or lead-base alloys.

[4] The size of hole that can be cast depends on its length and the design and thickness of the casting. Holes not cast can usually be located by spotting the casting in order to facilitate drilling.

[5] While the draft limits given in the table are desirable, they may sometimes be modified to meet special requirements.

[6] For aluminum, cores less than ¼ inch in diameter should have draft of 0.005 inch per inch of length and diameter.

Composition of Babbitts

Babbitt bearings made by the die-casting process are accurate in every detail. When the bearing is made in halves, oil-grooves may be included in almost any form desired. When the bearing is made as a single cylinder, oil-grooves, of course, must be straight, parallel to the central core, and opening at least at one end, preferably opposite the flanged end if the bearing is of the flanged type.

Bearings made by this process, on account of their hardened surface, are especially adapted for gas engines and machinery where the bearing metal is subjected to severe duty. There are a large number of babbitts used at present, all of which are successfully die-cast. Two babbitts used for connecting-rod bearings of motors and bearings subjected to high pressures have the following composition:

Franklin B. Babbitt

Constituents	Per Cent
Copper	4.75
Antimony	13.75
Lead, maximum	0.35
Tin	Remainder

S. A. E. No. 11 Babbitt

Constituents	Per Cent
Copper	5.75
Antimony	6.75
Lead, maximum	0.35
Tin	Remainder

Another babbitt that is used where it is not subjected to external heat and that normally runs at a low temperature has the following composition:

Constituents	Per Cent
Copper	4.25
Antimony	13.25
Lead	4.00
Tin	Remainder

A comparatively cheap babbitt that is recommended for bearings subjected to moderate pressures, has the following composition:

S. A. E. No. 12 Babbitt

Constituents	Per Cent
Copper	3.00
Antimony	10.50
Lead	25.00
Tin	Remainder

The following is a very cheap babbitt which has been used with success when the surfaces of the bearings are large and the duty is not severe: It is not to be recommended, however, in preference to a high-tin babbitt.

S. A. E. No. 13 Babbitt

Constituents	Per Cent
Tin	5.00
Antimony	10.00
Copper, maximum	0.50
Lead	Remainder

The tin- and lead-base metals are used almost entirely for bearing purposes, but on account of the fact that they flow easily, readily filling the die, they are quite extensively used for very delicate and accurate parts. The tin-base metals, because of their resistance to corrosion are suitable for articles in which foods and drinks are contained. The selection of a babbitt adapted for a particular class of work is in the last analysis, a problem for the individual engineer. It is not uncommon to find that a babbitt that gives excellent results in one motor, for example, will fail in another, due to different conditions of service and to the different duties required of it.

Zinc-base Alloys

The zinc-base alloy that has given the best service in die-casting, according to the experience of the Franklin Die-Casting Corporation, has the following chemical composition and physical properties:

Chemical Composition

Constituents	Per Cent
Tin	7.00
Copper	3.50
Aluminum, maximum	1.25
Zinc	Remainder

Physical Properties

Melting point, degrees F.	690
Brinell hardness number	65
Tensile strength, pounds per square inch (die-cast)	23,000
Elongation in two inches, per cent	½
Specific gravity	7.17
Weight, pounds per cubic inch	0.258

Among the zinc-base alloys containing higher percentages of aluminum, used for die-casting purposes, the following has given the best results:

Constituents	Per Cent
Copper	3
Aluminum	5
Zinc	Remainder

On account of the high percentage of aluminum in this alloy, horsehead spelter, or its equivalent, should be used in order to guard against deterioration when the metal is subjected to warm, moist atmospheric conditions.

The zinc-base metal, on account of its cheapness and properties that especially adapt it for the die-casting process (such as low coefficient of expansion and greater strength, as compared with babbitt metals) is used in a great number and variety of die-castings. When a very fine finish is required on castings made from this metal, or when it is necessary to protect the surface, it can easily be plated with nickel, copper or brass, or it can be given an oxidized finish. In some cases, these castings may be enameled, but special care must be observed in the baking process, on account of the low melting point of the alloy.

Aluminum Alloy

Aluminum die-castings are rapidly coming into general favor for classes of work where lightness, toughness, and resistance to corrosion and to severe shocks and strains are required. The alloy most commonly used, known as the No. 12 alloy of the Aluminum Co. of America, consists of 8 per cent copper and 92 per cent aluminum. It has the following physical properties:

Melting point, degrees F.	1175
Brinell hardness number	60
Tensile strength, pounds per square inch (die-cast)	23,000
Elongation in two inches, per cent	1½
Specific gravity	2.86
Weight, pounds per cubic inch	0.103

This alloy presents greater difficulties during casting on account of the melting point, which is about 500 degrees F. higher than the zinc-base alloy, and on account of its corrosive action on the steel dies, especially if the metal becomes overheated or the dies become too hot. The high melting point and corrosive action of the metal makes it necessary to use the compressed-air type of machine.

Castings made from this metal weigh only 40 to 45 per cent as much as those made from the zinc-base metal. However, the price of the zinc-base metal is approximately 40 to 45 per cent of the price of the aluminum alloy, which makes the value of the metal for any particular casting the same whichever alloy is selected. The cost of casting aluminum, nevertheless, is considerably greater than that of casting the zinc-base metal. There are a number of aluminum alloys available for castings requiring a polished surface that will not tarnish readily and also for castings used for bearing purposes.

In order to maintain a high grade of metals, the virgin metals and alloys received at the plant of the Franklin Die-Casting Corporation are examined chemically to insure that the composition of the metal conforms with the required specifications. In addition to this, test bars are die-cast to determine the physical properties of the metal. This data on the various alloys is a great aid in the selection of the proper alloy for a particular casting.

There are a number of zinc-base alloys and aluminum alloys on the market for which special physical properties are claimed, but it is impossible to take up this subject at this time, for the tests on these metals have not yet been completed.

The limits given in the accompanying table should be borne in mind in designing parts for die-casting.

* * *

PROPOSED MODIFICATION OF METRIC SYSTEM

What appears to be an exceedingly unwise proposal is made in a recent number of the *Decimal Educator*, the official organ of the Decimal Association, in which it is proposed that the association concentrate its effort for the time being on obtaining an alteration of the value of the pound weight from 454 to 500 grams—that is, half a kilogram. The sixteen ounces to the pound would be retained, so that four ounces would equal 125 grams. A new ton would be adopted, which would be 2000 new pounds, which, of course, would then equal the metric ton. It seems as though we have sufficient confusion in our weights and measures as it is without proposing to add a new pound and a new ounce to those we already have. Any effort to introduce the metric system along such lines as these appears decidedly unsatisfactory.

DIE FOR ORNAMENTAL BRASS TACKS

Round-head hollow brass tacks of the type shown in Fig. 1 are produced at a high rate of speed on a Waterbury Farrel double-action power press at the plant of the U. S. Tool Co., Inc., Newark, N. J. These tacks are used for decorative purposes. The die, which is shown in Fig. 2, is of the follow type, arranged to produce two tacks at every stroke of the press. A roll feed is used, and in order to compensate for slight variations in the feeding movement an extra pair of punches is used; one of these punches pierces a hole near the edge of the strip, while the other enters the hole made on the previous stroke, and in this way locates the strip correctly in relation to the other tools.

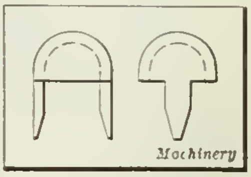


Fig. 1. Enlarged Views of Brass Tack

One pair of punches swages the points, which are approximately diamond shaped. The stock is then fed to the next position, where it is located by the means just mentioned. While in this position the swaged stock is blanked, and a drawing punch, working through each of the two blanking punches draws the tacks into the finished shape. At the same time that the blanking and drawing is taking place, another locating hole is being pierced on the margin of the strip, and the swaging punches are working at the first station of the die.

The maintaining of an accurate feeding movement is of paramount importance, because if this were not done the lengths of the prongs of the tack might be unequal, and the head would be off center. The stock from which these tacks are made is 0.020-inch brass, furnished in strips about 1 inch wide, so that the tools may be arranged to leave a minimum of scrap. The rate of production on this job is 200 tacks per minute; that is, the press operates at 100 strokes per minute.

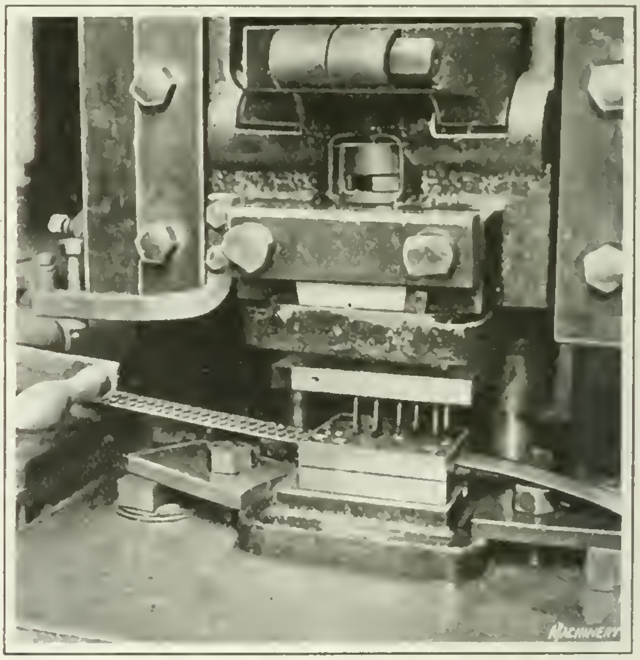
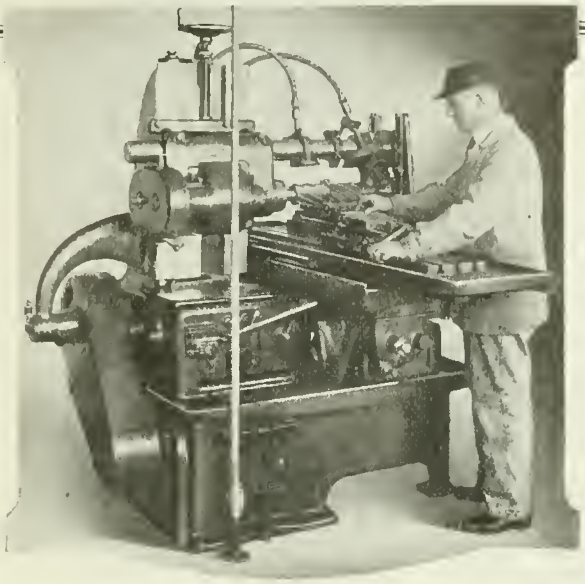


Fig. 2. Power Press with Follow-die for making Ornamental Tacks

* * *

England seems to be the only country that possesses a society of women engineers. The Women's Engineering Society is to hold its annual meeting at the Birmingham University this spring. It is stated that women engineers from Holland, France, Belgium, and the Scandinavian countries will be present, and American women engineers are also invited to be present.

New Automatic Manufacturing Type Milling Machine



A MACHINE that is designed primarily for the automatic milling of duplicate parts in large quantities has recently been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. This machine, which is shown in Fig. 1, is known as the No. 33 automatic milling machine.

Automatic Controls

A unique feature of the machine is the automatic control of the spindle and table by means of dogs located at the rear and front of the table. The variable feed and constant fast travel, as well as the stopping of the table can be automatically controlled by properly setting the dogs. A set of dogs is also provided for automatically actuating the spindle starting, stopping, and reversing controls. The table and the spindle can be operated independently of each other. The fast and slow controls may be made to function intermittently, with the table traveling in either direction and the spindle revolving either right- or left-hand.

The spindle can be automatically stopped when the table is on its return travel, thus eliminating the possibility of marring the work by allowing the cutter to be run back over the surface machined on the forward movement of the table. The provision for reversing the spindle permits the use of two sets of cutters with teeth facing in opposite directions so that a cut can be taken on both the forward and return movements.

The constant fast travel, in combination with the slow variable feed, can be controlled automatically with the table traveling in either direction. This feature, in addition to the independent automatic control of the direction of spindle rotation, permits the automatic machining of many duplicate pieces on a production basis which would otherwise be handled by comparatively slow methods. When not equipped with a motor, the machine is driven by belt direct from the main shaft or countershaft to the single driving pulley *A*, Fig. 3. This pulley runs at a constant speed, and is mounted on the main drive shaft *A*, Fig. 4.

Inside the driving pulley is the friction clutch, operated by a lever *A*, Fig. 2, which provides for stopping and starting the machine. When the clutch lever is thrown to its extreme position, it operates a brake that stops the machine instantly. This brake also serves as a means of locking the spindle when an arbor or cutter is being removed.

On the shaft *B*, Fig. 4, which is parallel to the main drive shaft *A*, and driven from the latter by spur gears (not shown) are the friction clutches that provide for the automatic starting, stopping, and reversing of the machine spindle. The cap *G*, Fig. 3, covers one of the end bearings of shaft *B*, Fig. 4. Power is transmitted from this shaft by spur gears to a sleeve on shaft *A*. On this sleeve is mounted a silent chain sprocket.

The spindle drive through the silent chain *G*, is so arranged that a system of idlers *D*, *E*, and *F* keeps the tension on the chain constant, regardless of the height or position of the spindle. The sprocket *D* at the top of the column may be easily raised or lowered from the outside of the machine to increase or decrease the tension of the chain.

An important feature of the drive is the complete separation of the spindle-driving members from the table-feeding mechanism. This permits any combination of feeds and speeds, within the capacity of the machine, to be used. Different spindle speeds are obtained through the use of change-gears which provide for twelve changes of speed in geometrical progression, ranging from 22 to 180 revolutions per minute in either direction. The view of the machine in Fig. 2 shows the compartment *B* in the machine base where the spindle change-gears are stored. The speed available with any set of gears is shown by figures cast on the inside of the cover *D*, Fig. 3. Changes of spindle speed are effected by changing the gears on the ends of shafts *B* and *C*. The cast-iron guard *D* which encloses these gears is hinged and can be easily opened to permit changing the gears. The table feeds are positive, and are entirely independent of the spindle speeds.

There are eighteen changes of table feed ranging practically in geometrical progression from 0.38 to 24.54 inches per minute. This provides feeds ranging from 0.002 to 0.136 inch per revolution of the spindle for small milling cutters, and feeds of from 0.017 to 1.115 inch for large milling cutters. The compartment cast in the machine base for holding the table feed gears is shown at *C* in Fig. 5. This compartment is similar to that provided for the spindle change-gears. The hinged cover *A* is swung back to permit changing the table feed gears.

This machine is well adapted for motor drive. Provision is made for enclosing a constant-speed motor in a well ventilated chamber within the base. This arrangement does not increase the floor space occupied by the machine, and provides ample protection for the motor from chips and dirt. A belt with an automatic tightener is used to transmit the power to the single driving pulley, and a cast-iron guard is employed to enclose and protect these parts from injury.

Spindle Construction

The tapered end of the spindle *D*, Fig. 6, is hardened and ground, and a recess is provided in the end, as indicated at *A*, Fig. 7. The recess is also shown quite clearly in Fig. 1. This recess in the spindle nose receives the driving lugs on the arbors and collets. The latter are provided with clutches and have a threaded hole in the end of the shank. The clutch lugs fit into the recess in the end of the spindle, and the arbor or collet is drawn into place and held securely by a draw-in bolt. This bolt passes through the center of the spindle *B*, Fig. 7, and the threaded end enters the end of the shank of the arbor or collet and is

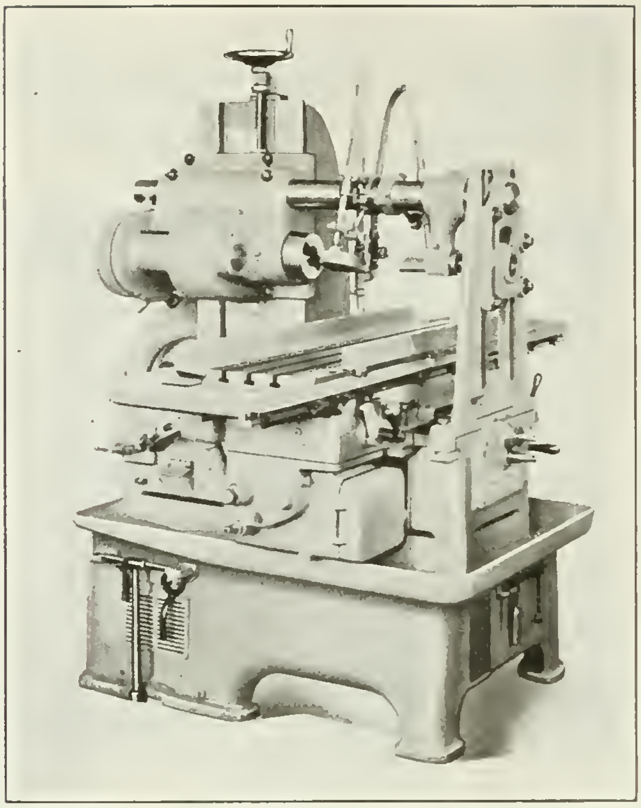


Fig. 1. New Automatic Manufacturing Type Milling Machine

tightened by a wrench from the rear of the machine.

The silent chain *G*, Fig. 4, drives sprocket *H*, which is also shown at *C*, Fig. 7. It will be noted that sprocket *C* is keyed to a sleeve and that one of the spindle change-gears *D* is attached to the rear end of this sleeve. Gear *D* meshes with its mating change-gear *E* which is mounted on the short counter-shaft *F*. A pinion *G* cut on shaft *F* transmits motion to the gear *H*, which is keyed to spindle *B*. The hinged cover *D*, Fig. 3, which encloses the spindle change-gears is shown at *J* in the cross-sectional view, Fig. 7.

Spindle Control

The lever at *J*, Fig. 4, and at *A*, Fig. 6, actuates a cam mounted on shaft *C*, Fig. 4, which controls the spindle starting and stopping clutch on shaft *B*. This lever thus controls the starting and stopping of the spindle independently of the other controls. The spindle reversing clutch which is mounted on the same shaft as the stopping and starting clutch is controlled by lever *B*, Fig. 6, through the medium of a cam mounted on shaft *C*, Fig. 4. The spindle is ordinarily started and stopped by the manipulation of lever *B*, Fig. 5. This lever may be automatically actuated by trip-dogs secured in slots at the front of the table. Lever *B* is also employed to control the table feeding movements.

Table Driving and Reversing Mechanism

Two units enclosed in separate oil-tight cases control the table movements. The first unit, which contains the table starting, stopping, and reversing mechanism, is driven by shaft *K*, Fig. 4. This shaft is driven by the main shaft *A* through spur gears. The driven gear on shaft *K* is held between two disks which form a friction coupling that is adjusted to permit slippage at a predetermined load. This feature eliminates the danger of damaging any important part of the machine should it become overloaded.

Shaft *K* may be seen at *C*, Fig. 2, at the point where it enters the oil-tight case of the first unit. In addition to the table stopping, starting, and reversing clutches, this unit contains a notched cam device which stops the table-feeding movement instantly when the driving clutch is disengaged. The lever *D*, Fig. 5, controls the clutch that stops, starts, and reverses the table feed. Levers *E* and *F*, when properly set in conjunction with dogs, such as shown at *G* and *H*, permit the table movements to be automatically controlled. The dog shown at *G* is used to stop the table, and the one at *H*, which has a longer point, is used to reverse the direction of the table travel. Levers *E* and *F*, as previously stated, are used in conjunction with these dogs.

In order to illustrate the method of employing the automatic table starting, stopping, and reversing controls, let it be assumed that it is desired to have the table feed to the right, automatically reverse, and feed to the left and stop. To obtain this movement, lever *E* would be left in the "up" position, as shown, and lever *F* would be given a half turn, so that it would point downward. Then a long pointed dog,

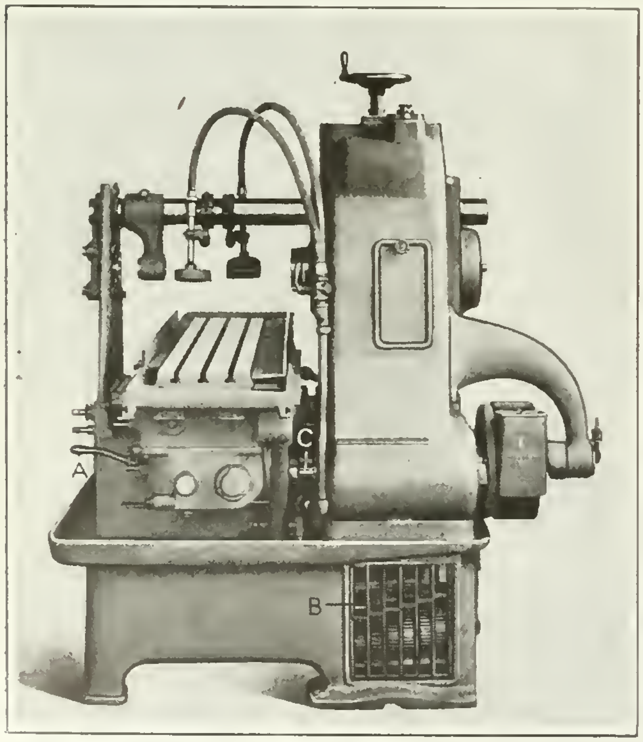


Fig. 2. View showing Right-hand End of Machine

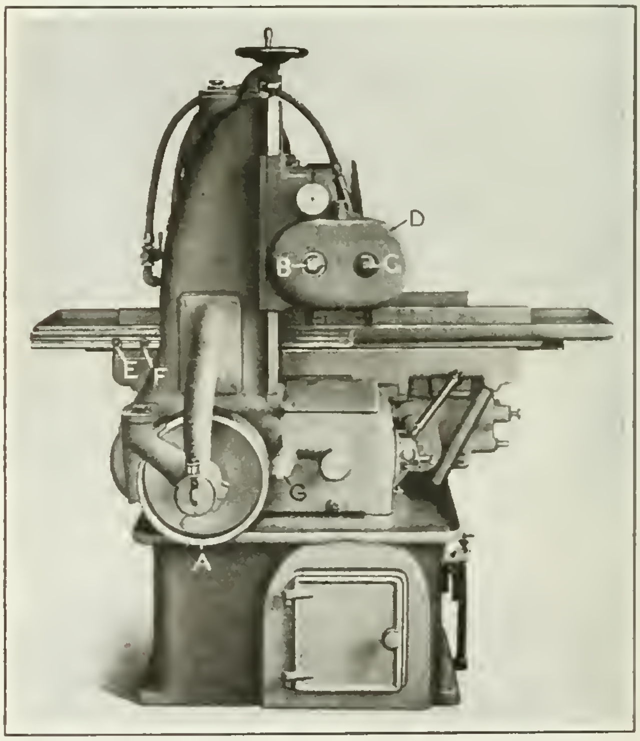


Fig. 3. Rear View of Machine, showing Driving Pulley

such as shown at *H*, would be placed at the left-hand side, and a short dog, such as shown at *G*, at the right-hand side of the plungers *J* and *K*, which must be actuated by dogs *G* and *H* in order to automatically reverse and stop the table travel.

If both levers *E* and *F* are turned to the "up" position, as shown, and a long pointed dog is attached to the table at each side of plungers *J* and *K*, the table will automatically reverse at each end of its travel. The length of the table travel is determined by the distance between the dogs. If levers *E* and *F* are both turned down and short dogs are properly set at each side of the plungers, the table will be stopped at each end of its travel. If it is desired to have the table feed to the left, reverse and then feed to the right and stop, lever *E* would be turned down and lever *F* up. In this case, a short dog would be placed at the left-hand side of plungers *J* and *K* and a long pointed dog at the right-hand side. Although the table movements can be controlled automatically by the use of dogs as described, the table may be easily controlled by the hand-operated lever *D*, the same as in an ordinary plain milling machine.

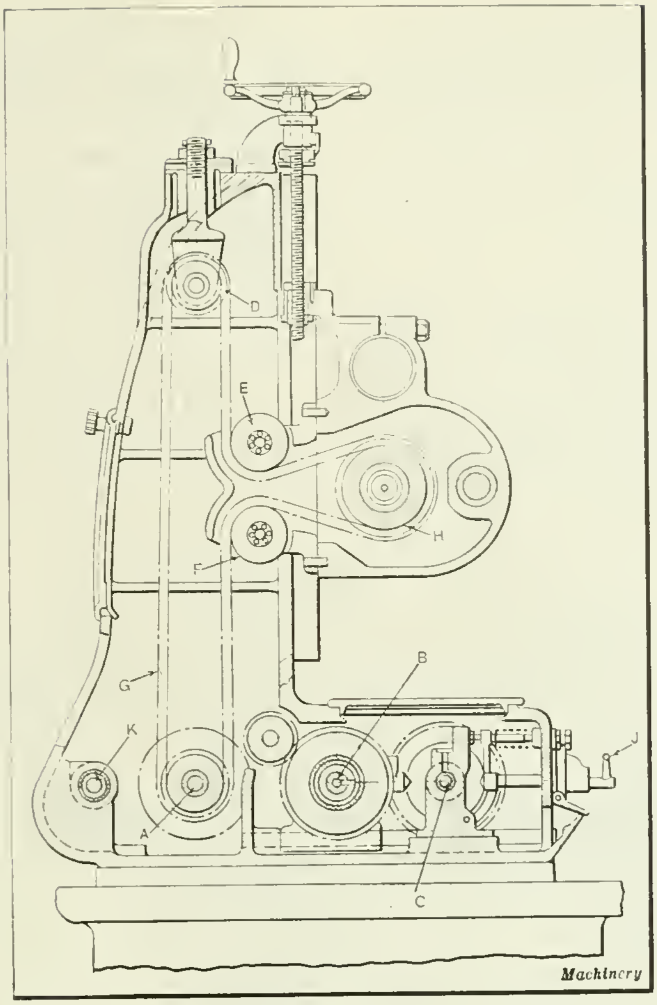


Fig. 4. Diagrammatic View, showing Method of driving Spindle by a Silent Chain

Feed Varying Mechanism

The table feed-varying mechanism is enclosed in an oil-tight case, and is driven from the starting, stopping, and reversing unit through a universal joint connection. The feed-varying mechanism is a complete unit in itself, which, when actuated by means of dogs such as shown at *L* and *M*, Fig. 5, permits the table to be automatically given a fast or a slow feed as desired. The table feed change-gears previously referred to are used with this unit to obtain the desired rate of feed. By pulling the small button *N* outward the power drive can be disconnected so that the table may be fed by hand.

Lever *B* controls the fast and slow feed, and, in addition, actuates the spindle stopping and starting clutches. All the automatic operations of the machine are controlled by means of the adjustable table dogs. Four different styles of dogs are necessary if every automatic control available is to be employed. However, for ordinary milling operations only two or three of these styles are needed. Dogs such as shown at *E* and *F*, Fig. 3, at the back of the table, control the reversing of the spindle.

A trip-dog such as shown at *P*, Fig. 5, designed to act on the pivot gear sector *Q* engages the table slow-feed clutch. The same dog also starts the spindle automatically when the slow feed begins. The long dog *L* can be set to operate, when the table is moving in either direction, for the purpose of engaging the fast feed mechanism. The table moves at a constant fast rate of travel when reversed, and the spindle

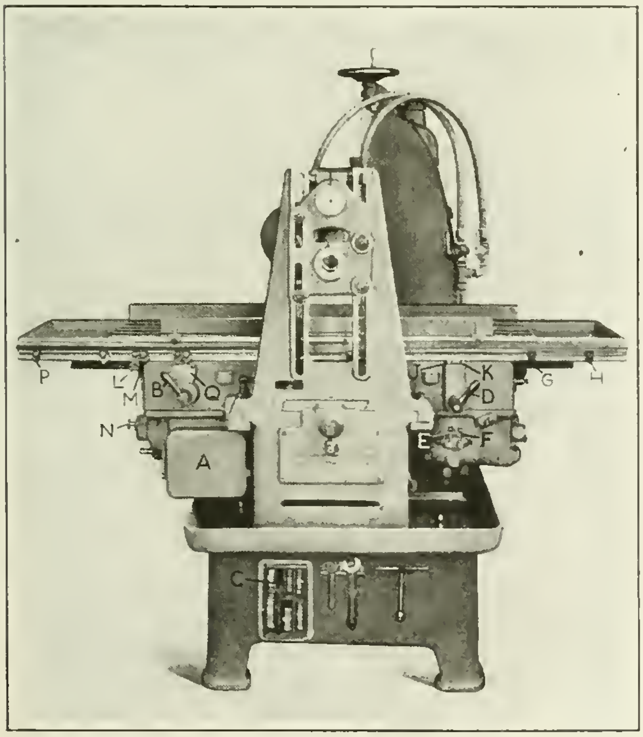


Fig. 5. Front View of Automatic Milling Machine

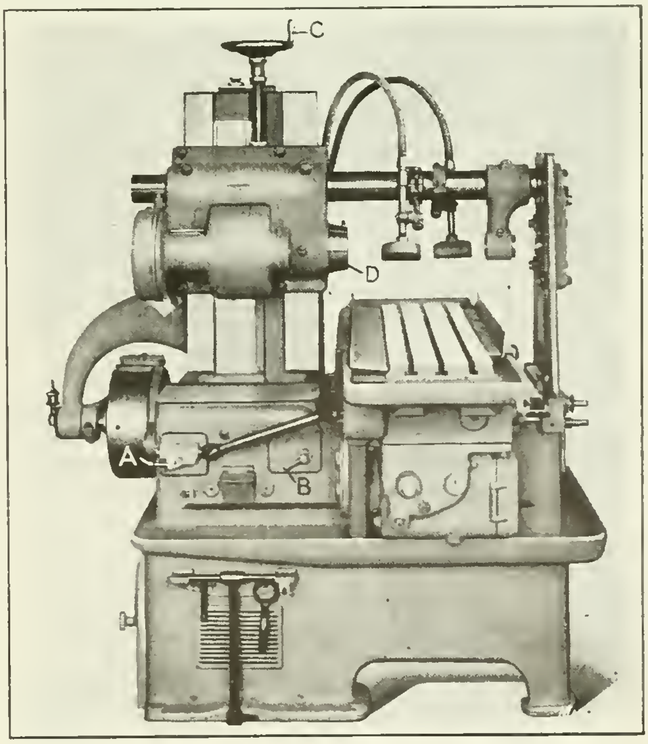


Fig. 6. View showing Left-hand End of Machine

is automatically stopped when the table is reversed or stopped, and started again only when the slow feed is engaged. Of course, lever *B* can be operated by hand instead of by the table dogs, if desired. When this lever is moved to the left-hand position, as shown, the slow table feed is engaged. A movement to the right serves to engage the fast table feed, and a still further movement in a right-hand direction serves to stop the spindle.

General Construction

The limited amount of space available prevents a full description of the table feeding and controlling mechanisms. These units are designed to withstand the hard usage to which a manufacturing type of machine is generally subjected. Ample strength and rigid construction have been secured by the use of box construction. The internal bracing of heavy webs throughout the frame makes the machine very strong and rigid.

The main drive shaft runs on ball bearings, and is supported on both sides of the driving pulley. The arbor is exceptionally well supported by an adjustable overhanging solid steel arm. An arbor yoke, employed for supporting the arbor at any intermediate point near the cutter, furnishes added support for heavy work. The wearing surfaces of the table and all bearings throughout the machine are of ample proportions. Provision for adjustment for wear is made throughout The complete enclosing of all working parts and the convenient arrangement of all controls at the front tends to develop a high degree of efficiency in operation.

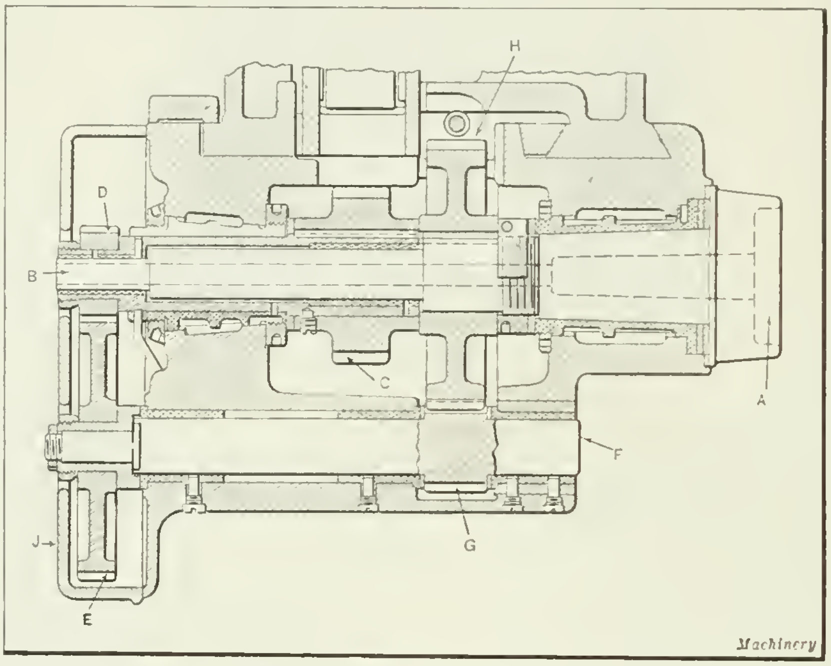


Fig. 7. Sectional View of Spindle

The automatic lubrication of all rotating parts within the frame of the machine is an important feature. The oil-tight cases contain reservoirs into which the rotating members dip, thus supplying ample lubricant for themselves and at the same time carrying the oil up to tubes running to the bearings. Rolls that dip into oil reservoirs keep a film of oil constantly on the table ways. The cutting lubricant is pumped to the work from a large tank cast in the base. Two nozzles are provided so that if two cutters are used, each will be provided with an ample supply of cutting lubricant at all times. Provision is made for cutting off the supply to either or both of the nozzles as desired.

The machine has an automatic longitudinal feed of 34 inches, and a transverse adjustment of 5¼ inches. The spindle can be adjusted vertically by means of the handwheel shown at *C*, Fig. 6, through a distance of 15 inches. The spindle nose has a No. 11 B. & S. taper, and the hole through the spindle which accommodates the draw-in rod is 13/16 inch in diameter. The diameter of the driving pulley is 14 inches, and it carries a belt 4½ inches wide. This pulley is intended to be driven at a speed of 350 revolutions per minute. With this speed the twelve available spindle speeds range from 22 to 180 revolutions per minute.

The diameter of the hole in the bronze bushing of the arbor support is 2 1/16 inches. The distance from the center of the spindle to the under side of the over-arm is 5½ inches. The greatest distance from the end of the spindle to the center in the arbor yoke without arm braces is 27 inches. The maximum distance from the end of the spindle to the bushing in the arm braces is 19¾ inches, and from the spindle head to the arm braces, 24 inches.

The working surface of the table is 52 by 12½ inches, and the over-all dimensions, 74 by 17¼ inches. There are three ⅝-inch T-slots in the table. The eighteen changes of feed range from 0.38 to 24.54 inches per minute. The fast travel between cuts is 210 inches per minute. The capacity of the cutter lubricant tank, which is cast in the base of the machine, is 42 gallons. The machine weighs about 6200 pounds, and requires a floor space of approximately 108 by 69 inches.

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EXPORTS BEFORE AND AFTER THE WAR

In an article published in *Commerce Reports*, by W. H. Rastall, chief of the Industrial Machinery Division of the Department of Commerce, statistics are given covering the exports of industrial machinery from the United States in 1921 to thirty different countries. From the figures given it will be seen that in the year 1921 Mexico imported American industrial machinery to a greater value than any other country, Canada coming second, Cuba third, Japan fourth, and China fifth. Among other big customers of the United States are the United Kingdom, France, British India, Brazil, and Argentina, in the order named. The table also shows a comparison with the exports of industrial machinery before the war, and it is interesting to note that there has been a considerable realignment of our foreign markets. Canada, however, has always been a leading customer for industrial machinery, holding the first place in 1913; but in that year the United Kingdom came second, and Germany third as buyers. In 1921 Germany was the thirty-first country on the list in respect to the value of industrial machinery imported from the United States. Altogether, $246,400,000 worth of industrial machinery was exported in 1921, as compared with $320,000,000 in 1919, and $384,000,000 in 1920. Latin America took a greater share of our exports in 1921 than in any preceding year. In 1910 it took about 30 per cent; in 1913, 23 per cent; in 1919, 19 per cent; in 1920, 27 per cent; and in 1921, over 37 per cent of the total exports in industrial machinery.

The tabulation appearing in *Commerce Reports* for January 22 is of great interest as indicating what countries are most active in developing along industrial lines at this time. It also indicates the great strides that have been taken in exporting machinery in the last decade. In 1910, the total exports amounted to less than $52,000,000. In 1921, the value was over $246,000,000, or nearly five times as much. Even when allowance is made for increases in prices, the exports in 1921 were fully double, by volume, what they were in 1910; and 1921—it must be remembered—was a year of business depression. Hence the outlook for the exports of industrial machinery in general is a promising one, great strides having been made in a comparatively brief period.

The British Metal-working Industries

From Machinery's Special Correspondent

London, February 13

THERE are many signs of a better state of things all around in the metal-working industries, and remarkable strides have been made toward normal trade conditions since the beginning of the new year. With the exception of the Clyde district, there has been a constant fall in the number of unemployed.

Conditions in the Machine Tool Industry

In the machine tool trade in both the Birmingham and Manchester districts there is a vivid contrast with the conditions of even a month ago. Several firms that were visited were noted to be working at their full normal capacity. This is particularly true of firms engaged in the manufacture of tools for general purposes. Makers of heavy machine tools are also fairly busy, and plants devoted to highly specialized lines are beginning to take on more men.

Demand is not confined to machines of any particular type. In fact, it is very general. For example, one of the largest machine tool makers in the West Riding of Yorkshire is reported to have taken orders during December for lathes, planers, and boring mills to the value of over £40,000 and during the second week in January obtained additional business to the value of about £12,000. Another firm in the same district is fully occupied in the production of radial drilling machines. Grinding machine makers report an improved demand, and a large amount of special work is being done for textile machinery makers. A well-known firm specializing in the production of machinery for twist drill making is taking on more men, and besides home orders, is engaged on a number of orders for overseas. Scottish machine tool makers report a slight improvement.

Generally speaking, fully 50 per cent of the work at present in hand is for overseas destinations, the railway shops of India being by far the largest individual buyers. Home trade is divided. That textile machine makers are taking a fair number of special machines has already been mentioned. Railway shops are also coming to the fore, and orders are at present being handled on their account, particularly for boring mills, lathes, and so on, as used in the manufacture of railway wheels, axles and tires.

Curiously, despite the prevailing conditions in the shipbuilding industry, a quantity of tools for use in the shipyards are now being built. The electrical trades are mainly interested in heavy machine tools, and quite a large proportion of the bigger machines now in the shops are for use on large turbine, turbo-generator and similar heavy electrical engineering work.

Makers of Diesel engines, both for land and marine purposes, are also taking an active interest in machine tools, and in view of the developments in this particular field, there is likely to be a demand for certain classes of machines in this specific direction. Engines of this type are particularly well adapted to modern manufacturing methods, and the grinding process, especially for finishing the internal surfaces of the engine cylinders, is attracting considerable attention.

In the fields related to the machine tool industry there are signs of greater activity. A fair amount of special jig work has recently been placed. Small tool, twist drill, and hacksaw makers are also active, and are busier than they have been for a long time. Makers of files experience a greater demand and also ruinous under-selling. As a measure to check this, many makers have agreed to minimum prices below which none of them will quote.

Overseas Trade in Machine Tools

It is now possible to compare the total exports and imports of machine tools in 1922 with 1921 and other years. The value of the machine tools exported during 1922 was only a little over half that of 1921, the actual figures being £1,530,800 and £2,920,500, respectively. The tonnage was 12,160 in 1922 as against 20,064 in 1921. Thus it will be seen that the value per ton of the total exports during 1922 fell from £145 (the average for 1921) to £126. The pre-war average over three years (1911-1914) was £61 per ton.

Imports also fell off heavily during 1922, although the total tonnage was increased. The total imports amounted to £423,500 as against £632,200 in 1921, the corresponding tonnage being 3385 and 3000. This increase of tonnage, despite the great drop in value, is accounted for by the heavy fall in the value per ton which averaged £210 in 1921 and only £125 last year. The last figure compares favorably with the pre-war average of £97 per ton.

It is interesting to compare the overseas trade in machine tools with the total trade of the country during the three years 1920, 1921 and 1922. If the total export trade in 1920 be taken as 100, the figures for the three years stated would be 100, 52, and 54. The machine tool exports for the same three years, letting 100 represent the exports for 1920, would be 100, 85 and 44. These figures show that the trade in machine tools more than maintained its position during 1921, but during 1922 fell considerably. These figures are based on total values only.

For the last month of the year the returns showed a further fall from the figures reached in October, the value of exported machine tools being £112,090 for 955 tons, giving a value per ton of £117. Imports rose from £26,820 in November to £36,833 in December, the value per ton also rising from £134 to £141. In December, lathes and the simpler heavy machine tools formed the greater part of the exports, totaling over 600 tons. The largest class in imports was drilling machines, which totaled 61 tons, lathes coming next with 45 tons. It is interesting to note that drilling machines and presses are the only items on which the value per ton of exports exceeds the value per ton of imports. For drilling machines, the value is almost 45 per cent higher, while presses are 25 per cent higher. On the other hand, imported grinding machines show a value per ton about 60 per cent higher than exported machines.

Iron and Steel and General Engineering Fields

In the general engineering and iron and steel fields, there is a decided improvement. Pumping machinery makers are finding conditions brighter, with some opening out of foreign business. Engine builders are moderately well off, but the textile machinery makers are better situated than any other branch of the engineering industry. There is also a considerable demand for rolling stock.

The iron and steel trade is on the up grade, and each week marks the re-opening of works and iron-ore mines that have been closed for two years. Today practically all Continental works are uncertain as to deliveries and prices, so that home makers are in an advantageous position for the time being. Foundries are relatively active, and there is an exceptionally good demand for pig iron.

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STANDARDIZATION'S ACTUAL RESULTS

The United States Chamber of Commerce estimates that the aggregate cost of production in the manufacturing industries could be reduced fully 25 per cent if unnecessary models, types and sizes were eliminated. This statement is not a guess, but is based upon statistics furnished by industries in which cooperative effort has made standardization and simplification possible. The Chamber of Commerce gives specific figures to show what standardization has accomplished by eliminating unnecessary sizes or types, a few of which are mentioned below.

Before an effort was made to standardize pipe fittings, there were 17,000 different styles, types and sizes made. Now this number has been reduced to 610. Car wheels have been reduced from 175 types and sizes to 4. Malleable chain has been reduced from 2044 to 820; dry cells, from 17 to 6; hammers and axes, from 2752 to 761; shafting, from 60 to 14; steel lockers for factory equipmeut, from 37 to 9.

An important work has been begun, and it must not be suspended until every possibility for standardization has been tried out in all manufacturing fields. Wherever economies can be effected, standardization is of the greatest importance to American manufacturers, because many of the European countries, particularly England and Germany, are working with a definite purpose along this line; and when the world again returns to an economic equilibrium, our manufacturers should be ready for the world's markets with products economically manufactured under systems of standardization as nearly complete as possible. We are a long way from perfection now.

* * *

BUILDING SPECIAL MACHINERY

Many manufacturers employing special machinery for an unusual operation or process still believe they can save money by developing such machines in their own shops instead of employing a machine tool builder or a shop that specializes in that kind of work. As a rule, the manufacturer who employs his own designers to develop special machine tools finds the cost considerably greater than if he had employed a specialist; and it is seldom that the results are as satisfactory as when the work is done by an experienced machine tool builder.

In one instance a builder of heavy machinery figured on saving money by developing in his own shop a machine of a type offered by a special machinery builder. His designers were occupied for five months without producing a satisfactory machine and finally an order was placed with the machine tool builder requesting that the machine be delivered within one week.

Users of special machine tools do not always have a clear conception of the cost of developing machines of unusual types, and often compare the price of a special machine, of which only one or a few are built, with that of a standard machine tool of which several hundred or thousand are manufactured. A well-known machine tool builder some time ago refused to build a special machine for less than $30,000; and as this figure was considered exorbitant by the prospective customer—an automobile manufacturer—the latter proceeded to develop the machine in his own shop. After two years spent in experimenting, scrapping and rebuilding, a satisfactory machine was developed at a cost of over $50,000. There are exceptions to the rule, for various reasons; but, generally, a shop organization experienced in handling such work can build special machinery better, more promptly and cheaper than can the user himself.

* * *

ADEQUATE SHAFT SUPPORTS

A fault frequently overlooked in power transmission installations is the overhanging shaft. When the end of a shaft projects beyond its bearing, both the bearing and the shaft are subject to unnecessary wear. The greater the length of the overhanging section, the more rapid the wear. The uneven wear to which the teeth of pinions and gears mounted on such a shaft are subject, is often the cause of noisy gearing, early replacements and needless expense.

The necessity for replacing gears, shafts and bearings is too frequently accepted as a matter of course, and an investigation into the causes underlying the need for frequent repairs will often reveal conditions that can be easily remedied. A few comparatively inexpensive changes or additions to the equipment may effect a worth-while saving in the annual expense for replacements and repairs.

The obvious remedy for an overhanging shaft is the addition of a bearing to support the overhanging end. Additional supporting bearings for long lead- or feed-screws, when possible, increase accuracy and eliminate needless wear on the screw thread. If a long lead-screw is not properly supported, the thread will wear unevenly. The pressure exerted by the nut in taking up the sag will be greatest at the point of maximum sag, and the thread at this point will wear more rapidly than at the ends near the supports.

Attention to the repair and upkeep of shop equipment is as important as the design or installation of new machinery.

* * *

BETTER EQUIPMENT FOR SMALL RAILROAD SHOPS

It is the practice of some railroads to transfer obsolete machine tools from the main shops to the smaller repair shops, evidently because it is believed to be economical to use, in the smaller shops, machines no longer considered adequate where a larger volume of work is done; but the fact remains that an inferior machine is inefficient wherever used. While small shops do not need as large a variety of tool equipment, they do require modern designs and types, since the function of railroad shops, regardless of size, is to keep locomotives in service and to reduce the idle repair periods to a minimum.

Even at the present time, machines of the lighter designs, antedating the introduction of high-speed steel, are found in many railway repair shops, especially in the smaller and less important ones. It is not uncommon to find lathes, planers, and other machines which have been used for twenty years, and some are considered worth shop-room even after forty years of service. Needless waste results from the use of such inadequate equipment. The relatively light cuts and slow speeds greatly decrease production, and errors often caused by such inefficient and inaccurate tools increase the time required for assembling machined parts. Antiquated designs are always discouraging to the men who must them—a factor of considerable importance, but one frequently overlooked. Well constructed machines inspire confidence and promote the production of more and better work.

The Need for Mechanical Training

MANUFACTURERS in the machinery field find that although their shops are operating on what is still only a comparatively light schedule, skilled mechanics are scarce. We have just passed through a period of widespread depression and consequent unemployment, yet complaints are already heard from many sources that it is hard to find skilled workmen in the machine shop field.

What is the reason? Isn't it that we have neglected to train the men the industry needs and must have? Where are the skilled men to replace those trained years ago, who are now passing out of the ranks? The machine tool industry, especially, needs a high grade of skilled labor. It needs men of all-around training for foremen and superintendents. It needs salesmen with thorough mechanical experience—the best type of machine tool salesman is the man who knows machine shop work from the ground up. Is there any problem of greater importance before this basic industry?

What is the best method of developing the supply of all-around mechanics? So far nothing that has been proposed is quite equal to the appenticeship method. Doubtless modifications should be made in the old type apprentice training to meet modern conditions, but it is beyond question that the industry must depend chiefly upon, and will profit most from, the training of an adequate number of apprentices.

Training for Responsibility in the Mechanical Field

It may seem more profitable to a manufacturer to train a young man in lathe work only—to make him a lathe department foreman perhaps; or in milling machine work, and put him in charge of the milling department. With this limited experience he is more likely to remain in the shop, and his training is comparatively inexpensive. But men of broad experience make the best foremen, and skilled men are needed for assemblers, erectors, toolmakers, service men and repairmen. They all require a much broader training than a single department of a shop can give, and without such men the machine industries are seriously handicapped.

To train these men adequately, a regular apprenticeship is needed. Four years is none too long for a boy to learn the trade thoroughly, and he should be given opportunity and incentive to acquire experience in every line of work in the shop. The apprentice cannot learn too much, and he should be guided and assisted in studying the trade literature of his chosen life-work.

Furthermore, provision should be made for the training of young men who have had more than an ordinary public school education. Some of the large corporations, like Westinghouse and General Electric, realize this. They have apprenticeship courses suited to boys from the grammar school, from the high school, and from college. It is particularly important to provide for the college man shorter courses than the regular apprenticeship term so that he can get a thoroughly practical training in a comparatively short time. Manufacturers must realize the importance of looking ahead. The machine-building industries must prepare to train the leaders that will be needed ten and twenty years from now.

Objection is frequently made that many apprentices, after completing their training, leave the shop that has spent time and money to train them, but this is only the natural thing for a young man to do. He wants to broaden his experience, and the manufacturer who loses one of his own apprentices in this manner is as likely to hire a skilled man who has been trained elsewhere. It amounts to a fair exchange, and generally speaking, the mechanic who has been in more than one shop is a better man for the industry. There is no loss anywhere; on the contrary, the industry as a whole gains by having a greater number of trained men available.

To place the system on a square and equitable basis, every shop belonging to one of the national trade associations that promote the systematic training of apprentices should be required to graduate annually a certain number, according to the size of the shop. When this is done, there will be no scarcity of skilled mechanics in the future. And until it is done, the industry is eating its cake and trying to have it too.

Progress and prosperity in the machine tool industry will depend very largely upon the number of skilled men available now and in the immediate future. This industry demands the service of high-grade skilled men more than any other branch of the metal-working industries, and has unequalled standards to maintain. There must be thoroughly established apprenticeships, and they must be made attractive enough and broad enough to tempt unusually intelligent and ambitious boys and young men to enter the trade. The last period of prosperity in this country showed clearly the great opportunities for men well trained in the industry.

It is especially the shop training that must be taken care of by the manufacturers. The training that the ambitious young man, willing to fit himself for greater responsibilities in the future, can obtain for himself by studying books and periodicals is well taken care of by the literature on shop and drafting-room practice that is available to any young man who wishes to devote some of his spare time to study.

There is no other way in which a sufficient number of young men can receive a satisfactory training than by a carefully planned apprentice system. Each manufacturer must be willing to do his share. It will cost something to train apprentices, but the industry will be amply repaid for this expenditure. The supremacy of the American machine-building industry depends upon it.

Industrial Conditions in Southeastern Europe

By OSCAR ERICSSON, Copenhagen, Denmark

In this article, the author, who for many years has sold machine tools in different parts of Europe, and who at present represents several well-known American machine tool builders there, records his impressions from an extended journey in southeastern Europe, during which he visited Poland, Czechoslovakia, Austria, Hungary, Jugoslavia, Bulgaria, and Roumania. As comparatively little is known in the United States of the present industrial conditions in these countries, this brief review will undoubtedly prove of interest to American manufacturers.

TRAVELING in the southeastern part of Europe is not very pleasant, and the inexperienced traveler is warned against undertaking a journey there. Both train accommodations and hotels are unsatisfactory. In the hotels and railroad cars, cleanliness is lacking, and the traveler is certain to have many unpleasant experiences. At every border—the writer crossed nine of them—the visitor spends three hours, on an average, in having himself, his passport, his money, and his baggage examined. In every city and town he must report in person, upon arrival and departure, to the authorities, and each time a certain amount must be paid for stamp fees.

It seems as if pains were taken to make traveling as expensive and difficult as possible. The short-sighted policies of those in power in these countries is beyond comprehension. It is no wonder that their industrial and financial status is what it is. The different nationalities that make up the new southeastern Europe all seem to hate each other, and to do everything in their power to injure one another by trade regulations and obstructive laws. They do not seem to realize that in this way they are injuring themselves as much, or more.

During my travels I was assisted to a great extent by the commercial departments of the American Consulates, and I think it is only fair to say here that probably no foreign consulates are doing as much, either for their citizens or for those who represent the business interests of their citizens, as the American Consular Service. I have had occasion during my many years of travel for business purposes to come in contact with the consular services of various nations, and I believe that this word of appreciation should be recorded.

From a business point of view, however, I found that the southeastern European countries were almost entirely neglected by American concerns, while the countries were literally swamped by the business agents and traveling representatives of English and German manufacturers. As to languages used by a commercial man traveling in these countries, German is the only generally understood language except in Roumania where French is also used.

Industrial Conditions in Austria

Austria is in great need of new machine shop equipment. The production machinery of the Austrian shops was subjected to severe service during the war, and much of it needs to be replaced. But at present it is practically impossible to sell American machines in this country on account of the abnormal exchange rate. As an example, I might mention that the 3½-inch by 5-foot Lo-swing lathe would cost about 120,000,000 Austrian crowns, delivered in Vienna.

Previous to the war, practically all the machine tool business of Austria was handled from Vienna, except the part that was handled from and through Germany—quite a large proportion. The splitting up of the Austrian Empire into many separate states has naturally made Vienna less of a trading center than it was in former years. At present it would be inadvisable to let an Austrian, or even a German, firm take charge of American interests in any of the new countries formed by the disintegration of the Austrian Empire, because there is a great deal of jealousy between different countries.

Czechoslovakia

Seventy per cent of the industries of the former Austrian Empire are located within the borders of the Czechoslovakian Republic. More than half of the country's industries are under the management of German or Austrian Czechs. The manufacturers in Czechoslovakia are thoroughly alive to the need for improved machine shop equipment, and give a great deal of attention to modern methods, but the financial situation here, as well as elsewhere, stands in the way of any business in the immediate future. While the Czechoslovakian money has improved in value to such an extent that the exchange rate is 100 per cent more favorable now than eight months ago, this is not an unmixed advantage. There is considerable unrest in industrial circles, because an improved exchange rate means greater difficulty in the export trade, and in Czechoslovakia the export business is the important matter; the country is in possession of most of the raw materials needed for manufacturing within its own borders. The improved exchange gives the country the ability to buy from abroad, but prevents it from selling, which appears to be exactly the opposite condition for best meeting the present needs of that country. As a result, while this nation would be capable of buying, fear for its future export markets prevents any industrial expansion at the present time.

Hungary and Jugoslavia

Hungary is greatly handicapped by having been deprived of a large territory which formerly supplied the country with coal, iron, and lumber. With the exception of Austria, Hungary seems to be in the worst condition of any of the countries in southeastern Europe. In the railroad shops, in one of the large electrical factories, and in one of the largest general machine-building plants in the country, I found definite need for modern machine tools. But Austria and Hungary are less able to buy than the other countries visited.

Jugoslavia presents a more favorable condition. Before the war, Austrian influence no doubt prevented proper industrial developments in this part of the former empire, and it was devoted almost entirely to agricultural pursuits. Since the war, efforts have been made to develop industries within the country. It is also surprising to note the great number of modern buildings that are being erected in Belgrade, in an effort to give that city a more European appearance.

The national debt of the country is comparatively small, and the natural resources comparatively great. For example, the oak forests of Jugoslavia are the greatest in Europe;

and in intensive agriculture the country is rated as the second in Europe, Denmark coming first. Hence, this country has good prospects of developing into a prosperous nation, provided steps are taken to utilize fully its natural resources. The English realize this, and British firms are busy building railroads and bridges here. At least one well-known British firm is also planning to build a branch factory in Belgrade. It may be of interest to American machine tool builders to know that Ingenieur R. Nikolitsh, Verkehrsministerium, Koenig Peterssstrasse 41, Belgrade, is in charge of all the equipment for the Jugoslavian State Railways.

Bulgaria and Roumania

There are practically no industries in Bulgaria and there is little or no demand for machine shop equipment at present, except for the state railway shops. A complicated course must be followed in doing business with the Bulgarian Government. The Government requires that the foreign seller maintain a representative in Bulgaria, and furthermore requires with each bid (1) a certificate from the Department of Commerce in the country of origin that the firm making the bid is in good standing and is actually a producer of the goods offered; (2) assurance that the firm making the bid has delivered similar goods elsewhere; (3) a certificate from the Department of Commerce covering the appointment of a representative for this particular transaction, or for business transactions in Bulgaria in general; (4) a deposit, which is usually 5 per cent of the total amount of the bid, or a 1 per cent deposit with the bid, and a guarantee by the Bulgarian National Bank that the other 4 per cent will be paid ten days after the order has been placed.

In turn, the Government usually pays one-third the value of the order upon a guarantee from the bank that the goods will be delivered; one-third against the bill of lading, sent through the bank, and the remainder after the final inspection of the goods. The financial transaction must pass through the seller's bank to the Bulgarian National Bank, where the seller must open a guarantee account in order to obtain the necessary deposit certificates to satisfy the Bulgarian Government.

American manufacturers should not send catalogues to Bulgaria by parcels post, as they are subject to a heavy duty. All catalogues should be sent as printed matter.

In Roumania practically all the industries are controlled by banking interests, except the shops belonging to the state railways. Since the territorial expansion of Roumania, important plans have been made for the expansion of the state railway system, which will involve the building of bridges, adding considerable mileage of track, and the building of new shops. The present rolling stock and permanent way of the Roumanian state railways is in a very bad condition, and there were not less than eighteen accidents in the month of October, three of them occurring at the same spot.

The Baldwin Locomotive Works maintain a large office in Bucharest, and have delivered many locomotives to the Roumanian railways. The address of the state railways administration is Le Direction de la Chemin de Fer de Roumania, Bucharest.

Poland

The greatest activity in Poland is in connection with railway development and the building of rolling stock. The chief of the machine equipment of the Polish state railways is Inz. Zygmunt Peszkowski, Nowy Swiat 14, Warsaw. The Polish Government has ordered 7800 passenger cars, and 70,000 freight cars from Polish firms, to be delivered over a period of years. In addition to these cars, the Government has ordered 2970 locomotives from Polish firms, one-half of this number being ordered from H. Cegilsky & Co., Posen.

Several of the firms that have received orders for locomotives and cars have negotiated with American firms for machine tool equipment. The great difficulty in selling to these firms is that they all want credit covering several years. One firm alone has bought from Sweden machinery valued at 1,000,000 kronor ($270,000), the payment for which is guaranteed by the Polish Government. But in general it is not possible to obtain a guarantee for equipment bought abroad, the Government taking the stand that the order it has placed with the Polish manufacturers with stipulated payments on given dates should be a sufficient guarantee for the foreign seller of machines.

When goods are to be sold to Poland, some information should be obtained in regard to the commercial law governing the part of the country to which the goods are sold because in those parts of Poland that formerly belonged to Germany and Austria, the laws do not yet agree with the Polish law governing the rest of the country. It is therefore advisable to obtain definite legal information from the American Consulate or from a law firm recommended by the consulate in that part of Poland to which the goods are to be sent.

All the firms that have obtained orders from the Polish Government for locomotives and cars are in great need of modern machine tools. At present most of these needs are met by German manufacturers, who are said to extend credit to the Polish buyers. The Polish firms ask that their payments be extended over a period of eight years, which is evidently an impossibility for any machine tool builder to grant. The Polish Government, when approached with regard to the buying of machine tools that their engineers state they prefer, wanted credit extended over a period of ten years! There is no duty in Poland on machinery of any kind if it is not manufactured in the country; and as there are practically no machine tools built in Poland, this means that machine tools are free of duty. But this does not help much when the finances of both public and private enterprises are such that they are unable to pay for their purchases except on an installment plan extending over a period of from eight to ten years.

Possible Market for Machine Tools

Generally speaking, there is no market for machine tools as yet, in Jugoslavia, Bulgaria, or Roumania. Poland and Czechoslovakia are possible buyers, but the credit conditions in the former country make any business transactions difficult. Roumania needs railway shop equipment, but the political conditions make it extremely difficult to do business with this government. Austria and Hungary both have industrial concerns of importance, and the need for machine tools is unquestionable; but here again the financial conditions are an almost insurmountable obstacle.

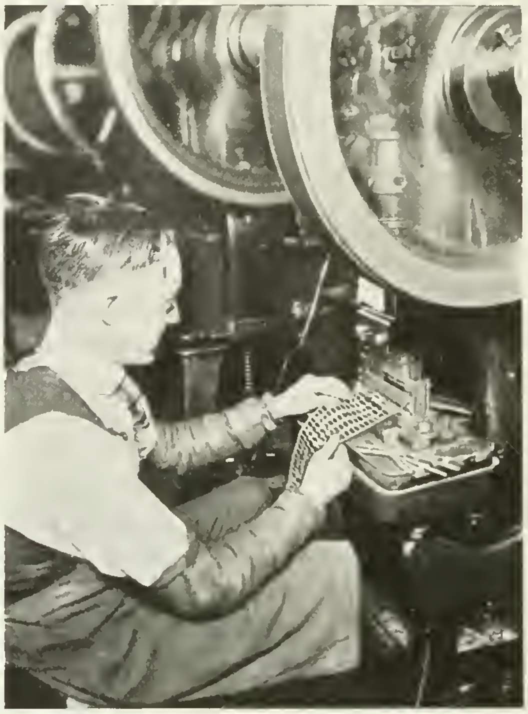
With regard to the type of machine tools that could be sold in those countries where any business at all is possible, it might be stated that there is no market for such lines as planers, lathes, or heavy shipbuilding machinery. The market is confined to more special machine tools, such as gear-cutting machines, large automatic machines, grinding machines of all kinds, high-speed saws, and rotary bevel shears. In some of these lines there is, of course, German competition to contend with. Grinding wheels and proper instructions as to their use are needed in all the countries visited, as the wheels now being used are very unsatisfactory.

* * *

There are more telephones in proportion to population in the United States than in any other country in the world, there being one telephone for every eight inhabitants. Denmark comes next with one telephone for every twelve inhabitants, and Sweden follows with one telephone for every fifteen. Next comes Norway, with one telephone for twenty-one, and England with one for every forty-seven.

Advantages of Built-up Die Construction

C. E. STEVENS, Chief Engineer, White Sewing Machine Co., Cleveland, Ohio



BUILT-UP dies are those in which the surfaces that are subjected to wear and that are difficult to machine are made in two or more parts and properly assembled. That there are advantages in such a construction is evident. Not only is the cost of making the die reduced and the machining of the impressions simplified, but also repairs may be readily made without the expense of replacing an entire die member. No essential points of die design should be sacrificed, however, in order to use a built-up construction in place of a solid die.

Points that should not be overlooked in designing dies, especially when they are to be used for quantity production, are: (1) The safety of the operator; this is of first importance, because it is very easy for an operator to be injured for life while feeding a power press. (2) Rapidity of operation; the dies should be designed to enable the operator to perform the work as rapidly as possible. (3) The combining of operations; this should be done whenever possible, but not to such an extent that the design will become so complicated as to cause the cost of repairs to amount to more than the net savings derived from combining operations.

The points of design mentioned have been incorporated in a set of dies for producing the rheostat base shown in Fig. 1, and it is believed that these dies are so constructed that the productive and repair cost is much less than for dies of solid construction. The rheostat base is made from a strip of soft cold-rolled steel, 5 inches wide by 0.035 inch thick, and there are four sets of dies used in completing the base. First the stock is perforated, then blanked, formed, and finally the lugs are produced. Three of the dies used in making the rheostat base are illustrated in this article.

Perforating Die of Built-up Construction

The first die used in the operations on this part is a perforating die of built-up construction. This is used for piercing four small round holes, two square holes and four slots in the strip, as shown in Fig. 2. The position of the stock before it is fed into the dies is shown by a heavy broken outline; the outline of the blank and the position of the holes pierced are also indicated. The die consists of a cast-iron shoe milled to receive die-block *A*, into which a center block *B* is fitted. The shape of this center block is shown in the lower right-hand corner of the illustration. It will be seen that the slots and openings that produce the square holes in the die can be readily milled in this block. The simplicity of producing the die openings in this way greatly reduces the cost of construction over that required when each opening is cut from the solid.

The center block is a press fit in block *A*, and both these members are made from oil-hardening tool steel. The larger block is fastened to the die-shoe by machine screws and dowel-pins. The stock is fed between two cold-rolled steel guide strips *C* and *D*, over which, at each end of the die the machine-steel members *E* and *F* are bridged. The guide strips are 1/8 inch thick, which provides sufficient clearance for the stock to pass under the bridge pieces. The guide strips and the bridge pieces are fastened to the die-shoe by machine screws and dowel-pins. Bridge piece *F* contains a slot in which the stop-finger *G* is held. This stop is operated at every downward movement of the press ram, by means of a trip screw attached to the punch holder.

The stripper *H* is of the familiar spring type, and is attached to the cast-iron punch-holder by screws, and guided by two posts which are a press fit in the stripper and a slip fit in the punch-holder. The stripper is operated by six coil springs of square-section wire. Both the punch pad *J* and the stripper are of the same construction as the guide blocks; that is, they are each made in two parts. By this construction, the center block for the die and the ones used in the stripper and punch pad may be milled as one piece, thus insuring perfect alignment of the punches with the holes in the stripper and die-block. The flat punches for piercing the slots are made of B & S ground stock; they are riveted over in punch pad *J* and are well supported by the stripper. Excellent results have been obtained with this construction.

In setting up the die in the press, the stripper springs are compressed enough to allow the punches to protrude beyond the stripper about 3/16 inch, in which position they are temporarily held by set-screws tightened against the shoulder screws that hold the

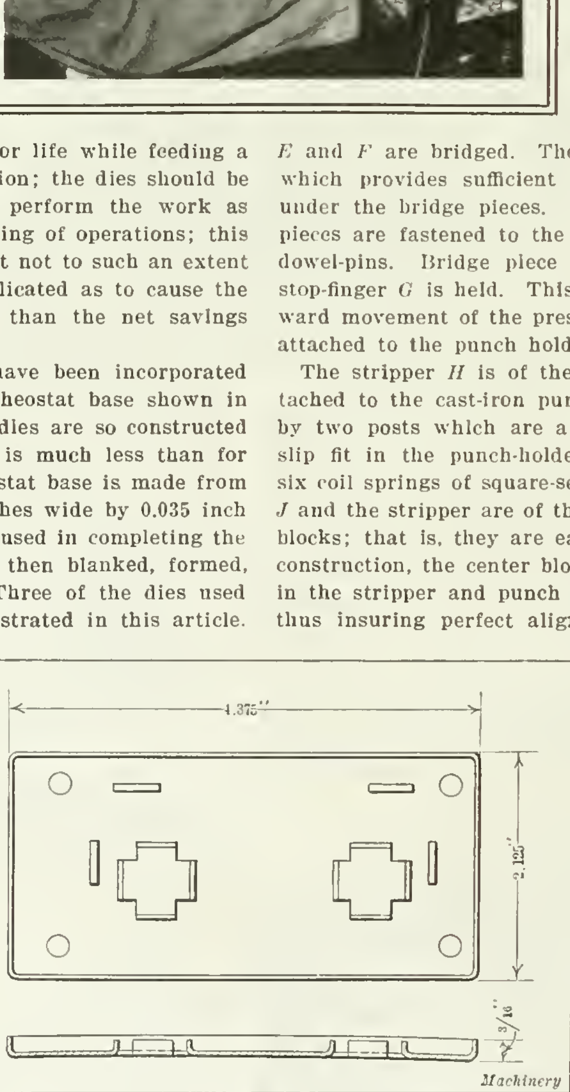


Fig. 1. Rheostat Base produced with Dies of Built-up Type

stripper to the punch-holder. After the punches have been aligned with the holes in the die, these set-screws are, of course, released.

Dies for Blanking

The second operation in the manufacture of the rheostat bases consists of blanking the pierced stock in the die shown in Fig. 3. The general construction of this die is not greatly different from that of the perforating die. It is of built-up construction, the die opening *A* being made of four sections, two straight pieces for the sides and two end pieces *B* in which the contour for the corners is milled. The shape of these end pieces is shown in the lower right-hand corner of the illustration. Each of the four sections is fastened to the die-block by two ¼-inch fillister-head machine screws and one dowel-pin.

The stripper plate *C* is made of machine steel, and it bridges the front and rear guides, after the general construction shown in Fig. 2. The slot for the feed-stop is cut in this stripper plate. Punch *D* is a solid piece of tool steel, fastened to the cast-iron punch-holder, and contains two pilot pins, which locate the stock from two punched holes diagonally opposite each other. In the operation of both the piercing and the blanking die, the strip stock is continuously fed through, being automatically stopped at each operation of the ram by the stop-finger. The press on which these dies were used operated at a rate of 112 strokes per minute on this job.

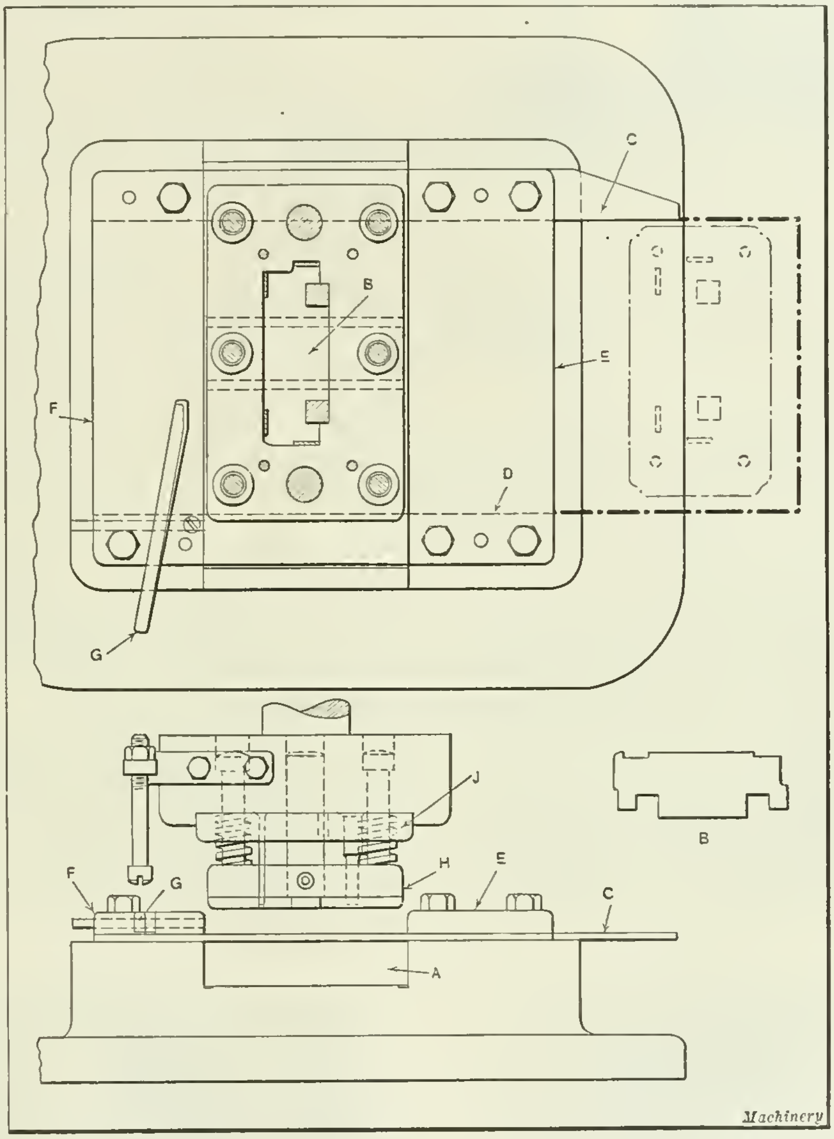


Fig. 2. Piercing Dies having Opening formed by Machined Blocks set into the Die-shoe

Construction of the Forming Die

The design of the forming die is not illustrated. The cast-iron die-shoe is cut out to receive four steel strips, which, when assembled, form the upper corners of the die opening, in which a weight-operated pressure-block is a sliding fit. The pressure-block and the four forming strips are of hardened tool steel. There are two gage strips fastened to the die-block by screws and dowel-pins at each side of the die opening, these strips being shaped to serve as stops when the blanks are fed into the die. The contour of the surface of these strips is the same shape as the corners of the blank (see Fig. 3). These strips are located back from the die opening enough to allow stock to form the sides of the rheostat base (see Fig. 1).

Above these gage strips, and also located on the sides of the die opening, are two stripper blocks, each of which has two projections extending in toward the die opening sufficiently to engage the formed side of the rheostat base and strip it from the punch on the upward stroke of the press. The screws and dowel-pins used to attach the gage strips also fasten the stripper blocks in place. The punch is of tool steel, and is attached to a cast-iron punch-holder by means of two dowel-pins, which also act as pilots to locate the blanks from the two square holes.

The die is provided with a feeding device of the chute type, which is capable of accommodating three blanks at a time. In operation, this feeding device is loaded and the blanks pushed along until one has been properly stopped under the punch. While this blank is being formed, the operator places a fourth blank at the edge of the chute so that as soon as the ram has ascended, the next blank may be fed along to the operative position.

The formed work is blown from the die by compressed air and deposited in a container at the back of the press. The valve for controlling the compressed air is operated by the upward stroke of the press. The weight-actuated pressure-block, previously mentioned, ejects the formed blank, bringing it to the level of the die so that the compressed air can remove it from the face of the die. There is little danger of injury to the operator with a die which is operated and constructed in this manner. When a formed part is produced at every stroke of the press ram, the rate of production is about thirty per minute.

Dies for Shearing and Forming the Lugs

The final operation in making the rheostat base is performed in the die illustrated in Fig. 4. The point of special interest in the construction of this die is that the die-block *A* is made in two pieces, as shown in the sectional view in the center of the illustration. Each of these pieces can then be readily milled to produce the die openings, which are in the form of a cross. These two blocks are set into the cast-iron die-shoe, and fastened by four fillister-head machine screws and two dowel-pins. Within the cross-shaped die openings there are two plungers *B*, each of which is actuated by a coil spring made of square-section wire. These coil springs surround the shank of the plungers, and a plate is set into the bottom of the die-shoe to support the springs. The springs furnish enough tension to eject the formed piece of work from the die.

The punches *C* shear the two square holes at the corners and bend the lips thus produced to a 90-degree angle to form the lugs. These punches are made of tool steel, and are provided with a 30-degree angle shearing edge at the corners, while at the ends there is a clearance of 0.035 inch (equal to the thickness of the stock) so that there may be space for the lug to be formed. The corners of the die *A* over which these lugs are bent are slightly rounded to facilitate the operation. The punches are set into the machine-steel punch-pad *D* and riveted over, and are provided with tool-steel pilots of sufficient length to project 1/32 inch beyond the lug formed on the work. The purpose of this is to force plungers *B* down ahead of the lugs being formed so that they will not interfere with the free cutting and forming action.

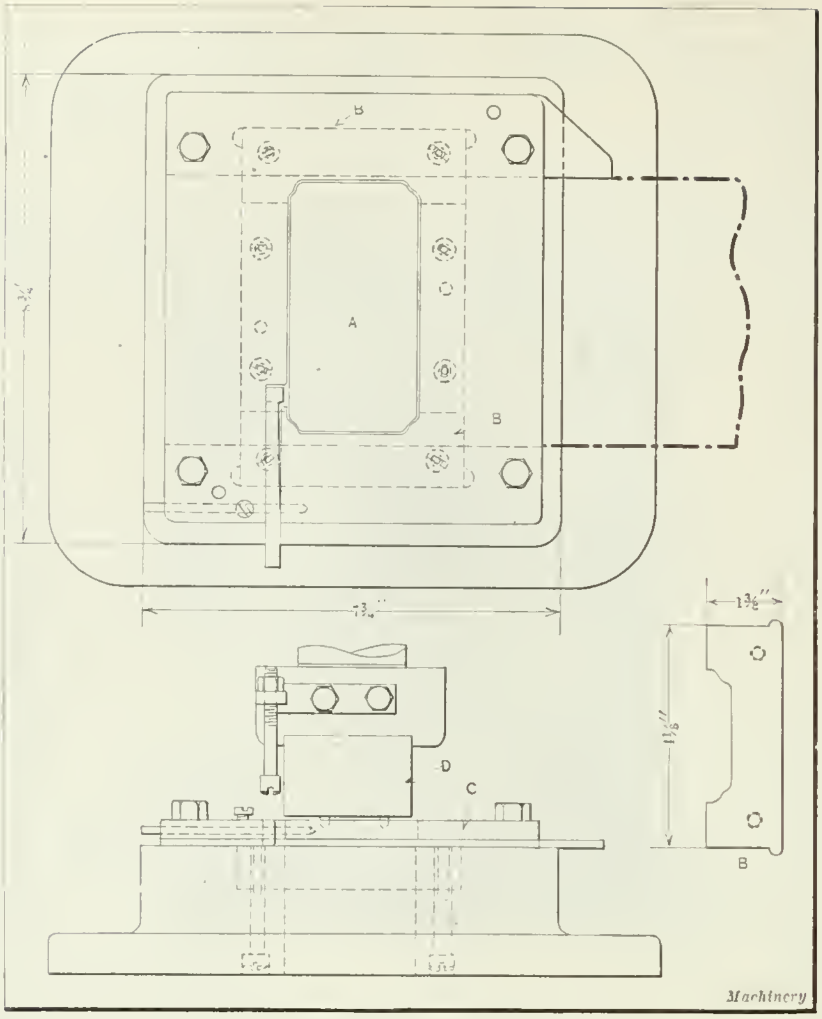


Fig. 3. Blanking Dies of Built-up Construction

The punch-pad is of two-piece construction like the die-block *A*, and the two pieces of the pad and of the die-block are all milled at one time. This gives the required alignment and also saves considerable time in machining. The punch stripper *E* is a machine-steel part, held in place by the customary arrangement of screws, and operated by four coil

The formed work is placed over the die-block, which is an easy fit inside the work. Any play between the work and the die-block is compensated for by the pilots on the punches which enter the square holes before they are sheared, and locate the work. In this particular case, it is necessary that the operator put each piece on the die separately. To prevent accidents when this is being done, the press is equipped with a safety device. It is also equipped with compressed air to keep the die clean. In setting up the die, the plungers *B* are depressed and locked in this position by set-screws. Then the punch stripper is forced up so that the punches extend, where they are temporarily locked by set-screws while the punches are being aligned with the die openings.

The fact that all the dies used for this job are of built-up construction decreases the total cost of production and makes repairs easier and cheaper, thus also reducing possible delays.

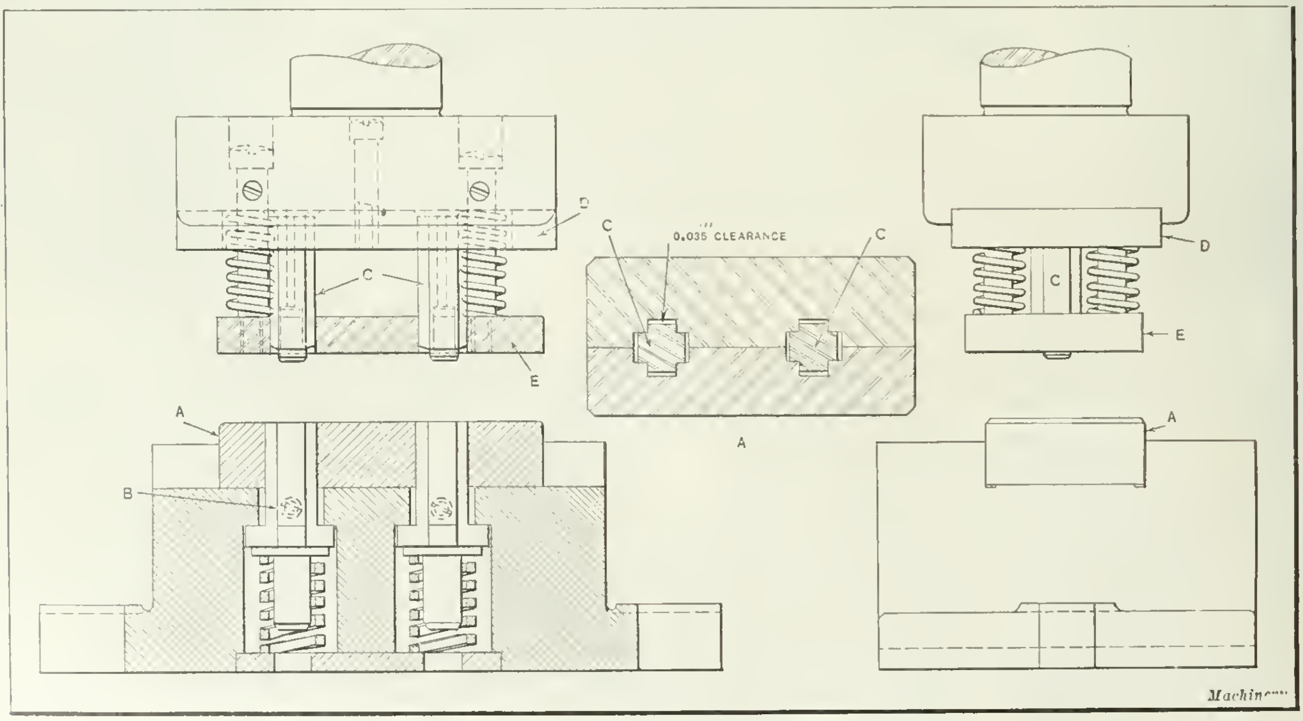
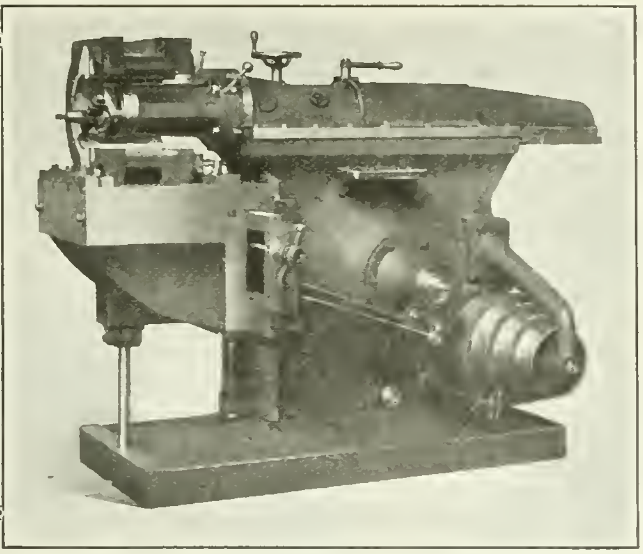


Fig. 4. Shearing and Lug-forming Dies, also of Built-up Construction

Planer and Shaper Attachments

Special Equipments that Adapt Planers and Shapers for Performing Unusual Operations

By EDWARD K. HAMMOND



FREQUENTLY a planer or shaper must be adapted for performing operations that cannot be handled with the ordinary equipment found on machines of these types. In such cases, an auxiliary attachment must be provided. For instance, while a planer cannot cut zigzag oil-grooves in slide bearings or plane concave or convex curved work, it is not difficult to make planer attachments that will enable such work to be performed economically. Likewise, shapers can be readily adapted for performing surface grinding operations, finishing internal or external cylindrical surfaces, and for various other operations.

Attachment for Planing Zigzag Oil-grooves in Slide Bearings

An attachment for planing zigzag oil-grooves in slide bearings, made by the Hanson-Whitney Machine Co., Hartford, Conn., is shown in Fig. 1. It is shown working on the inclined side *A* of a dovetailed slide, but it will be seen that this piece of work is set up in a fixture *B* in such a way that the surface in which the oil-groove is being planed is held in a horizontal position. The design of this fixture is such that it is a simple matter to work on surfaces at any angle from the horizontal to the vertical. This is accomplished by using the attachment in conjunction with either the rail-head or the side-head of the planer, and swiveling the head to bring the tool into the required position. On this oil-groove cutting attachment, as regularly furnished, the maximum length of groove that can be cut is 30 inches; the maximum width of the zigzag path for the oil-groove is 1¼ inches; and the minimum width of the zigzag is ⅜ inch. A complete description of the mechanism of this attachment and of the method of attaching it to a planer was published in October, 1920, MACHINERY.

Planer Radius Attachments

Figs. 2 and 3 illustrate a 30- by 30-inch by 10-foot open-side planer, equipped with an adjustable radius planing attachment which is adapted for work having a radius of curvature ranging from 5 to 15 feet. This machine is built by the Cleveland Planer Co. In order to understand fully the way in which the equipment operates, reference should also be made to Fig. 4, which shows the details of the mechanism.

The attachment is mounted on the planer table, by which it is reciprocated back and forth under the tool. It consists of a table *A* on which the work is mounted, and two radius rods *B*, the length of which may be adjusted to govern the radius of curvature to which the work is planed. These two radius-rods connect the table of the attachment with a fixed pivot point, so that as the planer table moves back and forth in a straight line, the attachment is also moved transversely across the planer table.

This combination of lateral and transverse movements causes the work to be planed to a radius of curvature governed by the position of the pivot point, which is adjustable to suit the requirements of different jobs. By

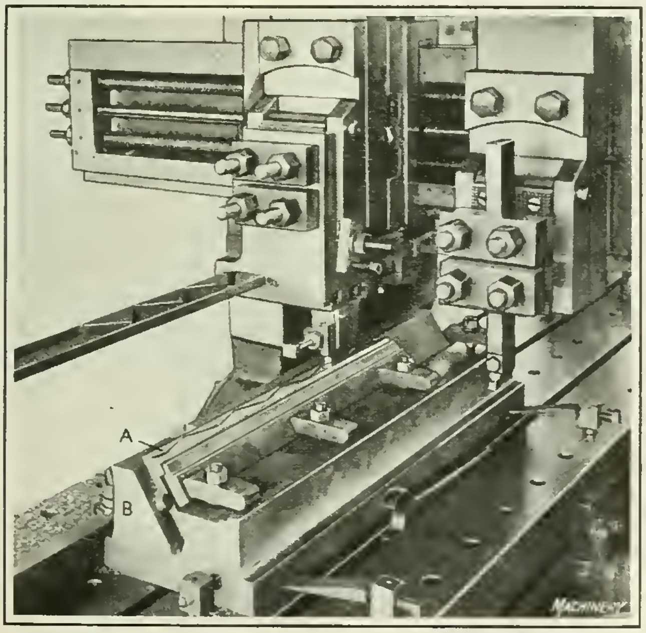


Fig. 1. Cam-actuated Attachment which adapts a Planer of Standard Design for cutting Zigzag Oil-grooves in Slide Bearings

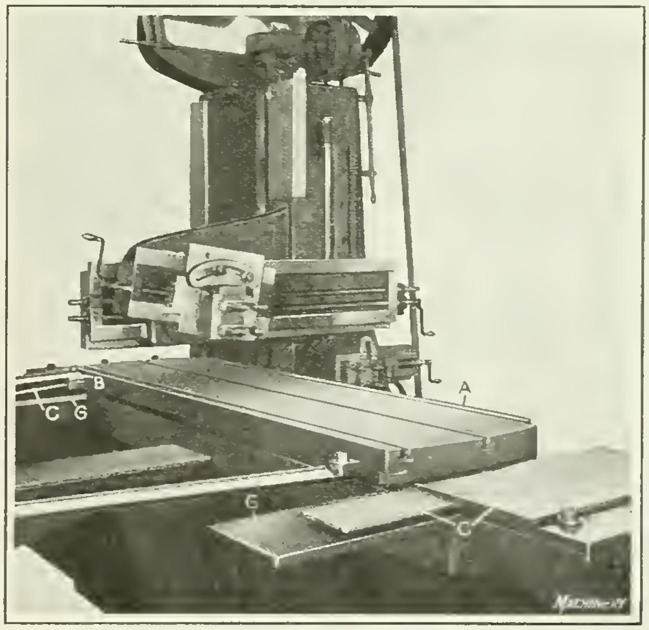


Fig. 2. Close-up View of Radius Planing Attachment for Use on an Open-side Planer. Adjustment is furnished for Different Radii

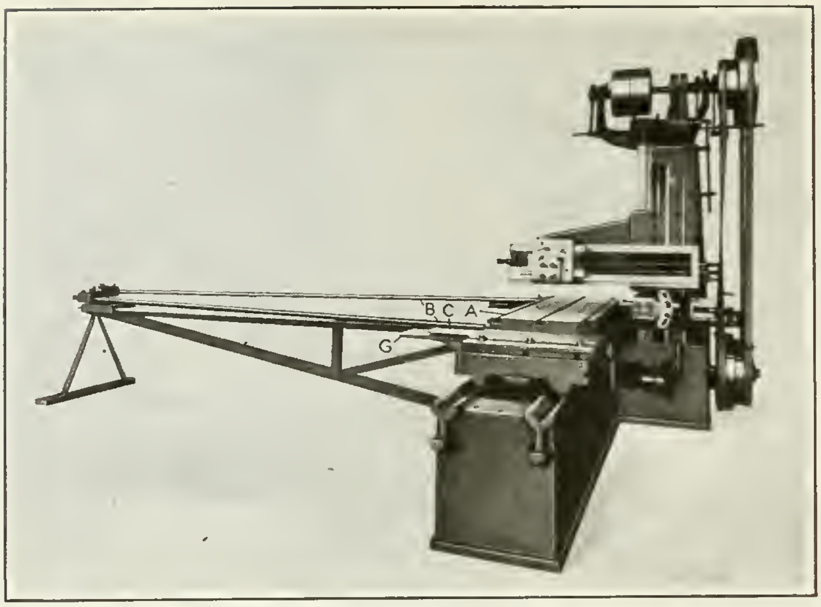


Fig. 3. Open-side Planer equipped with the Radius Attachment shown in Fig. 2

referring to Fig. 1 it will be seen that table *A* of the attachment has two offset portions at each end, over which caps *C* are secured to hold the table down. The two radius-rods *B* are connected to the table as previously mentioned, and beneath the table there is a link *D* with a stud hole at each end. The stud *E* which enters one of these holes is secured to the top of the main planer table, while the stud *F* in the other hole is held in the bottom of the auxiliary table. This arrangement causes a uniform reciprocating transverse movement to be imparted to the table of the radius planing attachment as the planer table reciprocates back and forth under the cutting tool. An attachment of this kind enables radius planing operations to be performed on a vertical plane on the work. Brackets *G* support the ends of the table *A* as they swing out from the main planer table.

Planing Concave Radial Surfaces

The cylinders at each side of a locomotive are separate castings, finished with a flanged joint between the two castings for bolting them together. At each side of this joint, a concave radial surface must be planed over an angle of approximately 90 degrees, forming a semi-cylindrical seat that receives the under side of the smokebox of the engine. It is required to have each of these radial surfaces of the cylinder castings accurately machined, and the usual practice is to handle this work on a planer. At the Burnside shops of the Illinois Central Railroad Co., in Chicago, Ill., a very simple method is used for performing this radius planing operation, the scheme being illustrated diagrammatically in the illustration Fig. 5.

The job is done on a planer having two heads on the cross-rail. One of these heads is connected to the feed-screw in the usual manner, while the other head is released from the screw and is allowed to swing freely on its pivotal support, although it is secured against longitudinal movement on the cross-rail. Each of the planer heads is drilled to receive a pin *A*, and a link *B* is put over these pins to connect the planer heads at the top. Then, in the head that has been released from the feed-screw, a tool-holder *C* is mounted so that the distance from the pivot *D*, about which the planer head swings to the cutting point of tool *C*, is equal to the radius of curvature which it is required to plane on the work.

After the cylinder casting has been properly located under this attachment, the planer is started with a suitable rate of feed to traverse the right-hand head along the cross-rail. Evidently, this movement of the head causes link *B* to swing the left-hand head about its pivot *D*; and as a result, the point of tool *C* swings over the work and generates a concave surface of the required radius of curvature. This special equipment can be quickly removed when regular work is to be done.

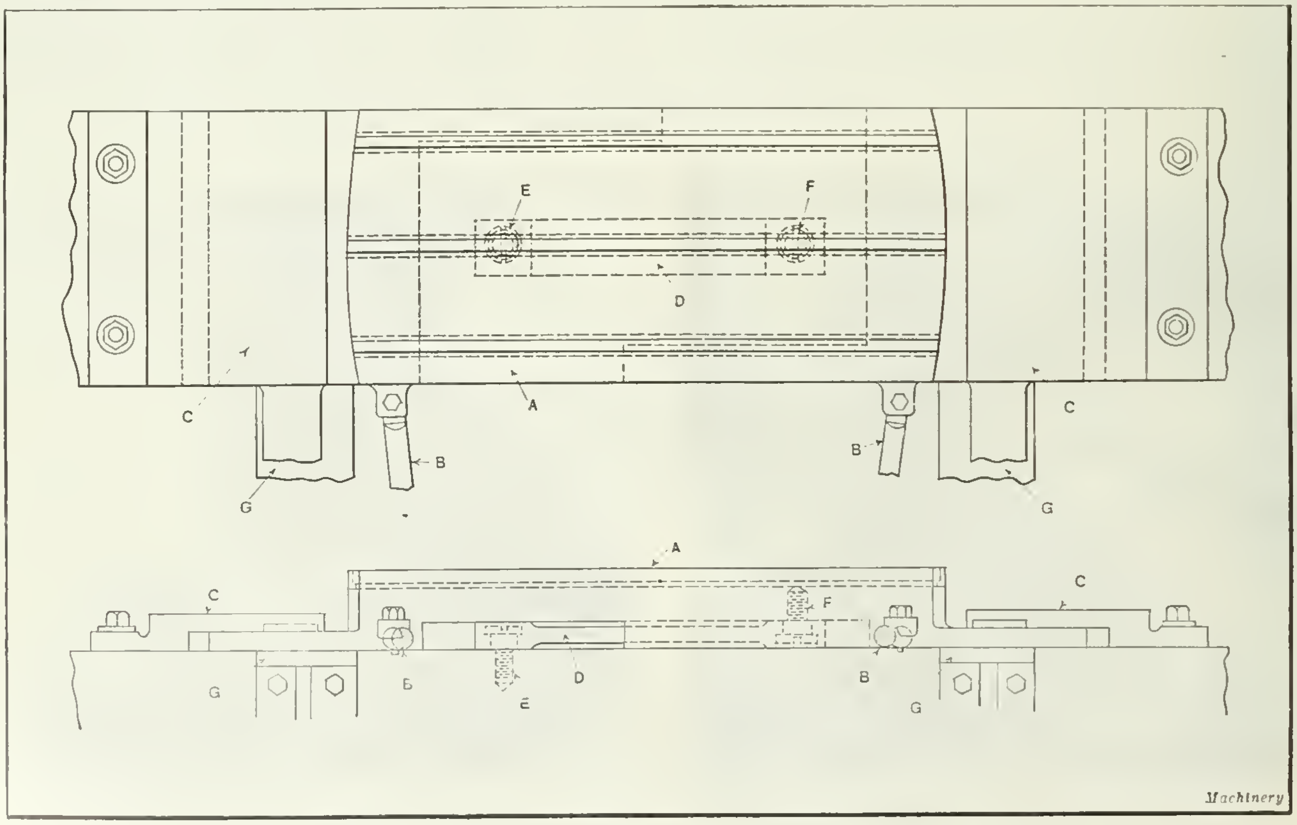


Fig. 4. Arrangement of Mechanism of the Radius Planing Attachment shown in Figs. 2 and 3

Planing Irregular Curved Surfaces

In building ironing machines for use in laundries, it is necessary to plane cast-iron beds which have an irregular curved surface. An ingenious method of planing these curved surfaces has been worked out by builders of these ironing machines, and as a similar procedure might be followed in the manufacture of other products, the way in which this planing operation is performed will be described. It should be understood that the surface of this work follows curves which are not only irregular, but which change from convex to concave while the tool is moving over the work from left to right. Hence, it will be apparent that a satisfactory method of planing such a piece would also be applicable to work of either concave or convex form, and of any reasonable radius of curvature.

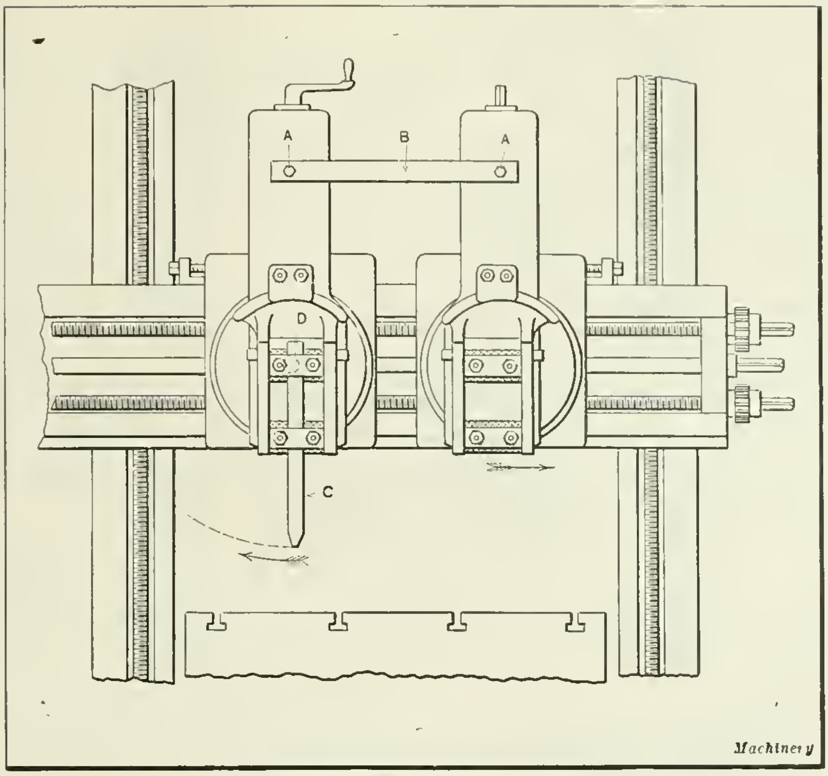


Fig. 5. Radius Attachment used for planing Smokebox Seat in Locomotive Cylinders

Fig. 8 shows, in diagrammatic form, the attachment developed for handling this job, and from the illustration it will be apparent that the principle of operation is simple. In the present case, two tool-heads are utilized in order to expedite the planing of a piece of work of considerable length, as one head is able to start at the left-hand end and one in the middle, thus cutting the production time in half. However, the same principle of form-planing could be applied on a planer equipped with either one or more than one tool-head on the cross-rail. Secured to the top of each planer head, is a bar *A* carrying a cam-roller *B* which runs in contact with a master form *C* of exactly the same shape and size as the work to be planed. This master form is secured between the planer housings so that its straight lower surface is located above and parallel with the cross-rail of the machine.

The planer heads are fed along the cross-rail in the usual manner, but the nuts are released from the vertical feed-screws, so that as each head travels along the rail, the vertical position of the point of tool *D* is governed by engagement between the cam-roller *B* and the master form *C*. As a result, the work is planed to exactly the contour of this form, which has been carefully developed for that purpose. One of the advantages of a planer attachment of this kind is that the planer can easily be adapted for handling other work. Unless the full vertical capacity is required, it is possible to leave the master form *C* in position between the housings and merely disconnect the links *A* from the tool-heads and connect the vertical feed-screws to the planer heads. This enables the machine to be used for other operations.

Grinding Attachments for the Planer and Shaper

It is sometimes desirable to equip a planer or a shaper for performing surface grinding operations. Examples of machines so equipped are shown in Figs. 6 and 7. Fig. 6 shows an open-side planer built by the Cleveland Planer Co., and Fig. 7 shows a shaper built by the John Steptoe Co., of Cincinnati, Ohio. These illustrations make the arrangement

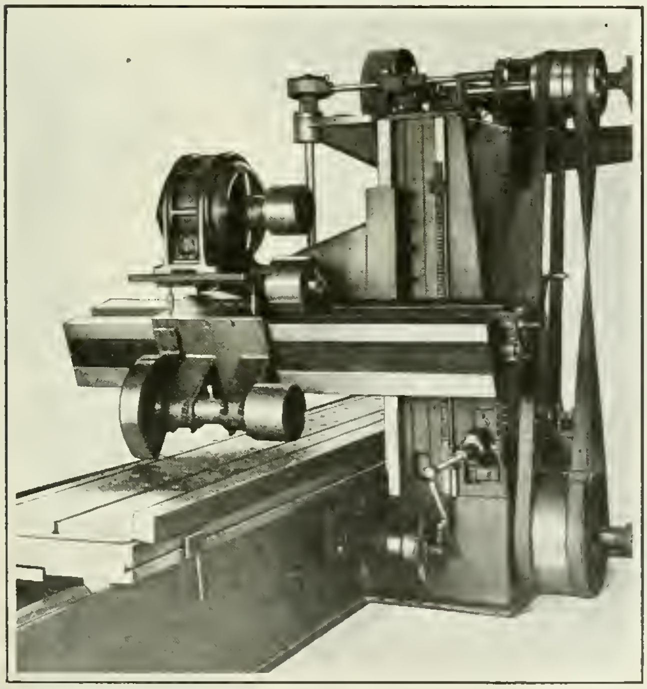


Fig. 6. Open-side Planer equipped with a Special Grinding Head on the Cross-rail for grinding Railway Crossings after planing

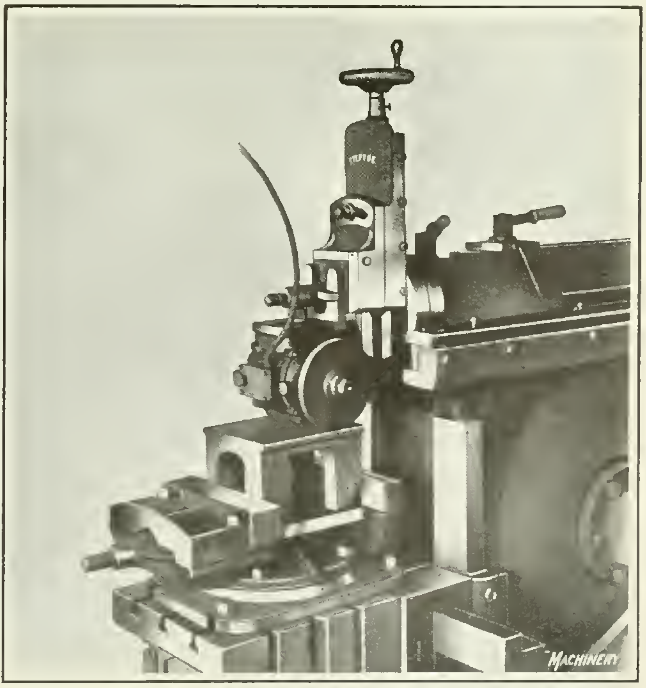


Fig. 7. Shaper furnished with Portable Grinding Machine in the Toolpost for performing Surface Grinding Operations on Small Work

and use of both of these attachments quite clear without requiring detailed descriptions, but it may be mentioned that the open-side planer shown in Fig. 6, was furnished with a motor-driven grinding head on the rail for grinding railroad crossings to a smooth finish, after planing. Similarly, a small electric grinding head is secured to the clapper of the shaper shown in Fig. 7 to adapt this machine for performing surface grinding operations on small and medium-sized pieces of work. Both of these attachments are in the nature of makeshifts, and are not intended for performing grinding operations on regular production work.

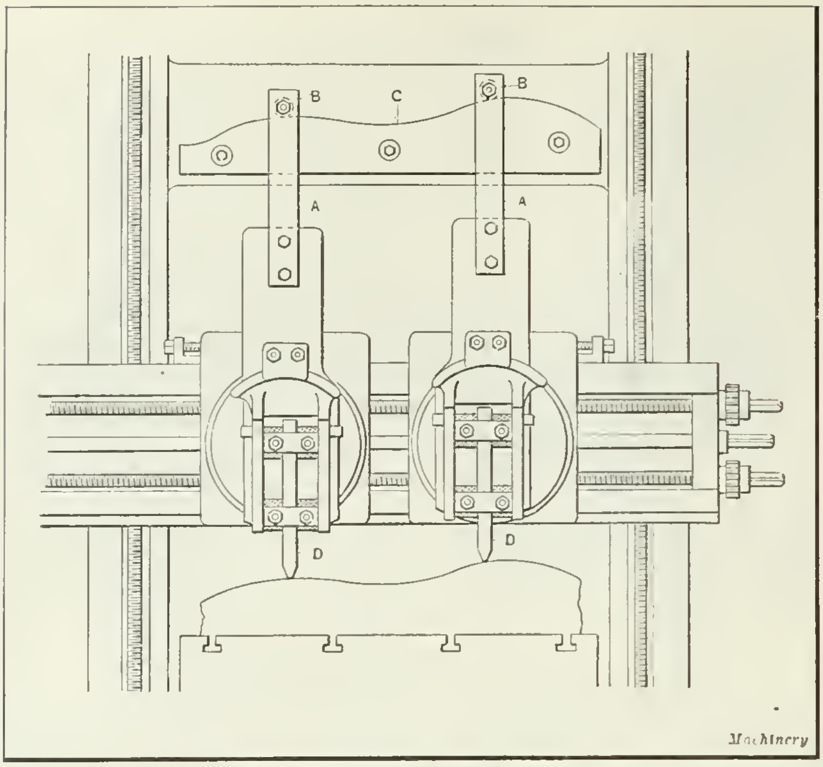


Fig. 8. A Planer Radius Attachment used for planing irregularly Curved Cast-iron Beds of Ironing Machines

Radius Planing Attachment for a Shaper

Fig. 9 illustrates a shaper with a traversing head, built by Gould & Eberhardt, of Newark, N. J., which is equipped for performing a radius planing operation. This is accomplished by removing the short rail that carries the tool-head from the shaper ram, and bolting it to a radius arm *A*. At the left-hand end of this radius arm a number of holes are drilled so that the attachment can be set up in such a manner that the distance from the pivot *B* to the cutting point of the shaper tool, is equal to the radius of curvature which it is required to plane in the work. At the right-hand end, the radius arm is secured to the ram by means of a pivot *C*. Bearing in mind that the tool-head is carried on the radius arm, it will be evident that as the ram reciprocates back and forth, the point of the tool will generate a surface with a radius of curvature equal to the distance from the pivot *B* to the tool-point. This distance can be adjusted by putting pivot *B* into different holes in the left-hand end of arm *A*. Obviously, the pivot *C* must be held in a lengthwise slot in arm *A*, to allow for the change of distance between pivots *B* and *C* while the shaper ram is reciprocating.

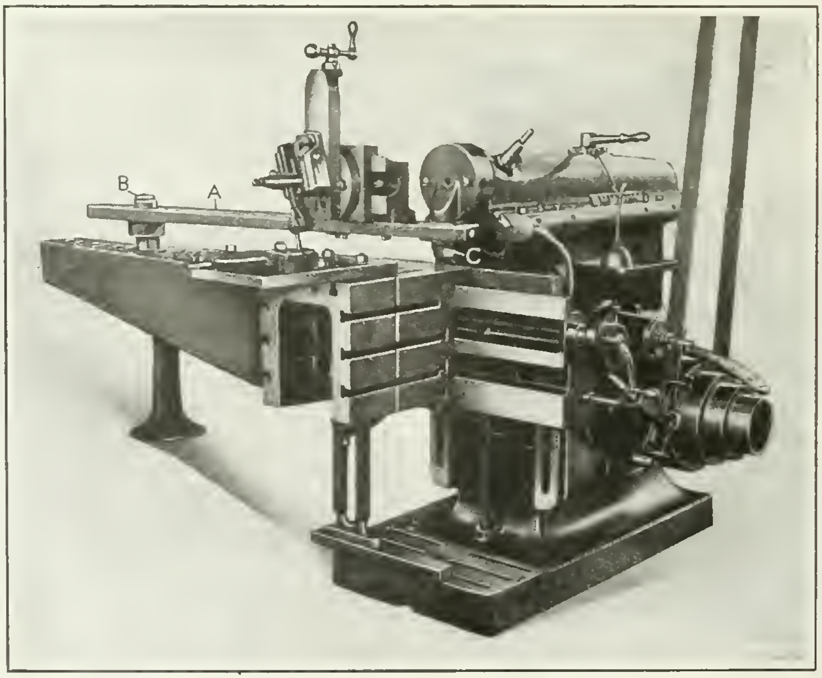


Fig. 9. Radius Planing Attachment for the Shaper

Radius Attachment for Emergency Use

Fig. 10 illustrates a form of radius planing attachment which may be used in an emergency. The way in which this device operates is so clearly shown in the illustration that only a brief description is necessary. A concave curved surface is to be planed on the work at *A*, and to accomplish this result the tool is mounted on a pendulum link *B*, the distance from the center of oscillation of this link to the point of the cutting tool being equal to the required radius of curvature of the work. A pivoted link *C* connects the lower end of the tool-carrying pendulum with the tool-box on the shaper ram, so that as the ram reciprocates back and forth the tool planes the work to the desired form.

Attachment for Cutting Oil-grooves on the Shaper

When it is required to cut straight oil-grooves in bushings, without having them run out at either end, such work can be performed rapidly on a shaper equipped as in Fig. 11. This illustration shows tools applied to a shaper built by the Cincinnati Shaper Co. The bushing *A*, in which the oil-groove is to be cut, may be clamped to the table in any convenient manner. Secured to the shaper toolpost there is a holder, at the lower end of which a pivoted bar *B* is carried. At an equal distance in either direction from pivot *C*, are held a cutter bit and a cam-roller that runs in contact with master cam *D*.

The rise on this cam is of the same form as the oil-groove which is to be cut in the work, the oil-groove being depressed an amount corresponding to the rise on the cam. As the shaper ram reciprocates, the cam-roller runs up over the rise on master cam *D* and the cutter bit is correspondingly depressed. A compression spring *E* maintains uniform contact between the cam and the roller, thus assuring the planing of the oil-groove to the required form. The tool may be fed to depth either by hand or automatically.

Hacksaw Attachment for the Shaper

In Fig. 12 is illustrated a simple means of adapting a Cincinnati shaper

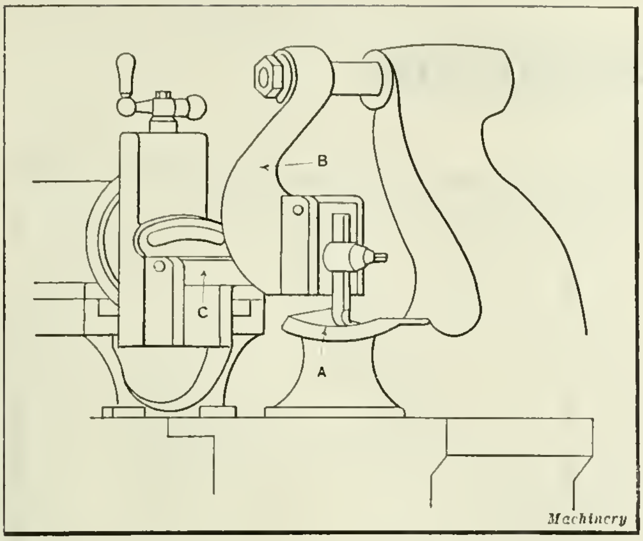


Fig. 10. Radius Planing Attachment for Use on a Crank Shaper

for use as a power hacksaw machine. This consists of the attachment of a saw frame to the tool-block on the ram. For a shop in which there is considerable amount of sawing to be done, such a method is not desirable; but in cases where it is occasionally necessary to do some cutting that is beyond the usual scope of a hand-operated hacksaw, a device of this kind constitutes an inexpensive and reasonably efficient means of handling the work.

Application of Index-centers on the Shaper

A jobbing shop is often called upon to execute orders for repair work on gears, and an occasional operation of this kind can be handled on a shaper furnished with a set of index-centers. Fig. 13 illustrates a machine built by the John Steptoe Co., which is furnished with index-centers of this firm's manufacture.

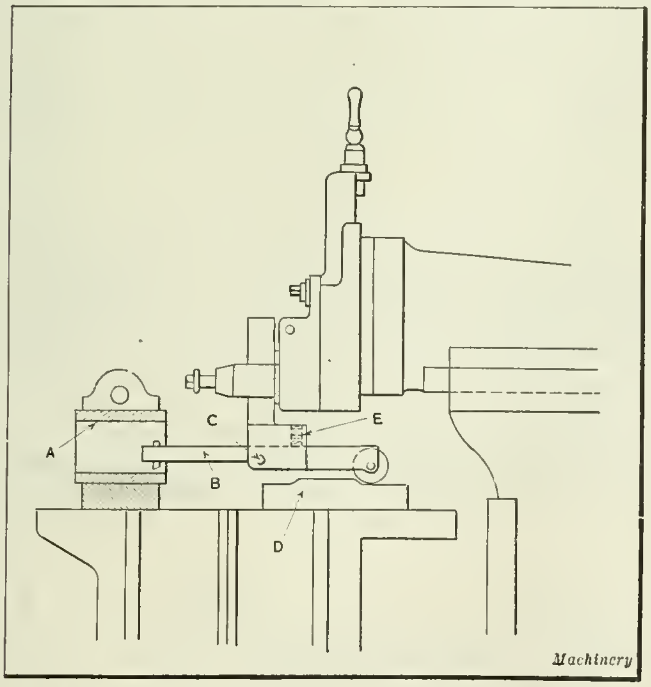


Fig. 11. Tool Equipment for shaping Oil-grooves in Bushings

In shops maintained by railroad or mining companies, far away from industrial centers where replacement gears could be purchased, a shaper is often used for repair work, instead of buying an expensive gear-cutting machine, for which there would be little regular work. The method of procedure is to form a piece of steel to approximately the shape of the tooth, insert it in the gear, and then plane this insert to the required tooth form with the shaper tool. Obviously the shaper tool must be finished to exactly the same shape as the space between two teeth of the gear on which the repair is being made.

* * *

SPRING MEETING OF THE A. S. M. E.

The spring meeting of the American Society of Mechanical Engineers will be held at Montreal, Canada, May 28 to 31. The following subjects will have specific sessions devoted to them: Power, Textiles, Railroads, Management, Paper Machinery, Port Developments, and Fuels. Following the meeting there will be excursions to Quebec and to points north and east of Montreal. The Engineering Institute of Canada is cooperating with the society in the plans for the meeting.

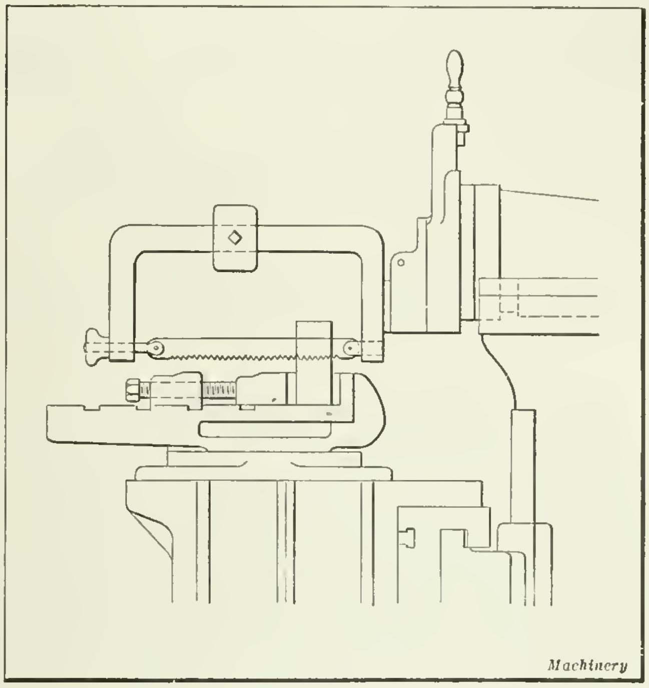


Fig. 12. Shaper equipped for Use as a Power Hacksaw Machine

Late in April a regional meeting of the American Society of Mechanical Engineers will be held at Los Angeles, Cal. Further information relating to these meetings may be obtained from the headquarters, 29 W. 39th St., New York.

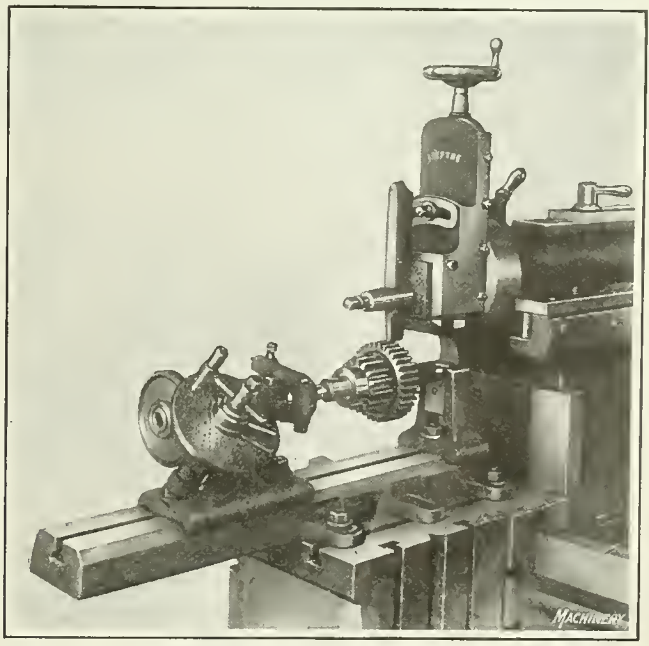


Fig. 13. Use of Index-centers and a Formed Tool for performing Gear Tooth Planing Operations on the Shaper

Ratchet Mechanisms

By C. M. LINLEY

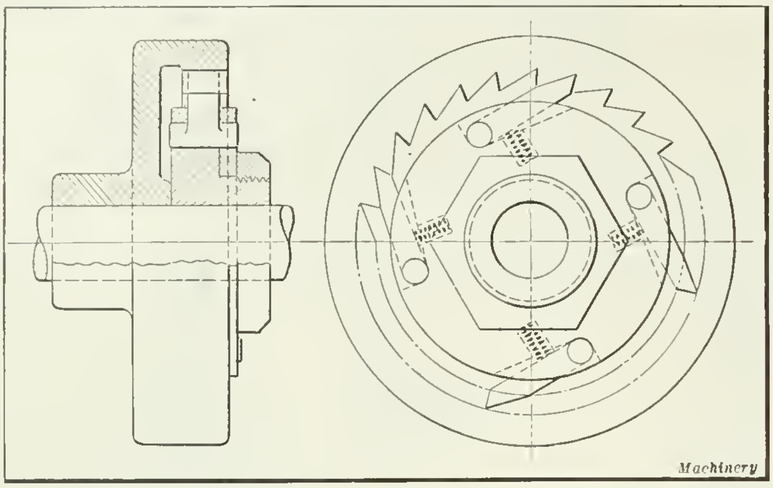


Fig. 1. Internal-tooth Ratchet especially Suitable for High-speed Drives

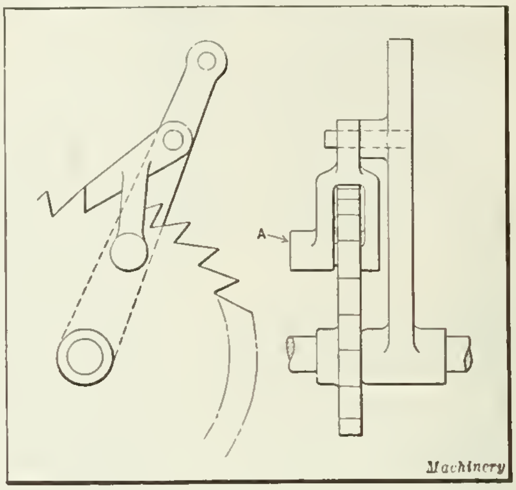


Fig. 2. Ratchet Mechanism with Silencing Device

In the design of ordinary ratchet mechanisms, care should always be taken to so locate the fulcrum and make the contact face of the pawl of such an angle that the pawl will engage a ratchet tooth immediately when pressure is brought to bear upon it. Otherwise, the entire pressure may be placed on the pawl before it reaches the bottom of a tooth, and then the whole load will be transmitted by the part of the tooth in engagement with the pawl. Such a condition is likely to result in chipping away the teeth and the end of the pawl. A ratchet having internal teeth is the best design to employ in a high-speed drive, because centrifugal force tends to assist the action of the pawl; this is particularly true when the pawl is mounted on the driving member. Fig. 1 shows an internal-tooth ratchet in which power is transmitted to the driven member through the medium of four pawls, each of which is assisted in its engagement with the ratchet teeth by a small coil spring.

Silent Positive Ratchets

A common ratchet equipped with a silencing device is illustrated in Fig. 2. Boss *A* contains a spring plunger provided with a fiber tip. This plunger produces a slight friction on the ratchet sides and so causes the pawl to be lifted from the ratchet teeth on the idle stroke and kept from contact with the teeth until the working stroke. Many modifications of this principle are possible.

Another design having an almost silent operation is shown in Fig. 3. This ratchet must not be confused with the friction type. Power is transmitted by gripping the balls or rollers between surfaces *A* and *B* of the driving and driven members, not between cam surfaces. No springs are employed to bring the balls into place, gravity alone being relied on. Usually only three balls are in action; in the illustration it will be observed that ball *C* is not in engagement. Either member *D* or *E* may serve as the driver. When this mechanism is used in a drive where the movement need not be accurate, it is not necessary to machine the engaging surfaces, and iron castings serve well unless the strain is severe.

Imparting Varied Rotary Motion

Ratchets for imparting a varied amount of rotary motion to a shaft are often looked upon unfavorably by machine designers because with such ratchets, in their ordinary form, the wear of parts results in uncertain operation. However, if the ratchet is of a frictional type, failure need not occur, because the ratchet will work satisfactorily provided certain points are attended to in the design.

In Fig. 4 is shown an ingenious ratchet consisting of a worm-wheel and a worm mounted on a forked lever. When this design is enclosed in an oil-tight case and the parts are properly made, it functions with a high degree of

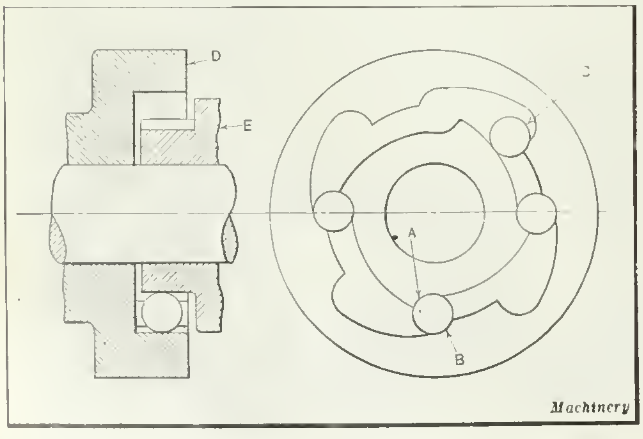


Fig. 3. Design that transmits Power by gripping Balls or Rollers between the Driving and Driven Members

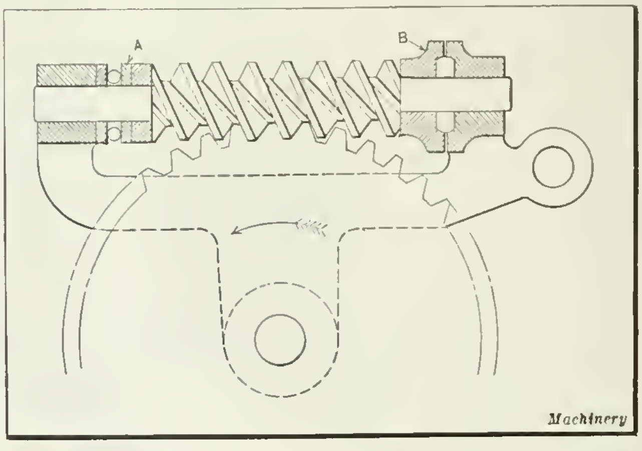


Fig. 4. Friction Ratchet in which the Worm rotates intermittently and the Worm-wheel revolves when the Worm stops

accuracy. However, it is a comparatively expensive arrangement. Either the worm or the worm-wheel may be used for driving the mechanism. It will be seen that the worm-shaft is equipped with a ball thrust bearing at *A* and is provided at *B* with a bearing that sets up an appreciable friction when subjected to a load. Bearing *B* and one race of bearing *A* are keyed to the shaft.

When the forked lever is operated in the direction indicated by the arrow, the thrust is against the plain bearing *B*, and the frictional resistance prevents the worm from revolving; hence the worm acts as a ratchet and turns the worm-wheel. On the contrary when the forked lever is operated in the opposite direction, the worm revolves, because it overcomes the relatively slight friction of bearing *A*; consequently, the worm-wheel remains stationary while the worm is swung backward.

By regulating the amount that the forked lever is moved in the counter-clockwise direction when the worm is the driving member, the movement of the worm-wheel can be varied. This device should not be regarded as a worm and worm-wheel mechanism in the ordinary sense, as no rubbing action takes place between the worm and the worm-wheel teeth when the two members are under a load. Added advantages of this construction are taking up the load without shock, and silent operation. An important point to be observed in designing a ratchet of this type is to make the helix angle of the worm such that the worm will just revolve when the load is on bearing *A*, and will remain stationary when the load is on bearing *B*.

Other Types of Friction Ratchets

Two more styles of friction ratchets are illustrated in Fig. 5. In the one at *A* the driving rollers are jammed between an internal circular surface of the outer member and cam surfaces on the inner member. With a ratchet of this type, springs are often utilized to force the rollers into contact with the jamming surfaces. One disadvantage of this design is that the rollers always bear at the same point on the inner member with the result that in time a depression is formed on each curved surface as shown at *C*. When this occurs, the device can no longer be relied upon, as a jamming action is impossible because of the shoulders that are formed. The ratchet shown at *B* was designed to overcome this disadvantage. The outer member is placed slightly eccentric relative to the center about which the inner member revolves, as indicated by the dotted lines, and so the jamming of the rollers is distributed on each curve between points *D* and *E*. By this provision the forming of depressions is obviated.

A final type of friction ratchet, which is fairly reliable in the ordinary form, when the disk is concentric, is shown in Fig. 6. However, if the disk is slightly eccentric relative to the fulcrum of the lever to which the engaging segment is attached, much better results will be secured, because the jamming is again distributed over a considerable area of the segment surface, and the forming of a depression on this member is avoided. This will be apparent by reference to the dotted positions of the ratchet disk and segment. Care must be taken to see that the amount of eccentricity is not too great, or the segment will not jam properly on one half of the disk periphery.

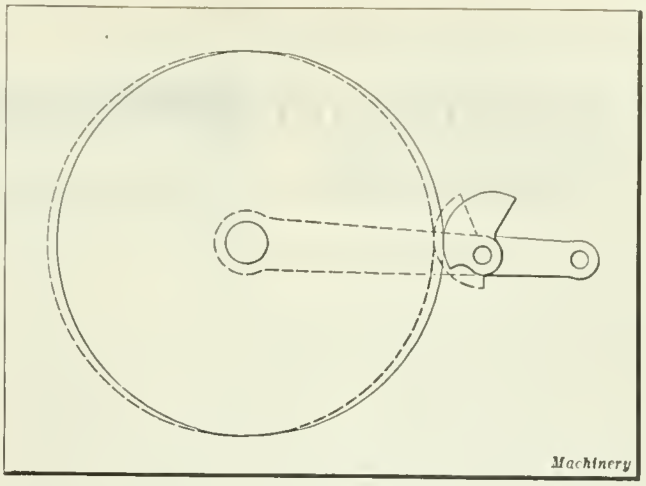


Fig. 6. Friction Ratchet consisting of a Disk, Segment, and Lever

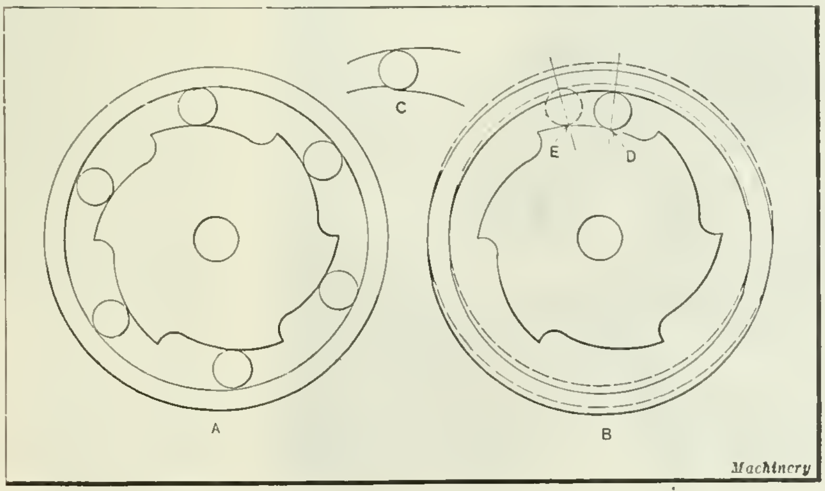


Fig. 5. Two Ratchet Designs that function by jamming Balls between the Driving and Driven Members

* * *

CUTTING METALS BY THE USE OF THE ELECTRIC ARC

For general cutting of metals by the electric arc, graphite or carbon electrodes are used with a current of from 300 to 1000 amperes, depending on the nature of the work and the cutting speed desired. Many foundries make use of arc-welding equipment for repairing defective castings, and use the same apparatus for cutting off risers and burrs from castings. For cutting rivets, currents of from 400 to 600 amperes are usually employed. When using 400 amperes, a good operator will average from 1800 to 2000 rivets, $\frac{5}{8}$ inch in diameter, in a ten-hour day. Some operators have cut as many as 2600 to 3100 rivets of this size, working on a piece-rate basis.

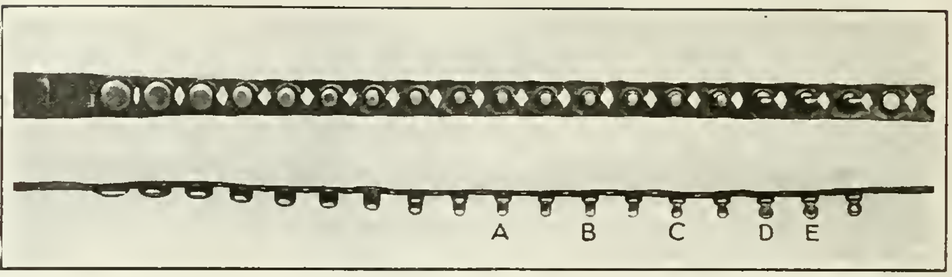
Cutting with the electric arc is not limited to iron and steel objects, but can be applied equally well to non-ferrous metals, such as brass, bronze, and copper. In fact for cutting copper which cannot be cut mechanically, the arc process is by far the cheapest to use. In cutting copper, current values of from 800 to 1000 amperes are used, because it is necessary to concentrate the applied heat at a sufficiently high rate to melt the copper before the heat is dissipated by the high heat conductivity of this metal.

* * *

EXPORT MANAGERS' MEETING

The 1923 meeting of the Export Managers' Club will be held March 20, at the Hotel Pennsylvania, New York. Among the subjects scheduled to be discussed at this meeting are the following: "Getting Results from the Sales Budget"; "Building Sales through Service"; "Manufacturers' Representative versus Merchant Distributor"; "Practical Problems of Marine Insurance"; "Discounting Drafts versus Collection"; and "Standardization of Practices." The meeting begins at 9 A. M., and there will be sessions in the forenoon, afternoon and evening. Those interested may obtain further information relative to the meeting from James S. Martin, Remington Typewriter Co., 374 Broadway, New York City.

Combination Follow-die



A POWER press die of unusual design has been developed in the plant of the V & O Press Co., Glendale, L. I., for use in the manufacture of brass button eyes. The shape and general proportions of these eyes are shown in Fig. 1. They are produced complete from ribbon stock in seventeen operations. The die is used on a No. 2 single-action, inclinable press of this company's manufacture. The heading illustration shows two views of a strip of stock; by referring to this illustration an idea of the successive steps in the manufacture of the eye may be obtained.

The dies, which are of built-up construction, contain more than 400 parts, and it is easily possible to replace or repair any part that is subjected to excessive wear without seriously disturbing the remaining parts of the tool. Fig. 2 shows the application of the die and the roll feed by which the stock is intermittently advanced through the dies. It would probably be impracticable to use a die having such a large overhang due to its extraordinary working length on a press of small size, if the machine did not have a full-length bearing for the vertical slide. This is a feature of the construction of the press.

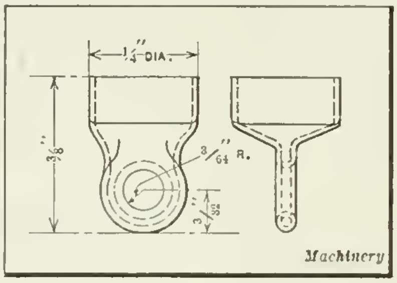


Fig. 1. Work shown to Enlarged Scale

The eyes are made from ribbon stock, 0.015 inch thick and 11/16 inch wide; the width is reduced during the various drawing operations to about ½ inch, as indicated in the heading illustration, leaving just enough scrap to hold the strip together. When many separate operations are performed successively, as in the present case, the liability of accumulative error in a roll-feed mechanism is considerable. For this reason, a release is provided for the roll feed, which operates just before the descent of the upper die member, permitting a locating punch at the farther end to enter a hole in the scrap prior to the operation of the drawing punches This corrects any slight inaccuracy of alignment, and compensates for inequalities in feeding movement due to varying stock thickness or other causes. The release of the feed mechanism is accomplished by the adjustable screw *A* which contacts with the handle *B* and lifts the top roll against the tension of two heavy coil springs *C*. Adjustment for the thickness of stock is made by the nuts that vary the compression of these springs.

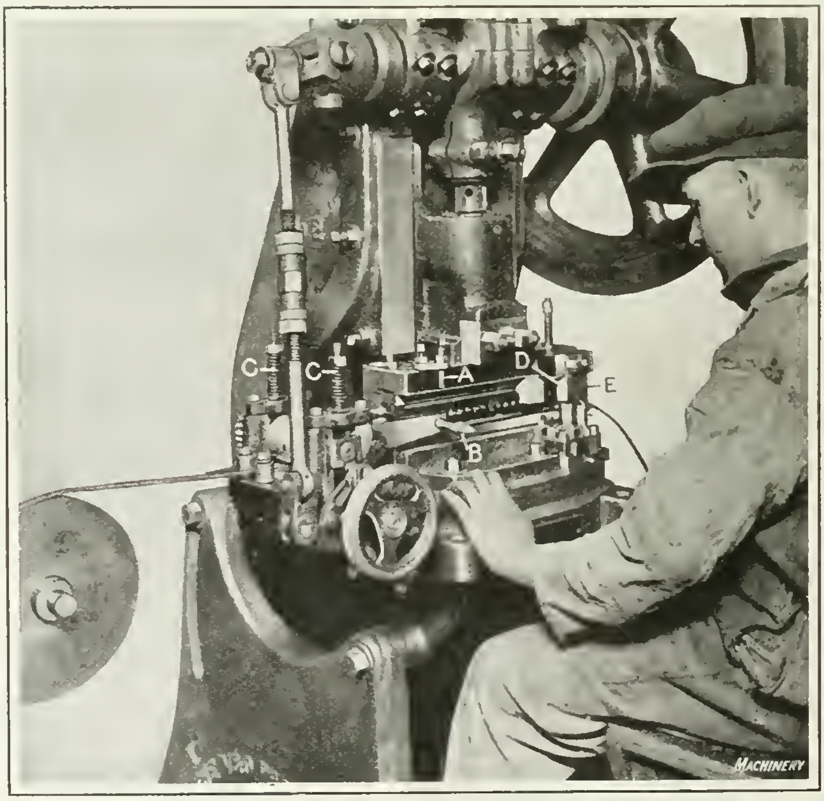


Fig. 2. Press equipped with Combination Button-eye Dies

An additional precaution against errors in feed is provided in the form of a ratchet mechanism, by which the feed-rolls are revolved. There are four pawls instead of one, so that the possible error is reduced to one-fourth of what it might be with a single pawl; that is, one pawl is always in readiness to engage a ratchet tooth with every movement that rotates the wheel one-fourth the pitch of the teeth.

Drawing and Redrawing Operations

Referring to the heading illustration, it will be apparent that the first punch produces a slit, which allows the stock to draw endwise as the eye is formed up. The second operation is drawing to 15/32 inch diameter and ⅛ inch deep, and the successive operations up to and including the eighth, are redrawing operations, producing a shell ¼ inch in diameter and 5/16 inch deep. The ninth, tenth, and eleventh are necking operations, which produce a shell ⅜ inch long and 11/64 inch outside neck diameter. The shape of the work after this step is indicated at *A*.

The next two shapes produced are shown at *B* and *C*. The dies used to form the head shown are set into the lower die member, and occupy more space than is regularly required, so that it becomes necessary to skip one regular spacing of the punches and use a dummy punch between the dies that form the piece to the shapes *A*, *B*, *C*, and *D*. The dies that close in the neck and form the head of the shell consist of a split collet *A*, Fig. 3, which is set into a button *B*. The collet is compressed by means of cap *C* as the punch descends and forces the work through the cap into the collet. When the punch ascends, the cap rises and the collet is forced open by the formed head on the shell. The shell is removed from the collet by the ejector. It is the space occupied by this mechanism that prevents the regular spacing of the die units.

The head is next flattened and a circular depression formed on each side, as shown at *D* in the heading illustration, and also in the enlarged section, Fig. 3. This is done preparatory to punching the eye-hole, and consists of "under-forming" on one side by compressing the metal, as indicated at the right in Fig. 3. If the stock were merely flattened as shown in the view at the left, the punch for producing the eye would cut a clean hole through one thickness of the stock only, and when it reached the other thickness it would tend to force the flattened head open instead of piercing the eye clear through. By under-forming one side, as mentioned, it is possible to punch the hole from the opposite side without destroying the part.

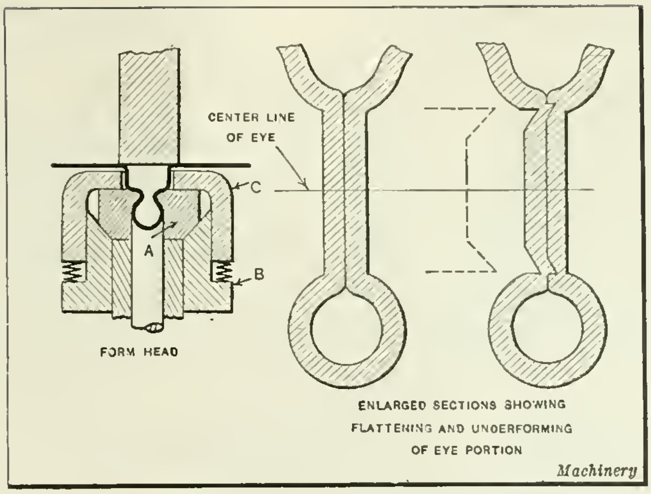

CENTER LINE OF EYE
C
A
B
FORM HEAD
ENLARGED SECTIONS SHOWING FLATTENING AND UNDERFORMING OF EYE PORTION
Machinery

Fig. 3. (Left) Die Unit for closing in Head; (Right) Partial Sectional Views of Work before piercing the Hole

The punches that perform the operations of closing the head and under-forming are held in slides which are advanced horizontally toward each other from the back and front of the die, by means of two cams, one of which is shown at *D*, Fig. 2. The arrangement is similar to that employed subsequently in piercing the eye-hole. A sectional view of the cam-operated slide mechanism used in piercing the hole is shown in Fig. 4. The slides for flattening advance and pinch the head of the shell to compress it, while the strip of stock lies on a plate which spans the space between the front and rear slides. At the same time that these dies are compressing the lower end of the shell, similar dies carried in the same slide under-form the central eye portion of the next shell.

Piercing the Hole

Next comes the piercing operation, in which two other die-slides operated by cams *E* (Figs. 2 and 4), front and back, are employed. The front die-slide *A* (see sectional view) carries the die member, which is in the form of a hardened steel bushing, while the rear slide *B* carries the slender punch. As soon as the strip of stock advances to this station of the die, it is held flat by the vertical punch on the locating plate *C* which bridges the two slides. The punch carries a spring pad *D* which enters the drawn shell and locates it during the piercing operation.

The front slide is advanced by the cam until the die bushing *F* comes in contact with one side of the flattened work. A lug on this slide extends downward and carries a stop-screw which contacts with the lower end of the small vertical stripper lever *G*. This lever is pivoted to a member carried in the rear part of the die-bed. The upper end of this lever acts as the stripper for the punch, and when it is caused to pivot by the stop-screw, it bears against the rear side of the flattened eye, so that the work is held between the die bushing and the stripper lever.

The advance of the front slide results in an equal clamping pressure being applied to both sides of the flattened eye, thus correctly locating it without danger of its becoming unseated due to the thrust of the horizontal punch. The upper end of the stripper lever is cut out sufficiently to permit the punch-holder *H*, which is in the form of a sleeve, to enter. The sleeve gives the required stiffness to the rather slender punch. The scrap from the hole is forced through a passage in die bushing *F*, and from this passage an opening leads down through the front slide so that the scrap can fall through to a receptacle beneath. After the eye-hole has been punched, the stock is fed to the next station, where it is blanked from the strip and the completed piece is delivered through a chute to a receptacle.

The drawing dies are each provided with a spring ejector so that, at each stroke of the press, the strip is lifted from the face of the die sufficiently to be fed to the next position. The right-hand end of this composite die, in which the forming of the head and eye occurs, is provided with a spring which aids the ejectors in lifting this end of the scrap to the proper level for feeding. These button eyes are produced at the rate of ninety per minute. The die illustrated has produced several millions of these parts.

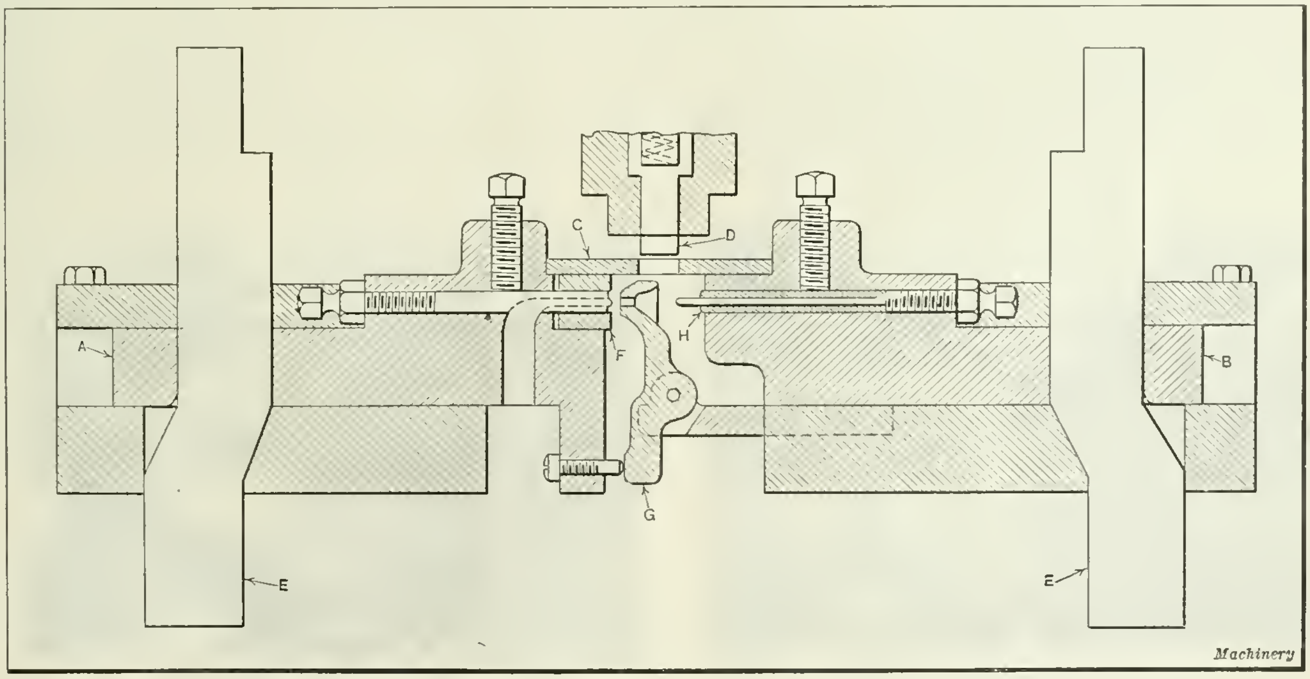


Fig. 4. Transverse Cross-section of Slides and Cams for operating the Piercing Punch and Die

NEW USE FOR AUTOMATIC MACHINES

By CHARLES W. LEE

In a certain shop a semi-automatic machine was made for a special line of work. This machine reduced production costs as compared with hand work for some types of this work, depending upon the shape, size, material, and other factors, all of which were well understood by the builder of the machine; but in some cases, hand work proved superior to the machine. As the limitations of the machine were thoroughly understood, the builder never tried to sell a machine for work for which it was not suited—partly because he was jealous of his reputation, and partly because he did not want to pay freight both ways.

Some time ago a customer ordered a machine for work that the builder knew could be done better by the old-fashioned hand method, and he therefore refused to fill the order; but the customer insisted upon buying a machine. He said he wanted it; he wanted it right now; he would pay cash for it and "no questions asked." Hence, a machine was duly shipped to him, paid for, and no complaints were heard in regard to it.

Some time later the builder of the machine, as was his custom, called upon the purchaser to ask whether the machine was working all right, and was told, "Oh, that machine! We never ran it. We stored it away on the top floor." Pressed for further explanations, the customer stated that his men had slackened their pace, and were not producing more than half a day's work as compared with pre-war days. So he told them that if they could not bring up production, he would buy one of these machines, which would throw most of the men out of a job. The implied answer had been "Go ahead and buy it. We will show that we can beat the machine." When the machine came in, they did quicken their pace, and, as both the builder and the customer knew that this machine was not particularly suited for the size of work handled in this shop, the machine was never installed.

Some expert in political economy may employ his spare hours to decide whether this machine was an economic loss or not, even though it was stored away on the top floor of the factory. The machine unquestionably aided in increasing production, and it accomplished this without throwing anybody out of a job, so that really both the employer and the employes gained their point.

TWO-WAY MILLING FIXTURE

By C. J. DORER, Chief Tool Designer, White Sewing Machine Co., Cleveland, Ohio

The fixture illustrated in Figs. 2 and 3 is used to hold the piece shown in Fig. 1 while the slots *A* and *B* and the teeth *C* are being milled. It will be noted that the slots *A* and *B* are at right angles to the teeth. Ordinarily it would be necessary to make two settings of the work in order to perform the required milling operations. With the fixtures shown, however, only one setting or clamping of the work is required. Altogether three cuts are taken, two to finish the teeth *C* and one to produce the slots *A* and *B*.

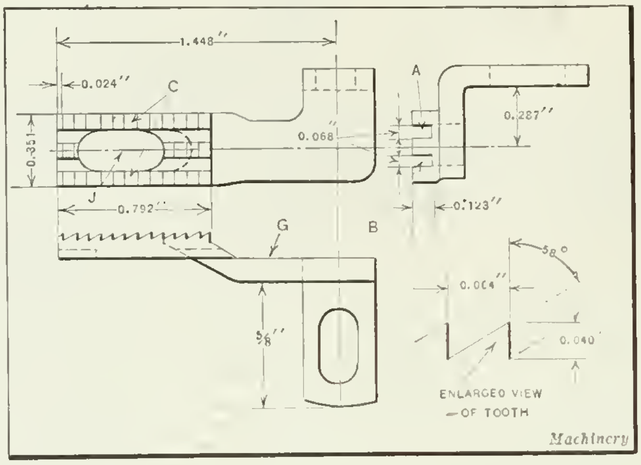


Fig. 1. Part milled in Fixture shown in Figs. 2 and 3

The first cut is taken with the work-holding member of the fixture in the position shown in Fig. 2. The cutter *D* squares the end of the tooth portion of the work while cutter *E* cuts the teeth *C* and cutter *F* forms the surface at *G*. The second cut is taken with the work holding fixture swung around or indexed 90 degrees to the position shown in Fig. 3, which permits cutters *H* to mill the slots *A* and *B*, Fig. 1, in the part. After these are cut, the fixture is turned back to the position shown in Fig. 2 and another cut is taken on teeth *C* to remove all burrs. Before this cut over the teeth is taken, shims are placed in the slot *J*, Fig. 1, to prevent the walls of the piece from collapsing under the pressure of the cutters.

The fixture is mounted on a Cincinnati milling machine, the end of the cutter-spindle being supported by the overhanging arm. The cutters, the part to be milled, and the center or pivoting point of the fixture, must be maintained in a definite relation to one another at all times. The relative positions of the cutters that mill the slots and the cutters that mill the teeth must be such that neither set of cutters will interfere with the work while the other set is in operation.

It is essential that the correct diameters be maintained on both sets of cutters in order to keep the correct relationship between the depth of the slots and the depth of the teeth. If this were not done, it would be necessary to raise or lower the table of the milling machine between cuts, which would be likely to affect the accuracy of the work. A skilled operator can produce thirty-seven pieces per hour with this equipment and still have time to operate other machines. All the cutters are form relieved. The cutter that forms the teeth also has clearance on the sides

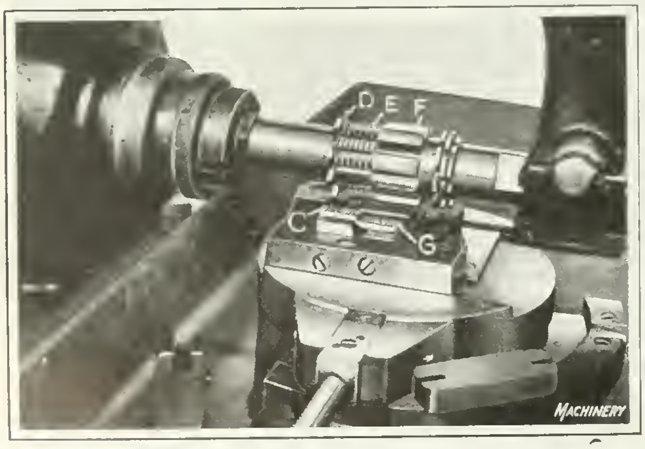


Fig 2. Milling Fixture in Position for cutting Teeth on Part shown in Fig. 1

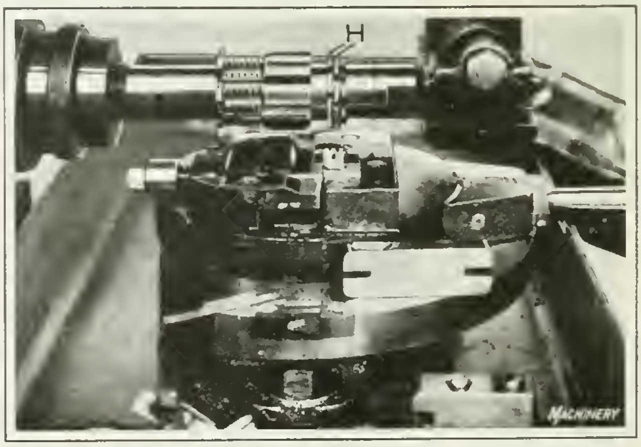


Fig. 3. Fixture in Position for milling Slots A and B, on Part shown in Fig. 1

so that the heel of the tooth will not drag and produce burrs on the sharp edges of the milled teeth.

Construction of Fixture

The plan view, Fig. 4, and the front view, Fig. 5, serve to show the construction of the fixture. Referring to Fig. 5, *J* is the cast-iron base on which the circular plate *K* is revolved when the work is indexed from the position shown in Fig. 2 to that shown in Fig. 3, or vice versa. Plate *K* is fitted with a locating block *L* against which the piece is clamped by jaw *M* which slides under the block *N*. Jaw *M* is actuated by a screw *O* (see also Fig. 4) which has a quick lead, a half turn being sufficient to release the work.

Plate *K* has a hardened steel stud *P* fastened to it, which is a sliding fit in bushing *Q*. Split nut *R*, which is threaded on stud *P*, serves to hold the plate and the base together. This nut may be locked in place by a set-screw *S*. Plate *K* is revolved by means of handle *T* which is pivoted on pin *U*. Handle *T* is provided with a hardened steel block *V* which engages a slot in the hardened block *W* attached to the base. When lever *T* is raised, plate *K* can be revolved to the position shown in Fig. 2. When the plate is in this position, the handle is lowered so that block *V* engages the slot in block *X*, Fig. 4, which is similar to block *W*, with which it was engaged in the previous position.

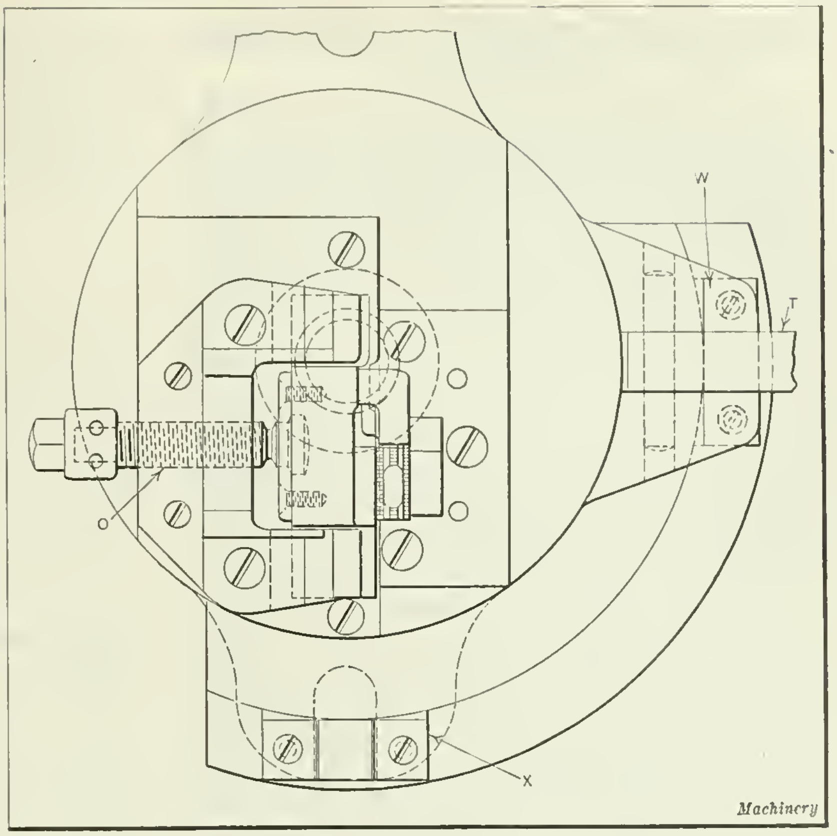


Fig. 4. Plan View of Fixture shown in Figs. 2 and 3

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METAL STRAPS ON BOXES

The thickness of lumber required in the sides, top, and bottom of a nailed wooden box to give it adequate strength and serviceability without metal bindings may safely be reduced 20 to 40 per cent if the box is properly bound with metal straps. This conclusion is based on numerous observations of boxes in commercial service and on the results of tests made on some 2000 strapped wooden boxes by the Forest Products Laboratory of the U. S. Forest Service, Madison, Wis. Some of the general conclusions derived from this investigation are given in the following:

As a rule, straps should encircle the small dimensions of the box and act perpendicular to the grain in the sides, top, and bottom. If only one strap is used, it should be nailless and applied around the center of the box. When two straps are used, they should be applied one-sixth of the length of the box from the ends or around the extreme ends, depending on whether they are nailless or nailed. When three or more straps are used, the two outer straps should be applied as specified for two straps, and the others spaced equally between them. Three or more straps are recommended on relatively long boxes.

Nailless straps placed some distance from the ends of the box distribute the shocks which otherwise would be locally absorbed. This action relieves the direct pull on the nails and reduces splitting or breaking of the sides, top, and bottom. On boxes with adequate end cleats, nailless straps properly spaced along the length of the box might sometimes permit the use of thinner lumber than straps nailed around the extreme ends. Straps nailed around the extreme ends act somewhat as a cleat and give more rigidity to the box than nailless straps.

The same total cross-sectional area of strapping is recommended for two and three straps, and the same reduction in thickness of box material is permitted; but when one strap is used it should have 60 per cent of this total cross-sectional area, and a lesser reduction in thickness of lumber is permitted.

Tests made thus far indicate that the total cross-sectional area of one strap in square inches should equal approximately 1/1400, and of two or more straps 1/840, of the square root of twice the gross weight of the box and contents in pounds.

All strapping should be applied immediately before the box is ready for shipment and should be drawn sufficiently tight to sink into the edges of the box. Nailless straps should be applied at right angles to the edges of a box.

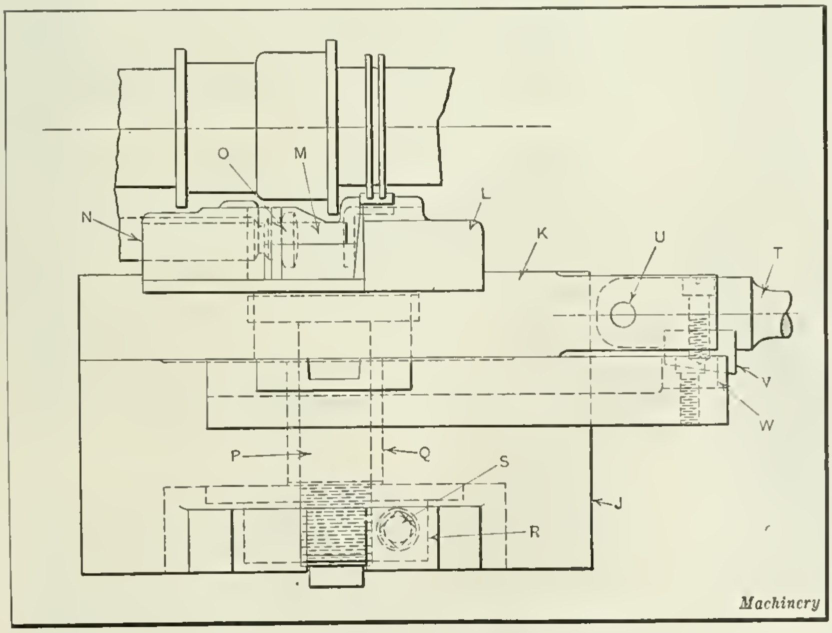


Fig. 5. Front View of Milling Fixture shown in Plan View in Fig. 4

CIRCULAR GRADUATING ON DIAL FACES

By HENRY B. FLINN

The common shop method of graduating the faces of dials is to employ an index-head on the milling machine, the machine and tool action, however, being really that of a shaper. This process at its best is necessarily slow because of the amount of hand work involved, and is little suited for quantity production. For doing this work on a production basis, a machine was sought with the following features: It must be capable of being accurately indexed; the tool action must be that of a planer or shaper; the design must permit indexing and machining either singly or in combination; and hand work must be eliminated as far as possible. It was found that the graduation of circular pieces, either on the periphery or on the face, could be rapidly and satisfactorily accomplished on the Fellows gear shaper. The periphery is easily graduated by a familiar method, but the circular graduating of faces by rolling or by marking with a single-tooth tool is of interest.

An application of the former method to production work and the latter to a single job in a tool-room will be described. The machine used in each instance was a Fellows helical gear shaper, the bed of which was raised 7½ inches from its normal position. A small faceplate was fastened to the work-spindle, and on this was mounted a Cincinnati index-head carrying a 6-inch three-jaw chuck, as shown in Fig. 1. The main spindle of the index-head was centralized with the work- and cutter-spindles. The lower worm-wheel and worm of the machine were meshed tightly and locked to prevent any rotary movement of the work-spindle, and the apron was also fastened in its seat.

Graduating by the Rolling Method

The piece graduated by rolling was a dial plate 6 inches in diameter, made from No. 16 B. & S. gage sheet brass. There were 360 graduations representing degrees radiating from the edge of the work. Each single-degree graduation was ¼ inch long; each fifth-degree graduation, ⅜ inch long; and each tenth-degree graduation ½ inch long. The graduating cutter was cone-shaped, as shown at *A* in Fig. 2, and had sixty teeth of the required lengths for the graduations. The tooth spacing of the cutter was the same as the desired spacing of the graduations on the dial, the diameter of the cutter at the base of the cone, being 1 inch. The face width of the cutter was ½ inch (the length of the longest graduation), and its cone radius, 3 inches to correspond with the radius of the dial. The base diameter of the cone and the cone radius being known, face angle *C* was easily determined to be 9 degrees 36 minutes. The cutter was placed in a standard holder and mounted in the cutter-spindle as shown in Fig. 1.

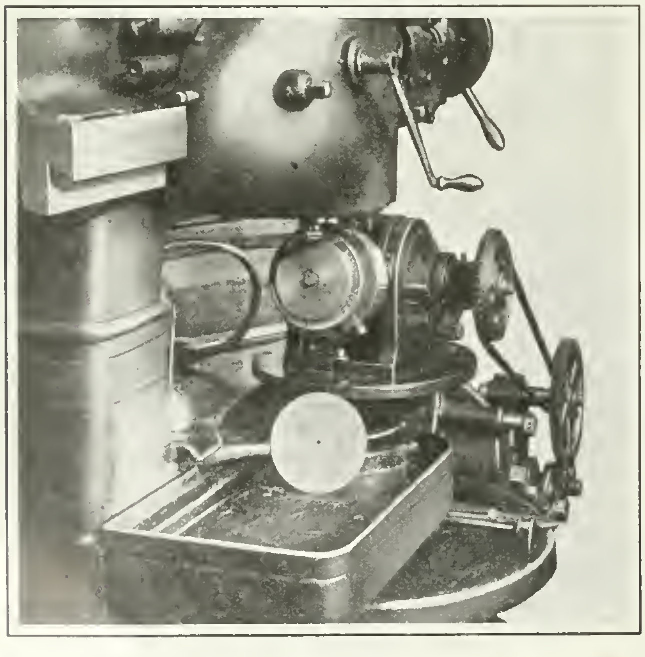


Fig. 1. Set-up of Fellows Gear Shaper for graduating Dial Faces by the Roll Method

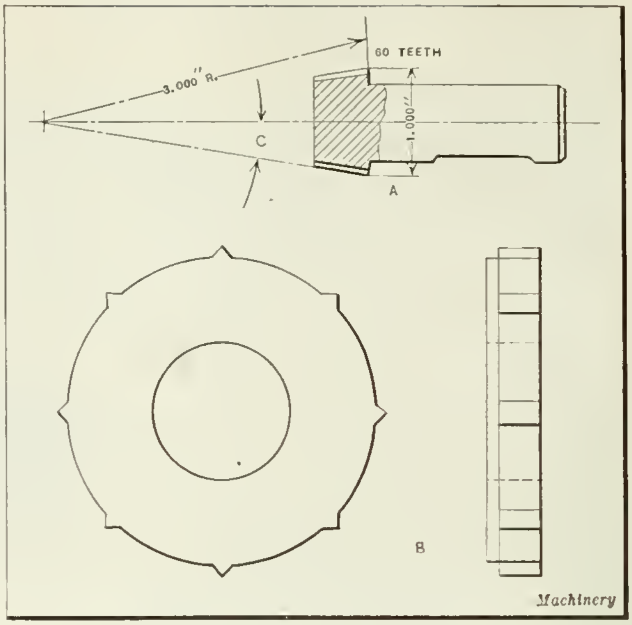


Fig. 2. (A) Cutter used for Roll Method of graduating; (B) Tool for Single-tooth Method

The dial was held between two cast-iron plates and located centrally on the chuck by means of a clamping screw, the body of which was a sliding fit in both the central hole of the dial and that of the rear supporting plate. This supporting plate had a shoulder by which it was held in the chuck jaws, and its position could not be altered after an alignment. The front clamping plate was backed by a pasteboard disk to prevent scratching the dial face. To remove the work, it was only necessary to take out the clamping screw. After the alignment of the supporting plate, the index-head was swiveled 9 degrees 36 minutes from the horizontal to bring the face of the work parallel with that of the cutter.

The feed and regular driving belts were removed from the machine, because the reciprocating movements of both the cutter-ram and the apron were not required. No action of the machine was necessary other than rotation of the cutter- and index-head spindles. In order to obtain a higher speed, the horizontal feed-rod was driven through a small pulley on its left end which was belted directly to a countershaft pulley. Power was transmitted to the index-head through the change-gears of the machine, sprockets, and a chain.

It was necessary, of course, to determine the correct relation between the rotation of the cutter and the work. The ratio between the number of teeth in the upper worm-wheel of the machine and the number of teeth in the worm-wheel of the index-head, taking into consideration the gears that transmit the motion from the upper to the lower part of the machine, was found to be 5 to 18. Substituting this ratio for that of 5 to 3 in the regular Fellows gear shaper formula for the computation of change-gears, and using this formula with 60 as the number of teeth in the cutter and 360 as the number of teeth in the gear, the proper gearing was found.

After a dial was placed in position and the height of the cutter-ram adjusted so that the lower edge of the cutter coincided with an inner circle stamped on the dial, the ram was locked in position. To bring the ram to the desired height, it was necessary to raise the guide case in the upper index-wheel of the machine by using several 1-inch ground blocks and clamp it by means of two screws. This could have been eliminated by using 8½-inch raising blocks under the bed instead of the 7½-inch blocks previously mentioned. The machine was then started and the cutter brought into contact with the work by moving the saddle along the rail. With the pulley on the horizontal feed-rod running at 640 revolutions per minute and the cutter fed in to a depth of approximately 0.010 inch during three revolutions of the dial, it was possible to complete the operation in 3½ minutes, floor-to-floor time.

Single-tooth Tool Method

The dial for which the single-tooth tool was employed was 10 inches in diameter and had 300 graduations on its face. These graduations were of three different lengths, each tenth one being ⅝ inch long; each fifth one, ½ inch long; and the others, ⅜ inch long. For this operation, the special pulley was removed from the horizontal feed-rod and the main driving belt put back on its pulleys. Reciprocation of the cutter-ram and the apron were necessary, and for this reason the machine was driven in the customary way. The feed belt, however, was not used, because there was no rotation of the cutter-spindle and the work was indexed by hand. The straight guide case was let down and fastened as usual to the upper index-wheel. The index-head was used as before, but the work was held on an arbor instead of in a chuck, and the index head was set at zero. As the indexing of the work was done by hand, the sprocket was removed from the index-head and replaced by the regular index-plate, sector arms, and crank. The sector arms were then set correctly for obtaining the 300 divisions. The cutter used is shown at *B* in Fig. 2. This might have been of any diameter, thickness, and number of teeth, but the hole had to be 1¼ inches in diameter to fit the cutter-spindle nose.

After the cutter was mounted on the spindle and a tooth centered with the work, the connecting-rod of the machine was set for the push stroke. The length of the stroke was adjusted to 1½ inches, the lowest point of the cutter travel being ⅜ inch from the edge of the piece. The extra travel of the ram allowed the operator sufficient time to index the work while the machine was in motion. The machine was then started at a speed of 55 strokes per minute and the cutter fed into the work 0.004 inch, two successive strokes of the cutter being made on each graduation. During the cutting of a line the operator set the sector arms ahead, and as quickly as the second cut was completed and the apron started relieving for the upward stroke of the cutter, the index-crank was moved forward into its next position.

When the ⅜ inch graduations had been completed, the sector arms were set for indexing 30 divisions and the lowest point of the cutter travel set ½ inch from the outside of the work, to cut the ½-inch graduations. Owing to the distance through which it was necessary to turn the index-crank, it was impossible to index the work during the time the cutter was making a stroke. Therefore, the cutter was fed to depth by turning the crank on the saddle, taking the reading from the micrometer collar on the lead-screw of the machine. After the cut, the tool was backed out, the work indexed, and the tool again fed to depth. This cycle was continued until the completion of the ½ inch graduations.

When these graduations were finished, the lowest point of the cutter travel was extended to ⅝ inch below the edge of the piece, after which graduations of this length were produced in the same manner every 60 divisions. Indexing of the dividing-head by hand while the machine is in motion is only possible when there are a large number of graduations that require but a short turn of the index-crank. When this can be done, however, a great deal of time is saved, as will be realized from the fact that the three hundred ⅜-inch graduations were made in a little less than fifteen minutes. The entire time consumed, including the setting up, was about one hour.

SAFETY ATTACHMENT FOR DROP-HAMMER

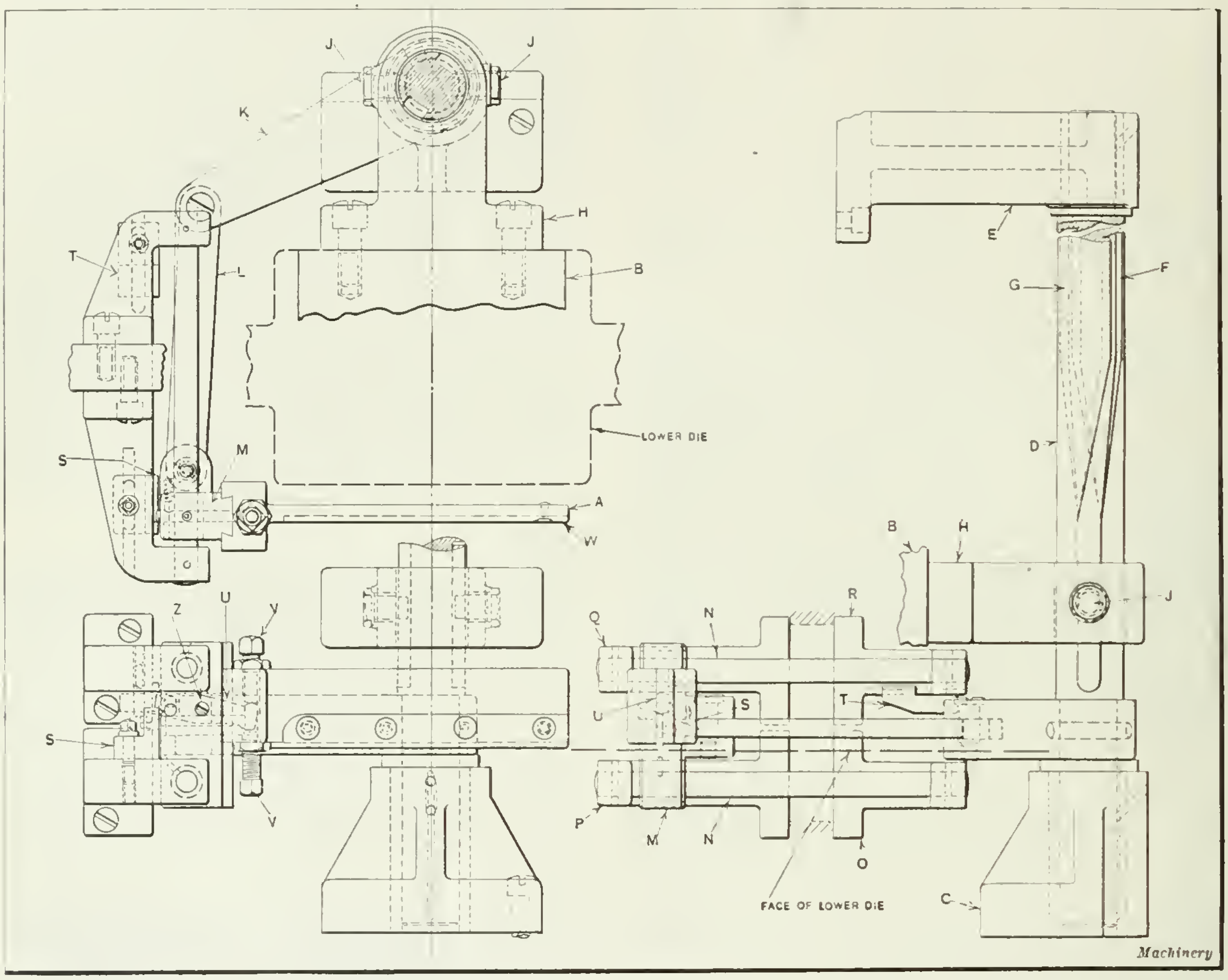
In a certain cutlery manufacturing plant, a 75-pound drop-hammer is used to straighten springs, blades, and other parts blanked out on a punch press. This straightening operation is commonly referred to as "flattening," and is performed without heating the part. On the particular drop-hammer used, gravity is the only force employed to propel the hammer downward. The hammer is raised for each stroke by a jack incorporated in the machine. At first, the pieces to be straightened were placed on the lower die by hand and removed with a wooden stick, which the operator held in one hand. This, however, proved to be a rather hazardous operation, and was responsible for crushed fingers on several occasions. In order to eliminate this danger, the writer designed the safety device shown in the accompanying illustration.

This safety device is so constructed that the knock-off *A* will automatically push the operator's hands off the die as the hammer begins its downward stroke, and on the return stroke will sweep the straightened work from the die. In the illustration, the knock-off *A* is shown in the position it occupies when the hammer is in the extreme downward position at the end of its stroke. In this position the flattening or straightening has been accomplished, and the hammer, a section of which is shown at *B*, is about to ascend. During the upward movement of the hammer, knock-off *A* is drawn backward across the die, so that it sweeps the finished work into a box located below the surface of the die. When the hammer comes to rest in the extreme upward position, knock-off *A* is at the back of the die. The operator can then place another part on the lower die.

The bracket *C* is fastened to the base of the drop-hammer and serves as a bearing in which part *D* oscillates. Part *D* is supported at the top by a bracket *E* which is fastened to one of the uprights on which hammer *B* travels. Grooves *F* and *G* are cut in part *D*. These grooves are diametrically opposite each other, and are cut straight up to a predetermined distance above the face of the lower die. Beyond this point the grooves follow a helical path for a short distance after which they continue straight until the top of part *D* is reached. This construction permits of adjusting the hammer to varying heights to strike a heavier or lighter blow without disturbing the functioning of the attachment. The lead and length of the helix section of grooves *F* and *G* determine the arc through which *D* is revolved or oscillated, and hence the distance knock-off *A* moves. Part *H* is fastened to the hammer *B*, and carries studs *J* which travel in the grooves in part *D*. This construction causes part *D* and the link *K* to oscillate during the rising and falling of the hammer.

An "in-and-out" movement is imparted to part *A* through link *K* and connecting-rod *L*. Cross-head *M* travels on guides *N*, which are held in brackets *O*, *P*, *Q*, and *R*. These brackets are fastened to the drop-hammer uprights. A sliding-fit dovetail joint holds parts *A* and *M* together. An interesting feature of the operation of the device is the method employed to raise the knock-off *A* slightly so that it will clear the work on its forward stroke, and then lower it so that it will sweep the flattened piece from the die on the return stroke. This is accomplished by means of cams *S* and *T* and pawl *U*. When cross-head *M* reaches the extreme rear position, the end of pawl *U* strikes cam *T*, causing the pawl to pivot on stud *Z* so that part *A* will be forced to slide upward at the dovetail joint. Part *A* then remains in the raised position during its forward movement so that it clears the work on the die. When it reaches the extreme forward position, the end of pawl *U* comes in contact with cam *S* and thus lowers part *A* so that it will sweep the flattened work from the die on its return movement.

The helix formed by the grooves on part *D* should be so located that the forward movement of knock-off *A* will take place just before the hammer falls, or at the beginning of the downward movement. With this arrangement, if the operator fails to withdraw his hands after placing the work on the die, they will be pushed out of harm's way by knock-off *A*. Part *A* is adjusted vertically by means of the set-screws *V* which bear on pawl *U*. A piece of leather *W* is fastened to part *A* to serve as a sweeper.



Drop-hammer Attachment, which pushes Operator's Hands from Die on Down Stroke and sweeps Work into Receptacle on Return Stroke

At the time the device was made, the writer suggested that a magazine with a shuttle arrangement be provided to feed the work to the die automatically. However, the production did not seem to warrant the additional outlay which this feature would necessitate, and was therefore not included. G. F. S.

* * *

SEPARATING NICKEL-STEEL BARS FROM MIXED STOCK

By ARTHUR L. COLLINS

In a certain factory large quantities of nickel-steel parts were being heat-treated to meet very definite requirements as to physical properties. It was found, however, that a considerable percentage of the parts were failing under tests. Upon investigation, it developed that there was a lot of straight-carbon steel mixed in with the nickel steel, and of course the two kinds required entirely different heat-treatments. If the whole lot was treated for nickel steel, the straight-carbon steel parts would not, of course, give the desired results. It was therefore necessary to pick out the straight-carbon bars from the stock that had not been made up.

As there were thousands of bars, it would have been an endless task to make a chemical analysis of each. So the works laboratory was called upon to devise a method of separating the carbon-steel bars from the nickel-steel bars. The laboratory men soon had a method working which was extremely simple, yet effective. One drop of nitric acid having a specific gravity of 1.20 was placed on a spot on the bar from which the scale had been removed and allowed to work for ten seconds. A piece of white blotting paper was then pressed lightly on the spot to soak up the nitrates of iron and nickel (if present). Two drops of dimethylglyoxime solution were put on the nitrates on the blotting paper. If the color appeared red, the steel was known to contain nickel, but if it was brown, the test showed that the steel contained no nickel. This method was sensitive to 0.17 per cent nickel. The time required to make the test was about three minutes. This procedure resulted in saving large quantities of steel which otherwise would have been scrapped or sent back to the mill that supplied the material. In this particular case the steel mill was really responsible for the mix-up, and had the steel been shipped back to them, they would have had to separate the two kinds or else scrap the entire amount.

* * *

The chief advantages of grinding internal-combustion engine cylinders are, according to *Grits and Grinds*, as follows: (1) The accuracy is not affected by the springing of the cylinder walls; (2) the accuracy is not affected by hard or soft spots in the iron; (3) the accuracy is not affected by side ports, as in the two-cycle engine cylinder; (4) the wheel cuts with very little pressure; and (5) the grinding eliminates the necessity of lapping.

Leveling a Planer

By CHARLES OWEN LEWIS, Foreman of Planer Department, Lucas Machine Tool Co., Cleveland, Ohio

To obtain accurately planed surfaces such as are required for machine tool beds, columns, platens, etc., the planer must be dead level. Of course, a casting can be seriously distorted by errors in clamping, but in the case of heavy work this can be avoided by removing all clamping straps when the finishing cuts are taken, stop-pins being used to prevent the work from shifting on the planer table. By employing such methods in finishing well seasoned castings, a practically true flat surface will result, which will require a minimum amount of hand fitting or scraping. But how many planer hands know how to level a large planer? The writer ventures to say that there are very few who thoroughly understand this work. With the desire to assist those who may require information on this subject, a detailed description will be given of an accurate method of leveling up a planer.

Equipment Required for Leveling Operation

The planer should have a concrete foundation, and rest on screw-adjusting wedges, set three or four feet apart down each side, so that in leveling, any part can be easily raised or lowered. The tools needed for the leveling operation consist of a very accurate level, a straightedge finished on both edges and long enough to reach across the planer ways, and two cylinders of exactly the same diameter, preferably ground, which are laid in the ways to support the straightedge. With this equipment we are ready to proceed with the rough leveling, the purpose of which is to take out any twists in the planer bed.

Rough Leveling

First run the planer table as far forward as possible; then place the cylinders in the ways, one on each side, directly under the cross-rail; on these set the straightedge and level. Now raise the low side of the planer by means of the wedge under that point until it is level. Then move the level back until it is even with the end of the housing and adjust this point until it is level; move it farther down the ways until it is over the next pair of wedges, then level and proceed to the next and so on down to the end.

Now run the planer table as far back as it will go so as to expose the other half of the bed, and level in the same way, starting in the center and working toward the end. The back end of the planer, which was leveled first is now probably slightly out of level due to the twisting of the bed while leveling the front half. It is therefore necessary to check up by leveling all over again, the same as before. After this is done, the planer bed will be free from all twists and dead level crossways for its entire length.

To level a planer entirely by the bed, might be misleading, as the bed itself could be made perfectly level and yet when the heavy table traversed it, it might be distorted sufficiently to cause the planed surface of the work to be thrown out of true. It is the line, or plane, of the cut that should be level, not the planer bed, so to level the planer lengthwise use is made of what is termed the "running level."

The Running Level

Set the planer table so that the front end is even with the end of the bed, then place the level in a lengthwise position on the table at a point under the cutting tools. Make note of the position of the air bubble with reference to the graduations. Now move the planer table backward until the level is even with the back end of the housings and again inspect the level. If the bubble has changed position, the planer is not level.

Do not adjust the wedges yet, but move the table farther back until the level is over the next pair of wedges. Inspect the level again and move the table as before until the level is again over a pair of wedges. Continue doing this until the end of the table is flush with the back end of the bed. Now by comparing the readings of the level at the different positions it can be told whether the table made a gradual rise or descent, or rose and fell intermittently, that is, with a wave-like motion. The wedges should now be adjusted with a view to overcoming any irregularities thus revealed.

Second Leveling Operation

Next return the table to its original position, and repeat the whole operation. Continue leveling in this way until the bubble does not change position at any point. Now with the back end of the table flush with the back end of the bed, place the level in position again under the cutting tools and note the position of the bubble. It is not imperative that the level read exactly the same as it did before, because it is now at a different point on the table and the table may not be perfectly true. Simply note the position of the bubble and proceed to level the front half of the planer in the same way that the back half was leveled. When this is accomplished, check up the back half again to see if any slight change has occurred.

Crosswise Leveling

The planer is now perfectly level lengthwise, so the next step is to get it level crosswise by means of the running level. Place the planer table so that the front end is flush with the end of the bed, and set the level in a crosswise position under the cutting tools. Note the position of the bubble and move the table backward until the level comes over a pair of wedges, and again read the level. If the bubble has changed position, adjust the wedge on the low side until the bubble returns to its original position.

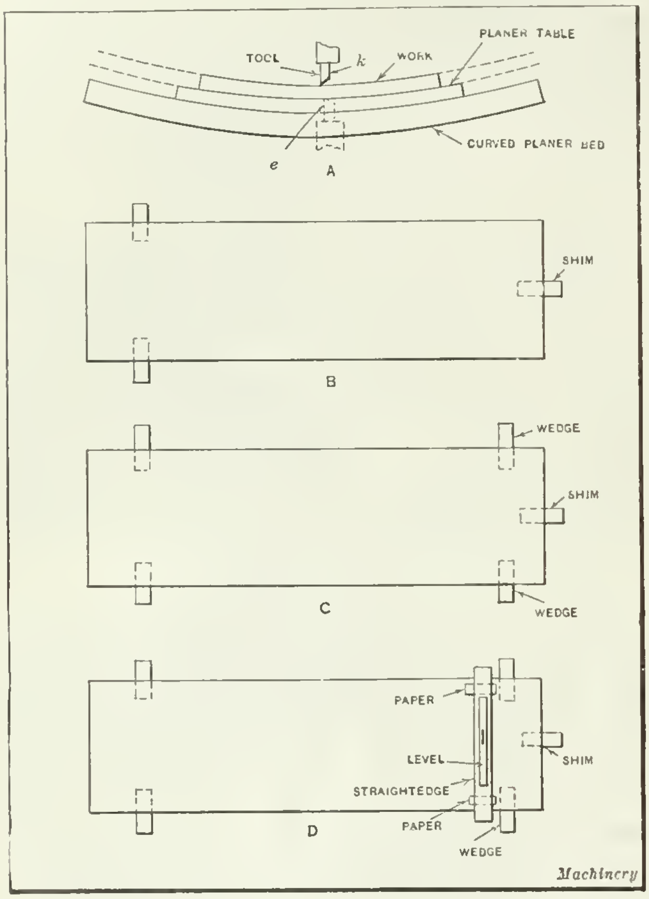
Now move the table again until the level is over the next pair of wedges, and adjust as before. When the back end of the planer is level, the front end should be leveled in the same manner. It is a wise plan to check up the lengthwise leveling again, as some little alteration may be necessary because of the effect of crosswise leveling.

The planer will now be dead level both lengthwise and crosswise, and the only thing remaining to be done is to see that all the wedges are supporting their share of the load. This can be done as follows: Place the level on the planer table identically the same as for crosswise leveling, and tighten the wedge on one side until the bubble moves very slightly; then tighten the other wedge until the bubble returns to its original position. Repeat this operation over each pair of wedges, and in this way it will be known that they are all tight. A planer leveled in this way will turn out work which is absolutely flat, if care is exercised in setting up the job.

Some castings, because of their construction, will be found to be high in the center when they come to be scraped, even if planed on a planer that is perfectly level. This can be overcome by raising the ends of the planer slightly. This is good practice in such cases, as a large bed can be scraped down much quicker if the surface plate bears strongly on the ends. If the center of the planer is lower than the ends, the finished surface will be concave, and if the center is higher than the ends, a convex surface will result. The effect is that of a planer bed traveling on the arc of a large circle, as in turning and boring. If the tool is on the outside of the circle, as indicated at *e* in the diagram *A*, the work will be convex, and if on the inside as at *k* it will be concave.

Setting up the Work

A few points on setting up machine tool beds, etc., for planing may be of interest. In planing beds of the box type construction, which are very stiff, the work should be supported at three points, as indicated at *B*. Pieces of gib steel, say, ¼ by 1 by 4 inches, make excellent packing for this class of work. As the work is supported only at three points it is not twisted, but retains its true shape while being planed. It should also be set on the same three points for scraping. Rectangular pieces, which have previously been rough-planed, and which are not stiff enough to set on three points for finishing, such as horizontal boring mill and milling machine tables, can be supported at five or seven points, according to the length.



Methods of leveling Work on Planer Table

This should be done as follows: First set the casting on three pieces of ¼-inch gib steel, as indicated at *B*. Now procure some slightly tapered wedges, say cast-iron pieces about 1 inch wide by 4 inches long that have a taper of about 0.005 inch and are ¼-inch thick in the center o the tapered sides. Next slip two of these wedges under the corners of the casting at the end that has only one support as shown at *C*. Just press them in lightly with the fingers until they feel tight. If either one is too loose, a piece of paper can be placed under it to make it tight.

Now take a very fine level, one that is graduated so that the bubble will move one graduation, or about ⅛ inch, when a cigarette paper is placed under one end. Place this crosswise of the casting, on the end where the wedges were inserted. If the level is rather short, it is better to set it on a straightedge that has a piece of paper under each end so that it will not rock on the center. (See diagram *D*.)

Next read the level and notice the exact position the bubble takes in relation to the graduations. Now with a light hammer, tap one of the taper wedges until the bubble in the level moves very slightly; then tap the other wedge until the bubble returns to its original position. The casting is now resting on five points without any distortion. If the work is long enough to warrant it, an additional wedge may be placed under the center of each side, putting the level crosswise of the center and proceeding as before. This is the seven-point set-up.

There are some parts of machine tools, like the platens on horizontal boring machines, etc., on which the top has to be finish-planed after the bottom has been scraped to fit the saddle. Of course it is necessary that the top be planed absolutely parallel with the scraped surface. On work of this kind it is advisable to have a fixture or set of blocks that can be clamped to the planer table and a finishing cut taken over them. When the work is placed on these blocks or fixture, the side that is then planed will be perfectly parallel with the scraped surface. When planing the blocks or fixture, the planer cross-rail should be raised sufficiently to allow the work to pass through without having to change the height of the cross-rail.

* * *

STANDARDIZATION OF ABBREVIATIONS AND SYMBOLS

The American Engineering Standards Committee held a conference February 13 for the consideration of the standardization of abbreviations and of the symbols used in engineering equations and formulas. The object of the conference was to determine whether unification of engineering abbreviations and symbols should be undertaken, and the scope of such work. The need for the standardization of abbreviations is emphasized by the existing confusion resulting from the variety of symbols used to designate the same thing, and the multiplicity of meanings of the same symbol applied to different things. The expression "pounds per square inch" may be represented by at least half a dozen abbreviations. Some British journals use "h. p." for high potential, whereas in the United States this symbol is generally understood to mean horsepower. Whether or not the letters "h. p." should be capitalized or hyphenated is a matter upon which the styles used by different journals and authors are not agreed. The symbol (") may mean inches, seconds, or a quotation. Great confusion necessarily occurs when several symbols are used to designate the same thing, as in the cases mentioned.

* * *

INFORMATION ON STEEL TREATING

The American Society for Steel Treating has decided to prepare, as a service to its members, loose-leaf data sheets relating to steel treating. These sheets will consist of tables, charts, and information for those interested in steel and its treatment. It is proposed to have these data sheets ultimately form a handbook that will have the same relationship to the steel-treating industry as the Society of Automotive Engineers' handbook has to the automotive industry. These fields are too specialized for extreme detailed treatment in regular engineering handbooks, which naturally must cover, in a broad manner, the entire machine-building or engineering field; and while the regular standard handbooks give a great deal of information relating to steel and its treatment, the American Society for Steel Treating believes that for the specialist in the field a handbook devoted entirely to the problems met with by its members will be of considerable value.

CALCULATIONS FOR DOVETAIL SLOTS

By EDWARD HELLER

Many of the mathematical problems with which the shop man or the draftsman has to deal, are of a nature that are not, generally speaking, difficult to solve. Nevertheless, in some cases there are certain intermediate steps that must not be overlooked or else the problem will appear difficult and even incapable of being solved. A problem of this nature is frequently encountered in laying out the outline of a dovetail slot when the top and the bottom corners are rounded, as shown in Fig. 1. In practically all cases, the known dimensions are W, w, A, and the two radii B and C. The angle to be found is x.

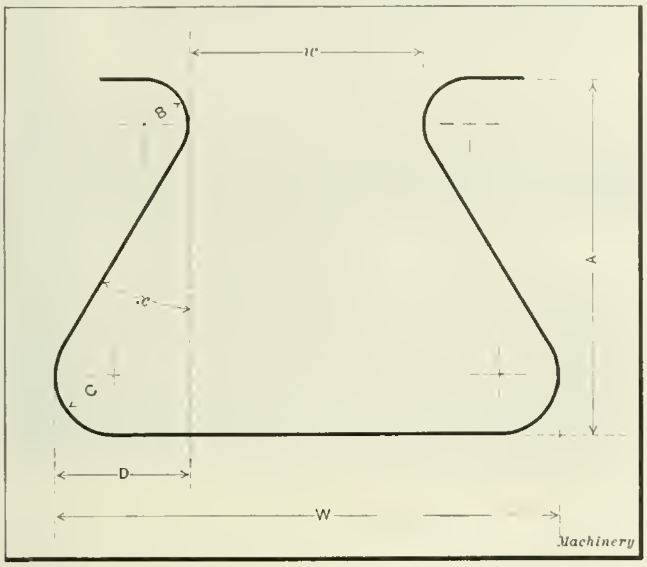


Fig. 1. Outline of Dovetail Slot with Rounded Corners

The procedure is to deal with one side of the slot only, so that it is necessary to find D which equals $(W - w) \div 2$. The conditions of the problem will alter the exact procedure followed in its solution, there being three distinct cases as follows: Case 1: When D is greater than $B+C$; Case 2: When D equals $B+C$; and Case 3: When D is less than $B+C$.

The formulas and an example covering each of these cases follow.

Case 1

Referring to the first diagram in Fig. 2,

$$E = A - (B + C) \qquad F = D - (B + C)$$

$$\text{Tan } y = F \div E \qquad G = \sqrt{E^2 + F^2}$$

The value of H in each case is found in the following manner:

$B : H = C : (G - H)$ Then $HC + BH = BG$

and

$$H = \frac{BG}{B + C} \qquad \text{Also} \qquad \text{Sin } z = \frac{B}{H}$$

and

$$x = y + z$$

The conditions of Case 1 will be satisfied if we let $A = 3$ inches, $B = \frac{3}{8}$ inch, $C = \frac{1}{2}$ inch, and $D = 1$ inch. Substituting these values in the foregoing equations,

$$E = 3 - (0.375 + 0.50) = 2.125 \text{ inches}$$

$$F = 1 - (0.375 + 0.50) = 0.125 \text{ inch}$$

$$\text{Tan } y = 0.125 \div 2.125 = 0.05882$$

Then

$$y = 3 \text{ degrees } 21 \text{ minutes } 59 \text{ seconds}$$

$$G = \sqrt{2.125^2 + 0.125^2} = 2.1286 \text{ inches}$$

$$H = \frac{0.375 \times 2.1286}{0.375 + 0.50} = 0.9123 \text{ inch}$$

$$\text{Sin } z = 0.375 \div 0.9123 = 0.41105$$

$$z = 24 \text{ degrees } 16 \text{ minutes } 15 \text{ seconds}$$

Adding y and z,

$$x = 27 \text{ degrees } 38 \text{ minutes } 14 \text{ seconds}$$

Case 2

The solution of the problem when the conditions place it under Case 2, is the simplest of the three. Referring to the second diagram in Fig. 2,

$$E = A - (B + C) \qquad H = \frac{BE}{B + C}$$

$$\text{Sin } z = B \div H \qquad x = z$$

The conditions will be satisfied if we let $A = 3$ inches, $B = \frac{3}{8}$ inch, $C = \frac{1}{2}$ inch, and $D = \frac{7}{8}$ inch. Substituting these values in the equations for Case 2,

$$E = 3 - (0.375 + 0.50) = 2.125 \text{ inches}$$

$$H = \frac{0.375 \times 2.125}{0.375 + 0.50} = 0.9107 \text{ inch}$$

$$\text{Sin } z = 0.375 \div 0.9107 = 0.41177$$

$$x = z = 24 \text{ degrees } 19 \text{ minutes}$$

Case 3

The diagram for Case 3 in Fig. 2 indicates that the solution of the problem when these conditions obtain is similar to that of Case 1. The same procedure is followed as in Case 1 and the same equations are derived, with the exception of the two following, and these two differ only in that the values are reversed in order.

$$F = (B + C) - D \text{ and } x = z - y$$

The conditions of this case will be satisfied if we let $A = 3$ inches, $B = \frac{3}{8}$ inch $C = \frac{1}{2}$ inch, and $D = \frac{3}{4}$ inch. Then by substituting the values in the equations for E, G, H, y, and z, given under Case 1, and in the two foregoing equations, we have:

$$E = 3 - (0.375 + 0.50) = 2.125 \text{ inches}$$

$$F = (0.375 + 0.50) - 0.750 = 0.125 \text{ inch}$$

$$\text{Tan } y = 0.125 \div 2.125 = 0.05882$$

$$y = 3 \text{ degrees } 21 \text{ minutes } 59 \text{ seconds}$$

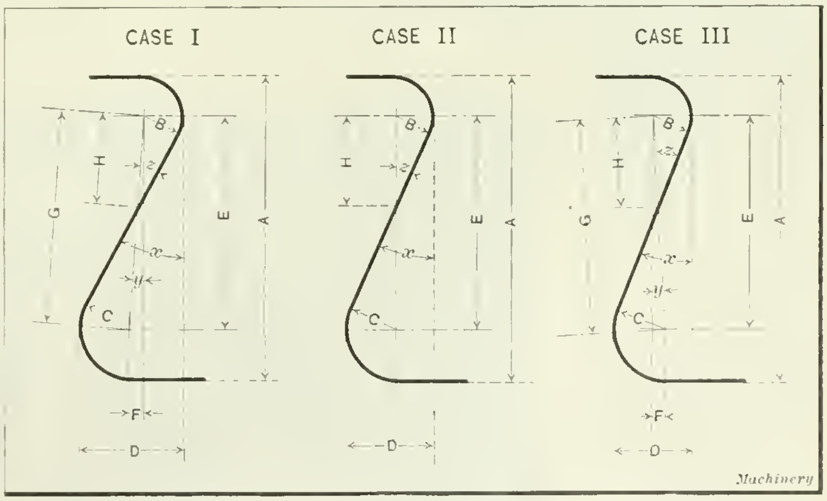


Fig. 2. Diagrams used in calculating Angularity of Dovetail Slot

$$G = \sqrt{2.125^2 + 0.125^2} = 2.1286 \text{ inches}$$

$$H = \frac{0.375 \times 2.1286}{0.375 + 0.50} = 0.9123 \text{ inch}$$

$$\text{Sin } z = 0.375 \div 0.9123 = 0.41105$$

$$z = 24 \text{ degrees } 16 \text{ minutes } 15 \text{ seconds}$$

Subtracting y from z,

$$x = 20 \text{ degrees } 54 \text{ minutes } 16 \text{ seconds}$$

Cutting Double Helical or Herringbone Gears

By FRANKLIN D. JONES

Application of Hobbing Machines of Single- and Double-hob Types—First of Two Articles

DOUBLE helical or herringbone gears may be produced either by hobbing, planing (using either a gear shaper or planer) or milling. In hobbing gears of this type, an ordinary machine designed for cutting spur and helical gears may be used, or the work may be done on a special machine intended particularly for herringbone gears. If the planing process is employed, the teeth may be formed by a generating method, or a machine of the templet or form-copying type may be used. The two general methods of milling are by using end-mills and by using cutters of the disk type.

Herringbone gears may be formed of one solid piece or of two half sections. When there are two sections these may be cut separately, the same as two single helical gears, and afterward bolted together so that the teeth of each section are either in alignment or staggered, as may be required. When herringbone gears are made of one solid piece, the right- and left-hand teeth may also be directly opposite or offset an amount equal to one-half the circular pitch. These solid gears usually have a clearance space between the right- and left-hand tooth sections to provide room for the cutter, but the amount of clearance required varies for different methods of cutting; in fact, the method may be such that the clearance space is eliminated, the teeth extending across the gear without a groove at the center.

Herringbone gears, except very large sizes, are usually cut on an ordinary hobbing machine designed for spur and helical gears. When this type of machine is used, the gear may be cut by finishing the teeth of one side and then turning the gear over, or it may be held in one position for cutting both the right- and left-hand sections. Fig. 1 shows a hobbing machine cutting a herringbone gear. A single-threaded right-hand hob is being used.

According to a rule given in the article on generating helical gears in February MACHINERY, when a hob is the same hand as the gear to be cut, the hob is inclined from a horizontal position an amount equal to the difference between the helix angle of the gear (as measured from the axis) and the angle of the hob, as measured from a plane perpendicular to its axis (the "end angle"). Since the hob illustrated in Fig. 1 is right-hand and is cutting the right-hand section of the gear, it is set according to the rule just given. On the contrary, when a right-hand hob is used for cutting gear teeth which incline to the left (when the gear is viewed from an endwise position) the hob spindle is inclined from the horizontal an amount equal to the sum of the gear and hob angles, instead of the difference between these angles.

Herringbone gears are usually cut to an angle of 23 degrees. This angle is selected primarily to allow successive pinion teeth of gearing having an adequate face width, to overlap properly when the gearing is in mesh. This face width is usually about six times the circular pitch. According to another rule, the minimum width of the active face should equal 16 divided by the diametral pitch.

In using a single-threaded hob for cutting herringbone gears having an angle of, say, 23 degrees, it is necessary, of course, to incline the hob, since its angle is less than that of the gear. Sometimes a multiple-threaded hob is used: in that case, the hob angle is made to agree with the gear, and the hob spindle is set at right angles to the axis of the gear. An example of the use of a multiple-threaded hob corresponding to the angle of the gear being cut is illustrated in Fig. 2, which shows a Newton machine hobbing a herringbone pinion. It will be noted from the illustration that the hob spindle is set at right angles to the axis of the pinion.

Several examples of hobbing herringbone gears are illustrated in Figs. 3 to 5, inclusive. The herringbone pinions (Fig. 3) are formed integral with their

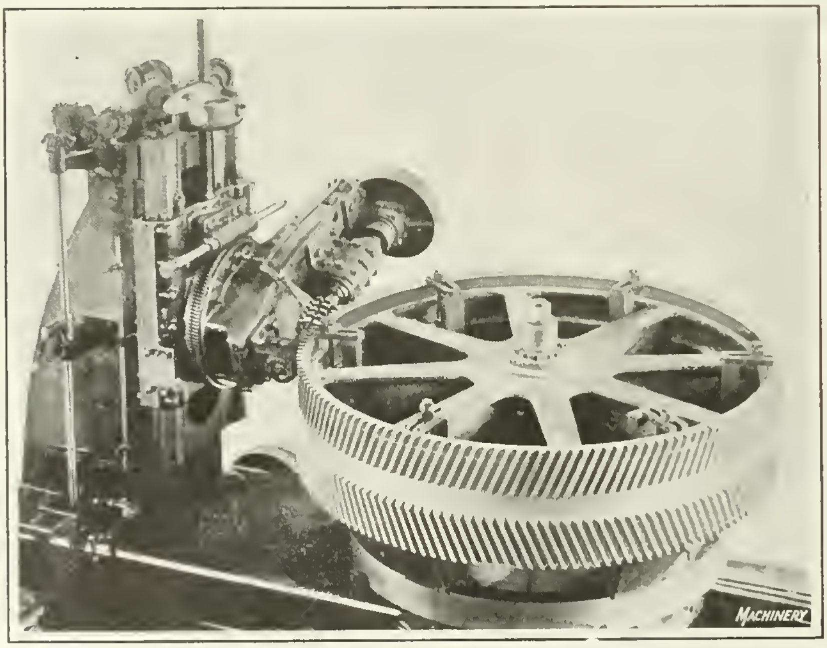


Fig. 1. Cutting a Double Helical or Herringbone Gear on a Hobbing Machine

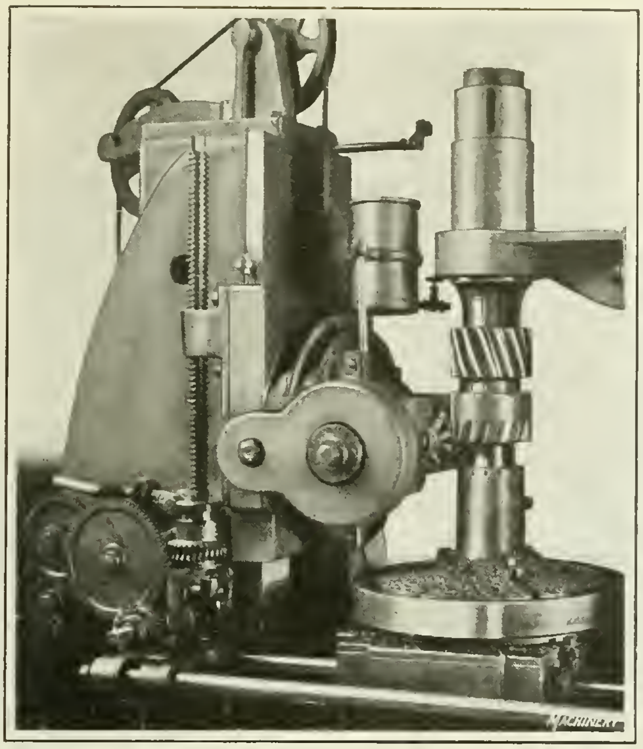


Fig. 2. Using Multiple-threaded Hob set at Right Angles to Axis of Gear

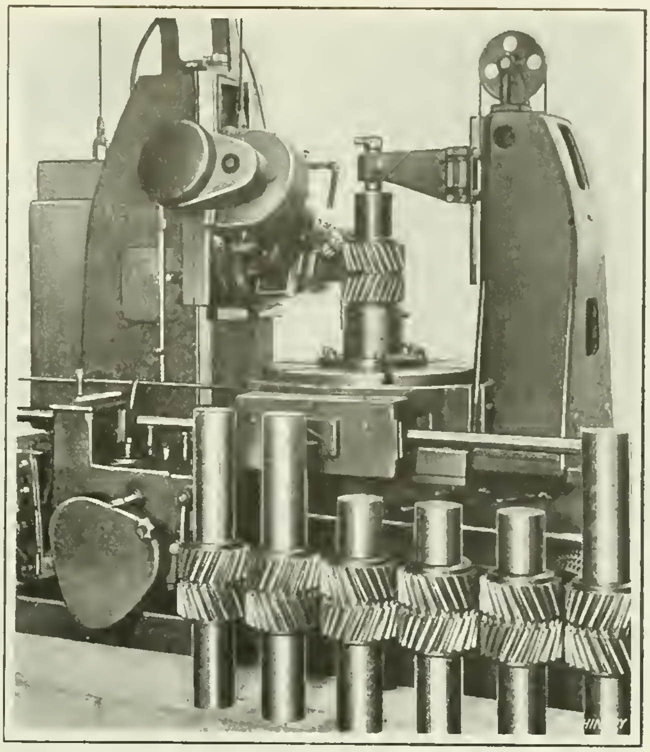


Fig. 3. Cutting Herringbone Pinions that are Integral with their Shafts

shafts, and are used for rolling mills. These pinions have 22 teeth which are staggered, the teeth on one side being opposite the spaces on the other. A cast-iron flanged sleeve bolted to the work-table is used for holding the lower end of the pinion, and the long shaft projects into a pocket in the work spindle. The gears are all cut on one side, and are then turned upside down for cutting the other side. A small finger or gage projecting above the cast-iron sleeve is used for locating the pinions after one side has been cut, in order to have the teeth on the opposite side offset or staggered properly and uniformly for each pinion. The pitch diameter of these pinions is 8 inches, and the angle 23 degrees 33 minutes. The normal diametral pitch is 3, and the face width 7⅝ inches. This work is done on a hobbing machine made by the Newark Gear Cutting Machine Co.

Fig. 4 illustrates the cutting of herringbone gears formed of two sections, which are bolted together after cutting the teeth. This view shows a Gould & Eberhardt machine at the plant of Foote Bros. Gear & Machine Co., Chicago, Ill. These gears are made of steel, and have 75 teeth of 2½ diametral pitch, a 36-degree angle, and a face width of 3 inches. The cutting of a fairly large herringbone gear is shown in Fig. 1. This gear has a pitch diameter of approximately 85 inches, a face width of 21 inches, and a tooth angle of 29 degrees 34 minutes. The work was done in the plant of the Farrel Foundry & Machine Co., Ansonia, Conn.

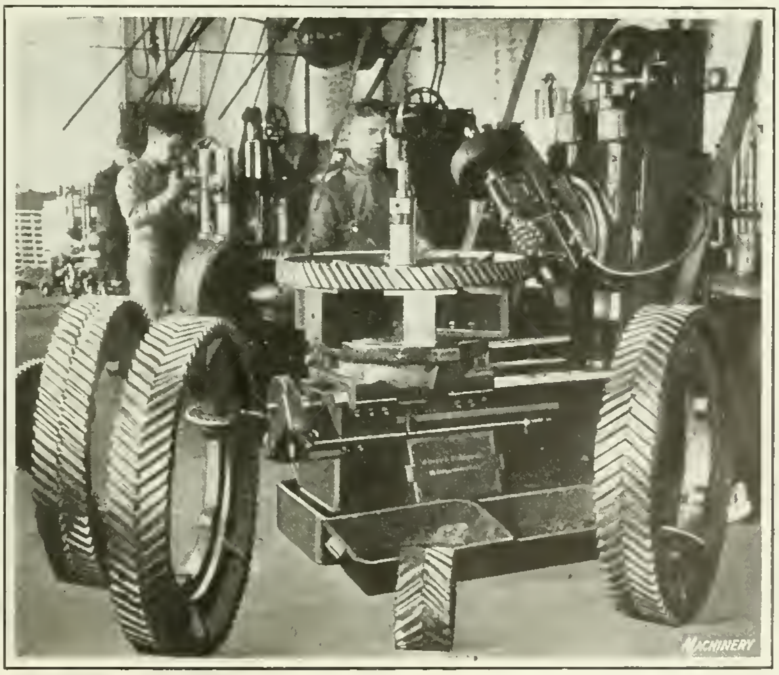


Fig. 4. Cutting Herringbone Gears formed of Two Sections

An interesting example of herringbone gear work is illustrated in Fig. 5, which shows another Gould & Eberhardt machine. This is one of the herringbone gears for reduction gearing used in conjunction with a steam turbine. These gears are made from steel forgings, and are 96 inches in diameter. Both sides of the gear are cut without changing its position on the machine, the hob being set at the correct angle first for one side and then for the other. One reason that herringbone gears are sometimes cut by first finishing the lower half and then turning the gear over is to keep the hob slide in a low and more rigid position on the column.

The application of a method developed by the Newark Gear Cutting Machine Co., for which a patent is pending, is illustrated in Fig. 6, which shows the hobbing of a cast iron herringbone gear having 65 teeth of 4 diametral pitch. A single-threaded hob of small diameter is used, and this hob is designed to generate more perfectly formed teeth than are obtained with a multiple-threaded hob set in the zero position or at right angles to the axis of the work. It is claimed that this single-threaded hob set at the proper angle gives a full generating action. The hob is made of special form to secure the desired involute and pressure angle in the plane of rotation of the gear.

This method is said to be rapid and accurate, and the gears operate satisfactorily just as they are cut by the machine, it being unnecessary to employ a running-in process using sand or other abrasive. The width of the gap between the

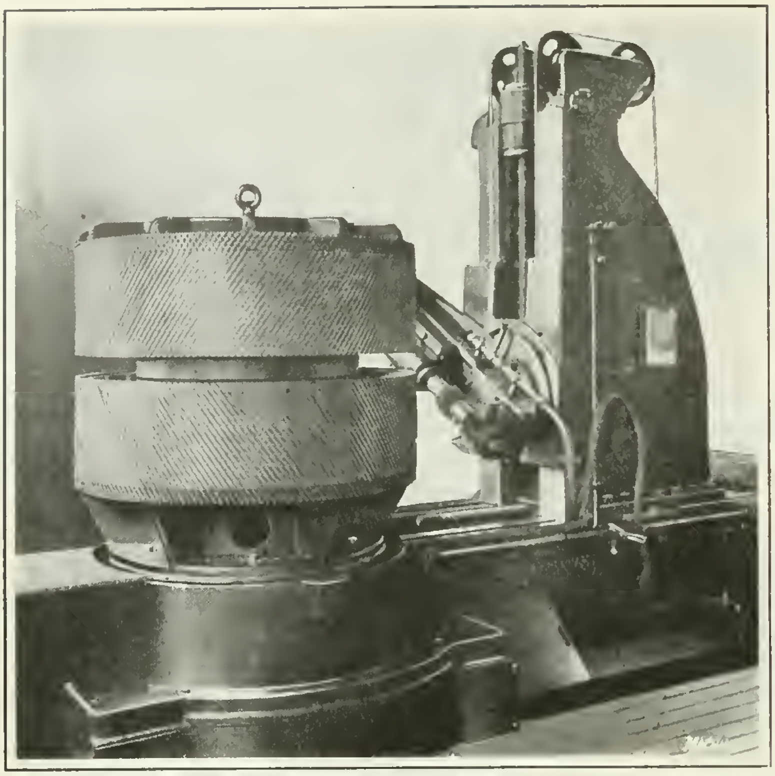


Fig. 5. Cutting Herringbone Gears for Steam Turbine Transmission

right- and left-hand sections is made just as narrow as the width specified by the American Gear Manufacturers' Association for multiple-threaded hobs set in a zero position.

Proportions of Herringbone Gear Teeth

In designing herringbone gears, all calculations for pitch, helix angle, addendum, and dedendum are based ordinarily upon the diametral pitch in the plane of rotation of the gear. This method greatly simplifies the calculations, as compared with those required for helical gearing connecting shafts that are not parallel. In the latter case it is necessary to consider the normal pitch, since this must always be equal on both gear and pinion, whereas the circular pitch (measured in a plane perpendicular to the axis) may vary considerably. With herringbone gears the designer may disregard the normal pitch and proceed on a basis of diametral pitch obtained the same as for spur gears, or he may use the circular pitch.

In cutting herringbone gears, however, the gear tooth calipers are set according to the normal thickness, and the hob (if designed to be set at an angle) is proportioned according to the normal pitch, the same as for other forms of helical gearing. If the axis of the gear and hob are at right angles (as for the Wuest method) the axial pitch of the hob equals the circular pitch of the gear.

Assume that the gear is of 2 diametral pitch. Then the circular pitch equals 3.1416 ÷ 2 = 1.5708, the same as for a spur gear, but the normal circular pitch equals the circular pitch times the cosine of the helix angle. If this angle is 23 degrees, then the normal circular pitch equals 1.5708 × 0.9205 = 1.4459; hence, the normal tooth thickness along the pitch surface equals 1.4459 ÷ 2 = 0.7229 inch.

Table 2, obtained from Gould & Eberhardt, gives normal pitches and tooth thicknesses for various diametral pitches, as well as other data for use in cutting and designing herringbone gears. This table is based on a helix angle of 23 degrees and a pressure angle of 20 degrees in the plane of rotation of the gear. The addendum is equal to 0.8 ÷ diametral pitch; the dedendum equals 1 ÷ diametral pitch; and the full depth of the tooth equals 1.8 ÷ diametral pitch.

Herringbone Gear Blank Diameters

The outside diameter of a herringbone gear blank under normal conditions is found by adding 1.6 to the number of teeth and dividing the sum by the diametral pitch. However, if the pinion is small, the diameter is increased to avoid undercutting of the teeth. In this case, the outside diameter is first calculated in the usual manner; then an amount (depending upon the number of teeth and the diametral pitch) is added to the diameter and a corresponding amount is subtracted from the gear, thus avoiding any change in the center distance. Table 1, representing recommended practice of the American Gear Manufacturers' Association, shows the amounts to add to the pinion and subtract from the gear. This table covers pinions having seventeen teeth or less, and diametral pitches from 1 to 10. If two enlarged pinions must be run together, the center distance has to be increased by one-half the sum of the enlargement. Some manufacturers enlarge pinions having less than twenty-five teeth. In setting up the machine for cutting an enlarged pinion or a reduced gear, the hob is set according to the helix angle at the true pitch circle, the enlargement or reduction of the blank not being considered.

Setting Gear after Cutting One Side

The teeth on each side of a herringbone gear may occupy the same relative positions or be staggered, as previously mentioned. The diagram Fig. 7 illustrates a simple method (obtained from Gould & Eberhardt) of locating the gear relative to the hob after cutting one side. When one side is finished, a square is used, as indicated by the dot-and-dash lines, to transfer or project the top edges of the finished tooth to the uncut side of the gear blank. In other words, marks are made on the uncut side corresponding in location

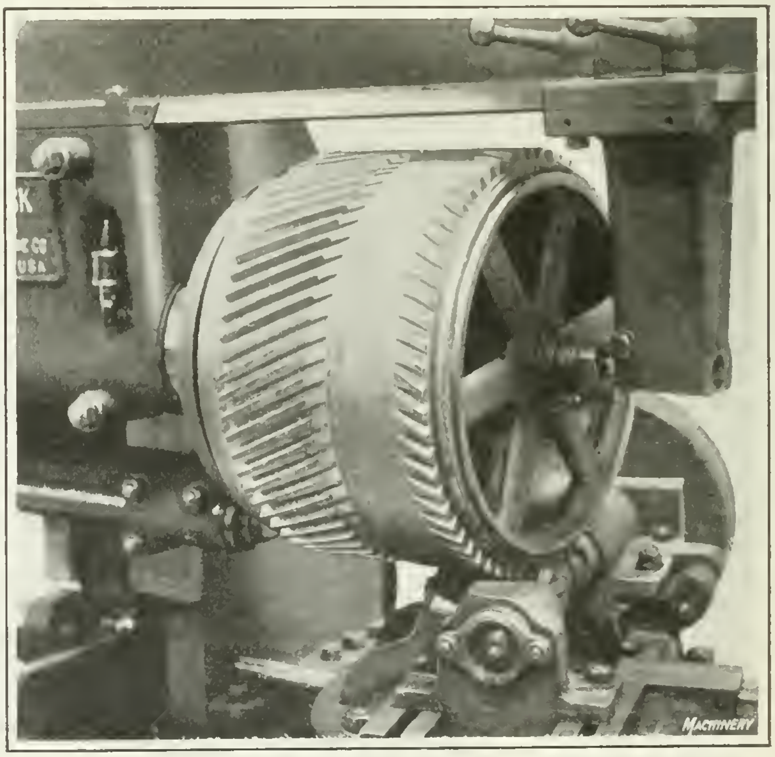


Fig. 6. Application of a New Type of Hob

TABLE 1. ENLARGEMENT FOR HERRINGBONE PINIONS

No. of Teeth	Diametral Pitch												
	10	8	6	5	4	3½	3	2½	2	1¾	1½	1¼	1
7	0.1181	0.1478	0.1976	0.2364	0.2954	0.3382	0.3938	0.4726	0.5906	0.6762	0.7882	0.9450	1.1810
8	0.1064	0.1330	0.1782	0.2128	0.2662	0.3046	0.3548	0.4258	0.5322	0.6094	0.7102	0.8514	1.0640
9	0.0947	0.1184	0.1586	0.1894	0.2368	0.2712	0.3158	0.3790	0.4736	0.5424	0.6322	0.7578	0.9471
10	0.0830	0.1038	0.1392	0.1662	0.2076	0.2378	0.2768	0.3322	0.4152	0.4756	0.5542	0.6642	0.8302
11	0.0713	0.0892	0.1196	0.1428	0.1784	0.2044	0.2378	0.2854	0.3568	0.4088	0.4762	0.5706	0.7132
12	0.0596	0.0746	0.1002	0.1194	0.1492	0.1710	0.1988	0.2386	0.2982	0.3420	0.3982	0.4772	0.5962
13	0.0479	0.0600	0.0806	0.0958	0.1200	0.1376	0.1598	0.1918	0.2398	0.2752	0.3202	0.3836	0.4792
14	0.0362	0.0454	0.0612	0.0726	0.0906	0.1042	0.1208	0.1450	0.1812	0.2082	0.2424	0.2900	0.3623
15	0.0245	0.0308	0.0416	0.0492	0.0614	0.0708	0.0818	0.0982	0.1228	0.1414	0.1644	0.1964	0.2453
16	0.0128	0.0162	0.0222	0.0258	0.0322	0.0374	0.0428	0.0514	0.0642	0.0746	0.0864	0.1028	0.1283
17	0.0011	0.0016	0.0026	0.0024	0.0028	0.0040	0.0038	0.0046	0.0058	0.0078	0.0084	0.0092	0.0113

Machinery

to a finished tooth on the opposite side. Then, by disengaging the clutch on the index driving shaft, the work-table and gear blank can be rotated by hand in order to center the tooth marks in relation to the hob. Next, the machine is started, and a slight notch is cut all around the blank, after which the machine is stopped to check the location of the notches relative to the tooth marks. If additional adjustment is necessary, this can be made by moving the hob, using the cutter-adjusting device. If the teeth are to be staggered, the same procedure is followed except that a tooth space is centered on the uncut side instead of marks representing a tooth.

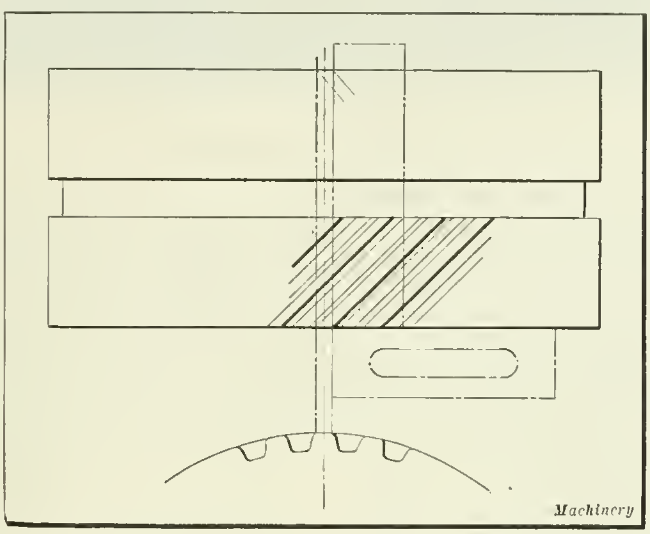


Fig. 7. Method of locating Gear Blank Relative to Hob after cutting One Side

Cutting Both Sections of Gear Simultaneously

Some types of hobbing machines designed for cutting herringbone gears are provided with two hobs for cutting both sides at the same time. For instance, two hobs are used in conjunction with the Wuest method (originated in Switzerland). These hobs are located on opposite sides of the gear blank, and one cuts downward while the other cuts upward. Helical teeth are formed as the result of an accelerating or retarding motion imparted to the work-table and gear blank.

Multiple-threaded hobs set at right angles to the axis of the gear are used, and these are so located relative to each other as to form staggered teeth. As these teeth are offset an amount equal to one-half the circular pitch, the tooth spaces of one side serve as clearance spaces for the hob cutting the opposite side when the inner ends of the teeth are being finished; consequently herringbone gears cut by this method do not require the wide clearance groove that is necessary for hobbing teeth that are in alignment.

Fig. 9 shows a large machine of special design used at the plant of the Falk Corporation, Milwaukee, Wis., for cutting herringbone gears according to the Wuest method. This machine has a capacity for diameters up to 16 feet 3 inches, face widths up to 6 feet, and diametral pitches up to ¾, although larger pitches have been cut. The massive heads or columns seen on opposite sides of the gear each support a hob. These heads are adjusted by power along the horizontal bed, to suit the diameter of the gear. Very accurate lead-screws are used for this adjustment, and the heads are located by graduations on the bed, in conjunction with graduated dials on the lead-screws.

Each hob is carried by a counterweighted slide located on the vertical face of the head. While one hob feeds from the top of the gear downward, the other is feeding upward from the bottom toward the center; at the same time the work-table is given a slow rotary motion to generate teeth of the required helix angle. Change-gears in conjunction

TABLE 2. PROPORTIONS OF HERRINGBONE GEAR TEETH

Diametral Pitch	Circular Pitch	Normal Circular Pitch	Thickness of Tooth on Pitch Line	Addendum	Dedendum	Clearance	Working Depth of Tooth	Total Height of Tooth
1	3.14159	2.89183	1.44591	0.80000	1.00000	0.20000	1.60000	1.80000
1.25	2.51327	2.31346	1.15673	0.64000	0.80000	0.16000	1.28000	1.44000
1.50	2.09439	1.92788	0.96394	0.53333	0.66666	0.13333	1.06666	1.19999
1.75	1.79519	1.65247	0.82624	0.45714	0.57142	0.11428	0.91428	1.02856
2	1.57080	1.44592	0.72296	0.40000	0.50000	0.10000	0.80000	0.90000
2.25	1.39262	1.28190	0.64095	0.35555	0.44444	0.08889	0.71110	0.79999
2.50	1.25664	1.15674	0.57837	0.32000	0.40000	0.08000	0.64000	0.72000
2.75	1.14240	1.05158	0.52579	0.29090	0.36363	0.07273	0.58180	0.65453
3	1.04720	0.96394	0.48197	0.26667	0.33333	0.06666	0.53334	0.60000
3.50	0.89760	0.82624	0.41312	0.22857	0.28571	0.05714	0.45714	0.51428
4	0.78540	0.72296	0.36148	0.20000	0.25000	0.05000	0.40000	0.45000
5	0.62832	0.57837	0.28918	0.16000	0.20000	0.04000	0.32000	0.36000
6	0.52360	0.48197	0.24098	0.13333	0.16666	0.03333	0.26666	0.29999
7	0.44880	0.41312	0.20656	0.11428	0.14285	0.02857	0.22856	0.25713
8	0.39270	0.36148	0.18074	0.10000	0.12500	0.02500	0.20000	0.22500
9	0.34906	0.32131	0.16065	0.08889	0.11111	0.02222	0.17778	0.20600
10	0.31416	0.28918	0.14459	0.08000	0.10000	0.02000	0.16000	0.18000
12	0.26180	0.24099	0.12049	0.06667	0.08333	0.01666	0.13334	0.15000

Machinery

with a differential mechanism, control the relation between the feeding movement of the hobs and the rotary motion of the work-table, in accordance with the helix angle and the number of teeth.

Each hob is adjustable relative to the work for cutting the teeth of each section in the proper alignment. A preliminary adjustment is first made for roughing; then, before taking the finishing cut, a gage is used to determine whether or not additional adjustment is necessary. Hobs having stepped teeth for breaking up chips have been used successfully for the roughing cut on this machine.

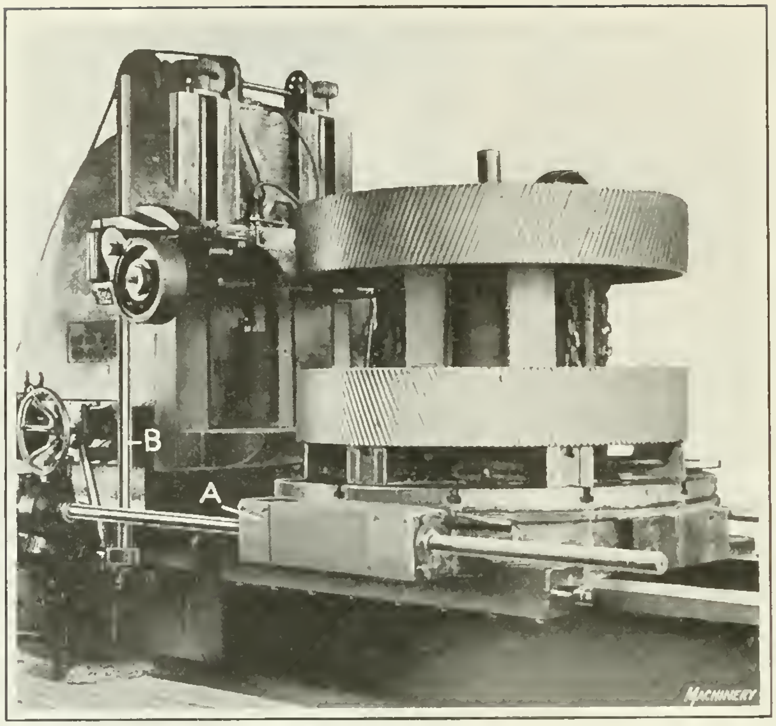


Fig. 8. Large Machine of the Type having Two Hobs for cutting Both Sections of a Herringbone Gear simultaneously

Machines having Two Hobs Located on Same Side of Blank

Two hobs located on the same side of the blank are used for cutting herringbone gears by the hobbing method developed by the Fawcus Machine Co., Pittsburg, Pa. The arrangement of the hobs may be seen in Fig. 10, which shows a 48-inch machine. These hobs operate simultaneously on both sections of the gear. Right- and left-hand multiple-threaded hobs are used, and these rotate in opposite directions. One hob begins at the top of the blank and feeds down to the clearance groove at the center, while the lower hob begins at this groove and feeds down to the bottom of the blank.

As both of these hobs are located on the same side of the blank, and are cutting teeth that incline in opposite directions, the helical teeth cannot be generated by imparting an accelerating or retarding motion to the work-table, as is done with an ordinary helical gear-hobbing machine. In order to obtain helix angles of opposite inclination, a differential speed mechanism is employed to retard the speed of one hob and increase that of the other, relative to the feeding motion and at such a rate that the required helix angle is generated on both sides of the gear.

Fig. 8 shows a 144-inch machine cutting a large ship transmission gear. The two hobs are mounted on a vertical slide. The bottom hob is not adjustable on this slide, but the top one is carried by an auxiliary slide which can be adjusted vertically for varying the distance between the two hobs in accordance with the face width of the gear. As each hob feeds downward across the face of the gear blank, it cuts tooth grooves corresponding to its own helix angle, which is 23 degrees. The upper hob is retarded and the lower one accelerated just the right amount for generating teeth on the right- and left-hand sections of the gear having the 23-degree helix angle. The differential gearing through which this compensating movement is transmitted is located at the lower end of the vertical splined shafts *B*, which drive the hobs from each side of the machine. These differential gears are controlled by the saddle feed, and they serve to retard the right-hand hob an amount equivalent to the acceleration of the left-hand hob. This saddle feed, in turn, is controlled by change-gears.

Motion is transmitted to the work-table of this machine through two splined shafts located on each side. These

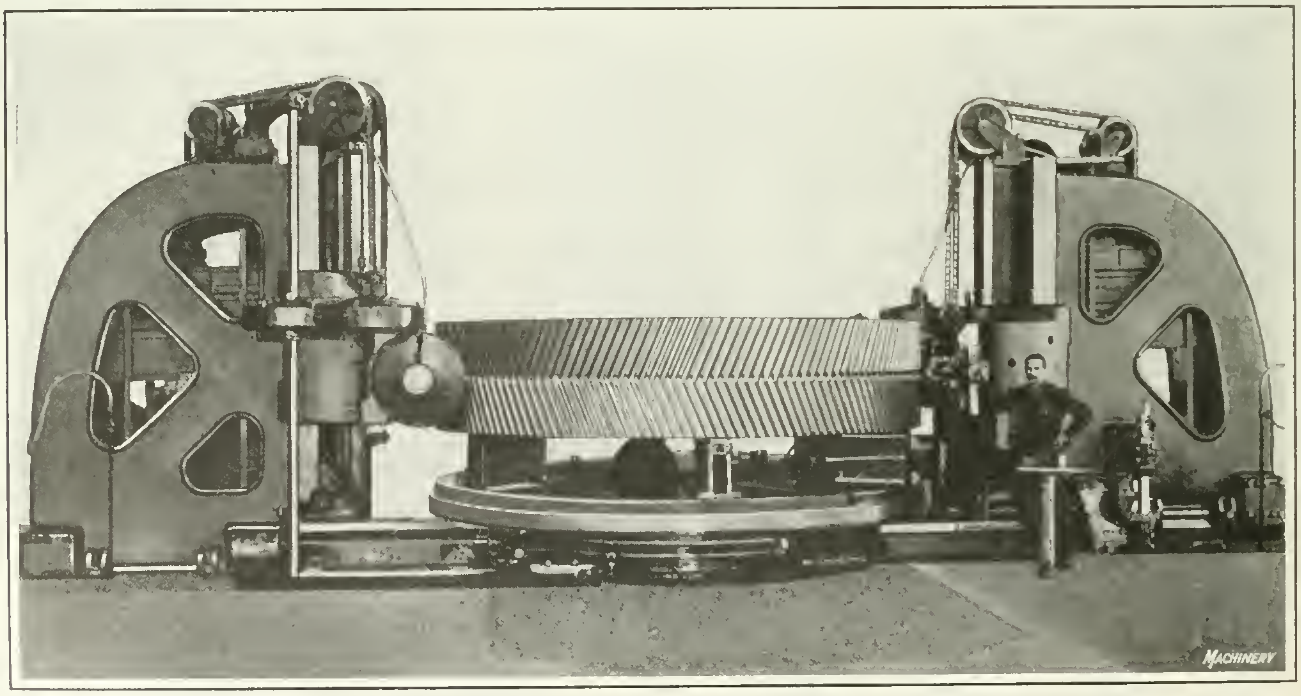


Fig. 9. Cutting Large Herringbone Gear on Machine having Capacity for Gears up to 16 Feet 3 Inches in Diameter

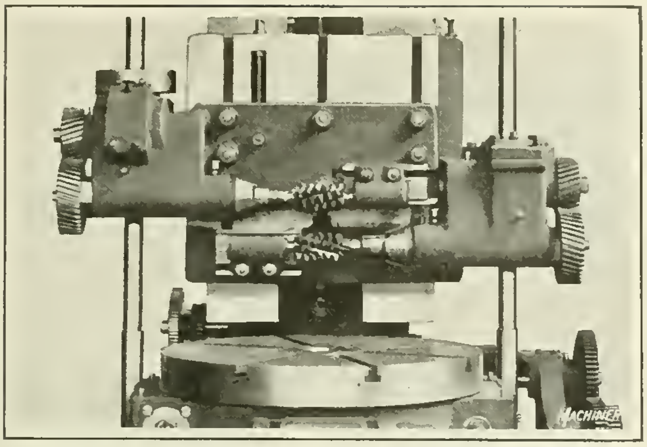


Fig. 10. Machine equipped with Two Hobs for cutting Right-and Left-hand Sections of a Herringbone Gear simultaneously

shafts drive right- and left-hand worms, enclosed at *A*, on opposite sides of the table and engaging a large worm-gear on the table spindle. The hobs used on these machines have three, four, five, or six threads, and since the helix angle is 23 degrees for all of the hobs, the number of threads determines the hob diameter for each pitch. These pitches are restricted to standard diametral pitches, and one pair of right- and left-hand hobs will cut any number of teeth of that pitch. The hobs are the same as ordinary worm-gear hobs.

The teeth on the herringbone gears cut on these machines converge at the center or occupy the same relative position on each side, instead of being staggered. These teeth are of short addendum involute form, having a 20-degree pressure angle and an addendum equal to 0.8 divided by the diametral pitch. The pitch diameters of the blanks are calculated in the same way as for diametral pitch spur gears. The hobbing type of machine is used for cutting gears of one diametral pitch and smaller. For larger pitches, gear planers are used, as explained in the next installment of this series.

* * *

MOISTURE-RESISTANT COATINGS FOR WOOD

Shrinking and swelling and internal stresses that cause warping and checking are brought about in wood by changes in the moisture content. Such changes are occurring continually when wood is exposed to changing atmospheric conditions, and the only way to prevent or retard them is to protect the wood from the air with some moisture-resistant finish or coating. In order to determine the protection against moisture afforded by various coatings, a series of tests is being conducted by the U. S. Forest Service, at the Forest Products Laboratory, Madison, Wis. No coating or finish that is entirely moisture-proof has yet been discovered, but several have been found to be very effective.

Linseed oil, although it is probably recommended more frequently than most of the other materials for moisture-proofing wood, was found in the absorption tests to be quite ineffective. Five coats of hot oil followed by two coats of floor wax failed to give any great protection. Oil paints form a film over wood, which is very durable even in exterior locations. Laboratory tests show, however, that such a film, although it may be continuous, does not prevent moisture changes in the wood. Graphite paints and spar varnish are about as effective as the ordinary oil paints with the heavier pigments.

Among the best coverings were found to be aluminum-leaf coating developed at the Forest Products Laboratory particularly for the protection of airplane propellers. Such a coating can best be applied to large unbroken surfaces. Some asphalt and pitch paints also have high moisture-resisting properties.

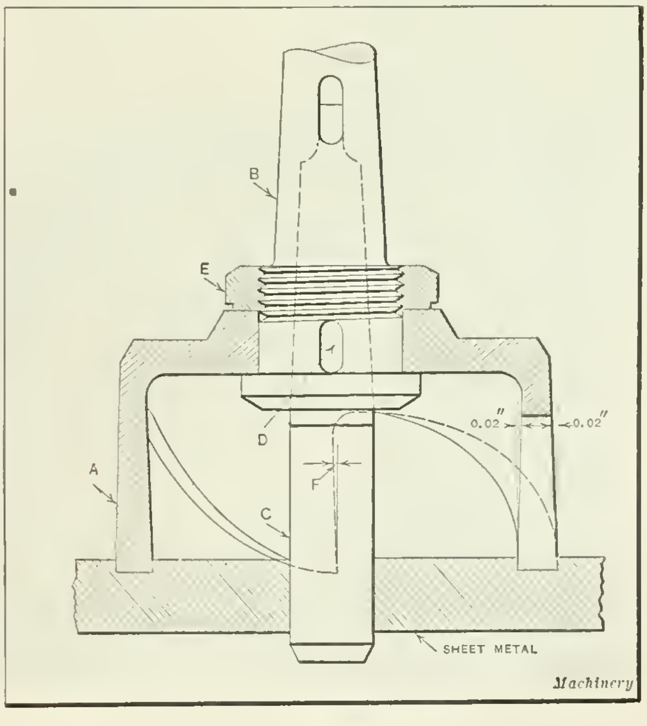
TREPANNING TOOL FOR CUTTING HOLES IN METAL PLATES

By JOE V. ROMIO

Boilermakers and sheet-metal workers are often called upon to cut large holes in metal plates. When the holes are too large to be drilled with an ordinary twist drill, a series of small holes can be drilled in a circle to remove most of the metal, after which the rough edges can be finished to a true circle. However, this method consumes considerable time. For such holes a trepanning type of tool can be used to advantage. A tool of this type designed to be used in a drill press is shown in the accompanying illustration. This tool has three or four teeth which are formed by removing sections of metal on the cylindrical part of a cup-shaped piece of tool steel *A*. The shank *B* is turned to size from a tough alloy steel. Usually, the shank is tapered to fit the spindle of the largest drill press available, and is threaded at the lower end, which terminates in a flange, as shown.

The shank is drilled and reamed to receive the tapered end of the pilot *C*, which is made of tool steel. A knock-out hole is provided to facilitate the removal of the pilot. The cutter *A* is made of tool steel, and the side walls are turned to a taper as shown. For small and medium sized tools, a taper of about 0.02 inch on each side of the teeth will usually give the best results. The closed end of the cup-shaped cutter is bored to fit the lower part of the shank *B*, and is held in place on the shank by a key *D*. A threaded nut *E* clamps the cutter against the flange on the lower end of shank B. The cutter is gashed for either three or four teeth, as desired; usually three teeth give satisfactory results.

A very slight rake, as indicated by angle *F*, may be given to the front side of the teeth. If the rake angle is too great, however, the tool will have a tendency to dig in. For the same reason the clearance angle on the sides of the teeth should also be small. When the cutter is sharpened it is ground only on the front side of the teeth. The height of each tooth should be accurately measured and care taken to keep all the teeth of a uniform height. With this type of tool one shank can be used for cutters of various diameters. Pilots of different diameters can also be employed. In using the tool, a hole is first drilled through the sheet metal to receive the pilot *C*.



Tool for cutting Large Holes in Metal Plates

PROPER LOCATION OF DOWELS

By FRANK W. CURTIS, Chief Engineer, Dowd Engineering Co.

In attaching locating blocks or other accurately located units on a jig or fixture, dowels are generally used. Frequently the positions of the dowels, as specified by the designer on the drawing, are not the best possible. Two examples of the use of dowels are shown in Fig. 1 at *A* and *B*. They are used in attaching locating blocks on a fixture, the blocks being held down by fillister-head screws. The position of the dowels at *A* only permits them to be placed apart a distance *C*. This location is not the best one, for they can be placed much further apart, as indicated at *B*, where they have a center-to-center distance *D*. The farther the dowels may be separated, the greater the accuracy obtainable. None but an inexperienced designer would space the dowels as indicated by the first example, but drawings of this sort are frequently seen.

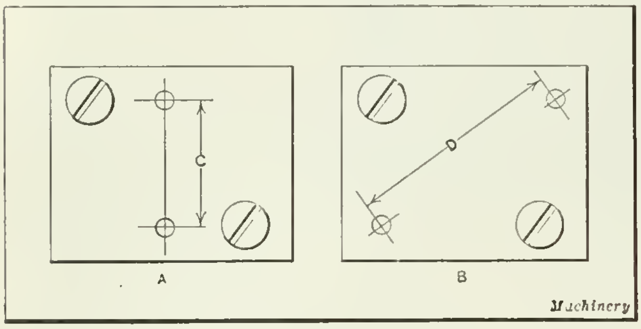


Fig. 1. Two Methods of locating Dowels, the One at B being Preferable

At *A* in Fig. 2 is illustrated a case in which the dowels are placed too near the edges of the plate located by their use. The dowels are likely to break out the thin wall of metal between them and the edges of the block, or distort the piece where they are driven in. Dimension *C* should always be at least equal to the diameter of the dowel, and a little more than this is preferable. This is clearly illustrated in example *B*, where dimensions *D* are somewhat greater than the dowel diameter. The sectional views illustrate the importance of this point in design.

Cases Where Only One Dowel is Needed

It is not always necessary to use two dowels in locating a part, as one is sufficient in certain cases. In Fig. 3, at *A*, the bottom of a circular block *C* fits a recess *D* in the part to which the block is attached, and is held in place by three fillister-head screws and one dowel. As plate *C* fits the recess, it need only be prevented from turning, and therefore a single dowel answers the purpose. In this example, plate *C* is plain, but it might easily have a locating groove that would need to be placed in a certain relation to some other part on the fixture, in which case a dowel would be necessary.

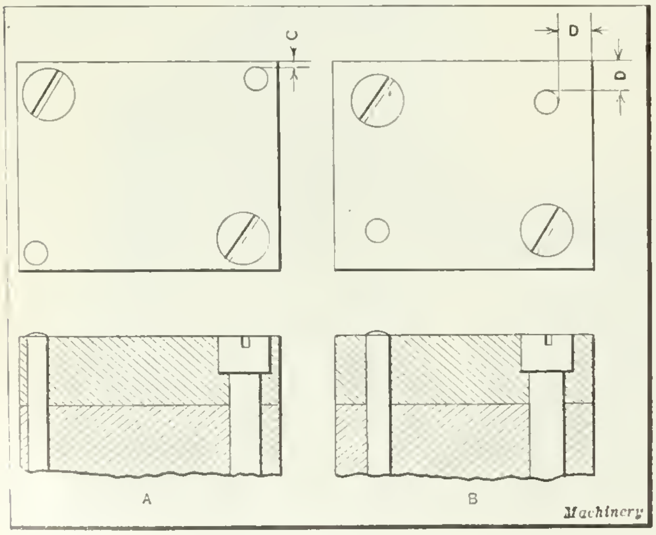


Fig. 2. Diagrams showing how far Dowels should be located from the Edges of a Part

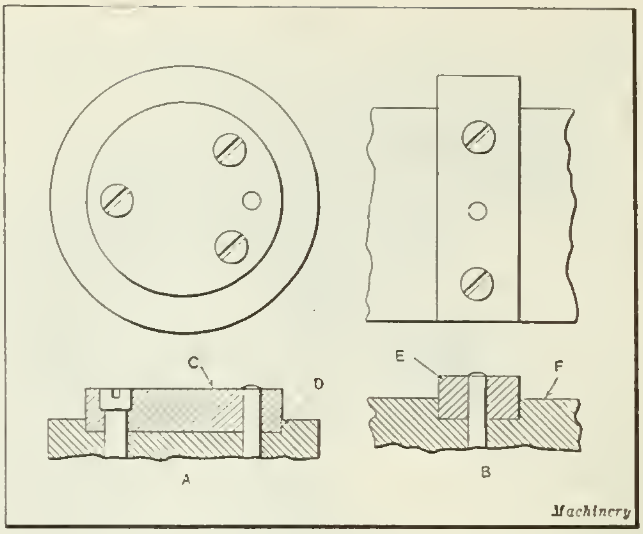


Fig. 3. Examples showing Cases where One Dowel is Sufficient to hold the Attached Part in the Proper Location

In the example illustrated at *B*, a locating plate *E* fits a slot in part *F*. Plate *E* is also fastened in place by means of fillister-head screws, while a single dowel is employed to establish the correct position on the part to which the plate is attached. Occasionally a part is made with a tongue that fits a groove or slot in the work, and in cases of this kind a single dowel also is sufficient.

When a locating block is so placed that it must resist considerable pressure and possibly a certain amount of lifting action, the screws should be located so as to resist the lifting action, and the dowels employed to make the location positive. An example of this kind is presented at *A* in Fig. 4, where a plate *C* is used as a locater for the work *D*, the latter being held against the plate by means of pressure exerted through a thumb-screw. In this particular instance, it would be much better to place the dowels as shown at *B*, because the latter arrangement permits the block to be hardened at the point where the work makes contact so as to reduce wear.

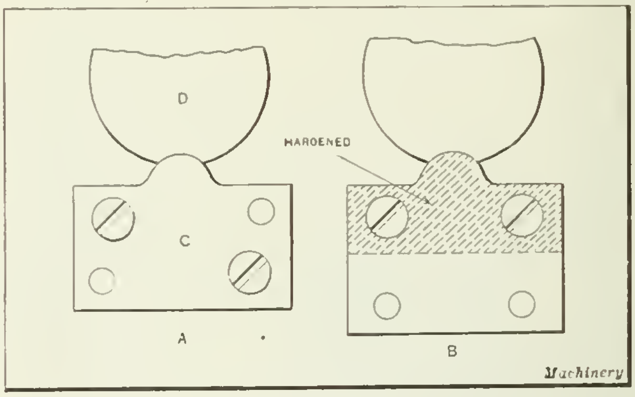


Fig. 4. Case in which the Locating Block can be hardened when the Dowels are positioned as shown at B

Drilling the Holes for the Dowels

The method of providing holes for dowels in the part to be attached and the part to which it is fastened will now be briefly dealt with. At *A*, Fig. 5, is illustrated a case in which a block *C* is to be secured in a given position on the wall of a fixture *D*. The block is first located correctly through the use of a micrometer. A C-clamp is then tightened on the parts, as shown, and the dowel-holes drilled.

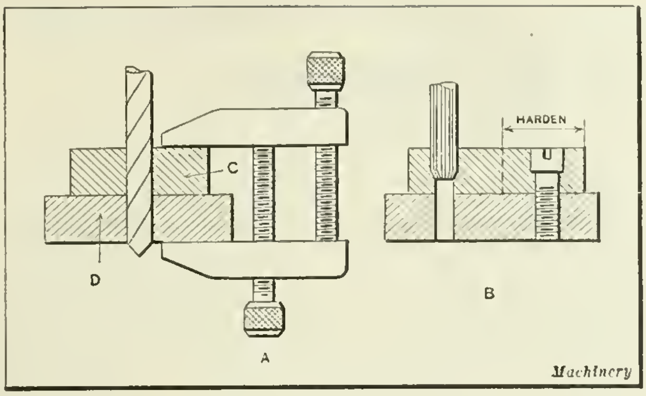


Fig. 5. Method of drilling and reaming a Hole for a Dowel

The drilling operation is succeeded by a reaming operation, as shown at *B*, after which the dowels are driven into position. This arrangement permits drilling after hardening, provided the dowels are located like those shown at *B*. Fig. 4, and the hardening operation affects only that part of the piece in which the screws are placed, the holes for which can be drilled before hardening.

* * *

MILLING CAMS FOR A TEXTILE MACHINE

A Leland-Gifford profile milling machine, changed over to perform a special groove-milling operation in racking cams for knitting machines, is shown in the accompanying illustration. This machine is used by the Leighton Machine Co., Manchester, N. H. The cams are of machine steel and have a groove in them that has four straight offsets or steps, each with a 3/16-inch throw. The cams are made both right- and left-hand, the grooves in opposite-hand cams starting at opposite sides of the faces. The cams are about 2 inches in diameter and have a wide face, and there is a hole ½ inch diameter in them. One of these cams, with its groove rough-milled, may be seen lying on the machine table.

The change in the milling machine consists of supplanting the regular machine table with a slide having a rack attached to the side and an auxiliary table which has a tongue and groove fit on the slide; the auxiliary table is held stationary by two tie-rods *F*, extending to the rear from each side. The table carries the device for supporting and rotating the cams during the milling of the groove. This mechanism consists of three journal boxes, two of which carry a 1⅛-inch hollow spindle on which the master cam *A* is secured by dowel-pins. The hollow spindle has a 2-inch thrust collar, bearing against the journal box *B*, with which the work *C* comes in contact. This construction permits a ½-inch shaft to be used to mount the work on, the shaft having its bearings in the hollow spindle at one end and in the end journal box *D* at the other. The ½-inch shaft is threaded at the end for a nut, by means of which the cam is clamped against the thrust collar.

This spindle mounting is located directly in line with the vertical center of the follow-pin *E* and the milling cutter, and is held in this position by the side tie-rods previously mentioned. The work-carrying spindle is connected by spur gearing to the rack attached to the side of the slide so that by operating handle *G* the slide is moved and the work-spindle rotated.

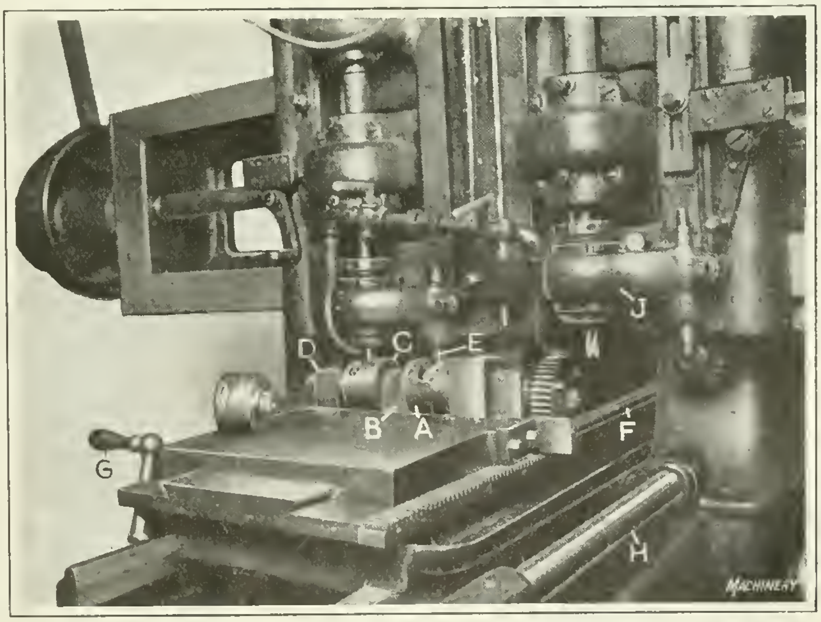
In performing this milling operation, the small shaft is first passed through the work into the hollow spindle and clamped against the thrust collar from the end. The cam is drilled on the end to fit a dowel-pin on the thrust collar, which prevents slipping. The drilling is done in a fixture, the spot for starting the cutter being drilled at the same time. The dowel-pin determines the position of the cam, as well as the starting point in relation to the master cam. In milling, the tool-head is lowered to the correct depth, using a detent stop on the cross-head. One side of the groove is milled first, keeping the follow-pin against the master groove by means of a handle on shaft *H*, until the slide comes to a stop, which indicates the end of the slot. The position of the operator is such that he can operate both handles at the same time, revolving the work and feeding the cross-head along on the cross-rail when the 3/16-inch steps are reached. The head is moved over when the end of the master groove is reached, to mill the opposite side of the groove, and the direction of the slide is reversed. The tool-head is raised to free the work, and the nut on the work-holding shaft released.

The machine has two tool-heads, one for the roughing tool and the other, *J*, for the finishing tool. A two-lip B & S stocking cutter is used for roughing, which leaves 0.005 inch stock on each side of the groove to be removed by finishing with a regular coarse-tooth high-speed B & S end-mill. The total tolerance on the width of this cam slot is 0.0005 inch. When the roughing operation on the cams has been completed, the cross-head is simply moved over to perform the finishing operation.

The master cam has two grooves so that opposite-hand cams can be milled by simply changing its position 180 degrees. To make this change, the slide is moved forward until the gear runs off the end of the rack; then the master cam can be rotated freely by hand. The sides of the master groove and the end of the follow-pin are tapered so that compensation for wear can be made by simply locating the follow-pin deeper in the master groove. The gears are made in two parts to provide for taking up lost motion due to wear; that is, two narrow-face gears constitute the full-width gear, and these may be set with the teeth slightly staggered to permit adjustment as wear occurs.

* * *

In the making of iron and steel, more power is required than in any other single industry. In 1904 this industry used 2,900,000 horsepower; in 1914, over 4,000,000 horsepower; and in 1919, 5,630,000 horsepower. Of this power 18.4 per cent was supplied by electric motors in 1904; 36.7 per cent, in 1914; and about 50 per cent in 1919. This great increase in the use of electric motors is an indication of the increase of electric motor drive, not only in the steel industry, but in all other industries.



Profile Milling Machine changed over for milling Cams

Setting Up Polishing Wheels

By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THE following recommendations for treating polishing wheels are given in detail because it is the lack of attention to apparently minor points that has been the cause of most of the difficulties met with in obtaining good results in polishing. Every new polishing wheel should be given from one to three coats of sizing, each coat being allowed to dry before the wheel is set up with abrasive and glue. The heads on polishing wheels are either rolled on or put on in paste form, and are known as "rolled heads" and "paste heads," according to the method employed.

Applying Sizing by the Pan Method

Compress polishing wheels having canvas, composition, or felt cushions, and also solid felt wheels, should preferably have the sizing applied by the so-called "pan" method. To prepare the sizing, take the liquid glue already prepared for the heading of the wheels and add three to five parts of hot water to one part of liquid glue, according to the consistency required. The sizing should be placed in a pan in which the wheel can be revolved with the cushion submerged to any depth desired. The temperature of the sizing should be 140 degrees F., and that of the wheel 110 degrees F. The number of sizing coats to be applied depends upon the kind of face required on the wheel. If a hard face is desired, more sizing is necessary than for one that is to be kept very soft and flexible. The sizing should be made a little thicker for each succeeding coat by adding the thicker heading glue, and each coat should be permitted to dry thoroughly before applying another. The second and third coats may be applied by the pan method or by brush. The wheel should then be placed on an arbor, and any uneven spots removed with sandpaper or pumice stone, care being taken not to gouge into the cushion of the wheel. After the sizing coats have been applied, one or more protective coats of heading glue of regular consistency should be brushed on, each coat being allowed to dry; then the wheel should be smoothed down, and the abrasive head put on, after which the wheel should set forty-eight hours.

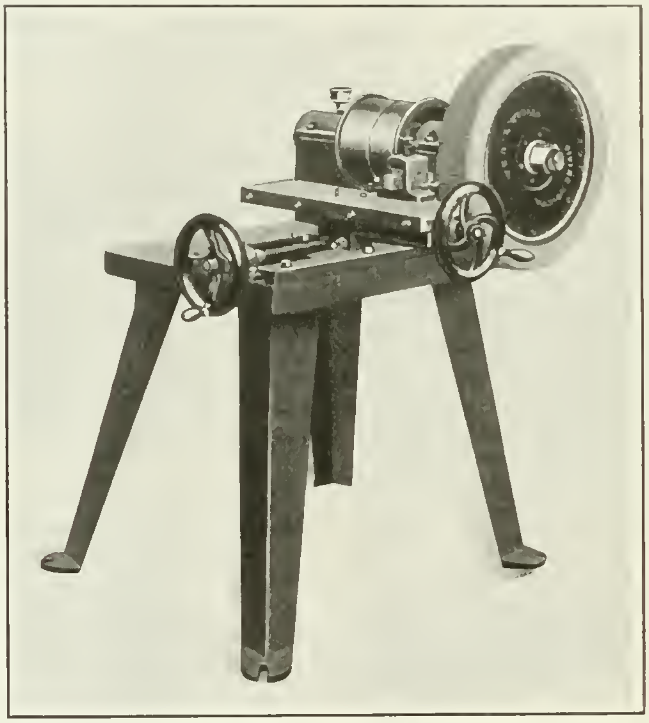


Fig. 1. Wheel-dressing Machine

Applying Sizing by the Brush Method

Compress polishing wheels having leather or paper cushions, and polishing wheels made of glued or cemented canvas or muslin, solid pressed paper, glued or cemented leather disks, solid leather, and leather-strapped wood wheels, may have the sizing applied with a brush. In this case the sizing may be somewhat thicker than when applied by the pan method. Each coat should be permitted to dry, and should be smoothed down before the succeeding coat is brushed on. Afterward the abrasive head is put on. Polishing wheels should be sized every time they are set up, but if the protective coats have not been removed, one or two coats are sufficient.

Applying Rolled Heads

Usually, for roughing and dry-fining, the roll method is used in setting up a wheel. When the wheel is set up by this means, one or two coats are all that is necessary. Two coats are generally applied when the abrasive is coarser than No. 60 grain, and one coat when the grain is finer.

The abrasive should preferably be in a metal trough, long enough to permit the wheel to roll one complete turn in it. The trough should be set on top of a steam coil or some other heating device so that the abrasive can be kept hot. The temperature of the glue should be 150 degrees F., of the abrasive 110 degrees F., and of the wheels 110 degrees F. This will allow the glue to set properly. A cold wheel or abrasive will chill the glue, impair its strength and cause shrinkage cracks. The result will be a head that will not last.

With the wheel mounted on a spindle, apply the glue with a brush as rapidly as possible, in a smooth uniform coat. Then take the wheel with the spindle and roll it in the abrasive, bearing down hard on both ends of the spindle so as to force as much abrasive into the film of glue as possible. The wheel should not be pounded in the abrasive in an effort to obtain even distribution of the grain, as this may throw the wheel out of balance. If the corners of the wheel are to be kept sharp, apply a liberal coat of glue to the sides as well as to the face, and roll it in the emery box cornerwise as well as on the face; for a very sharp corner, dress the head up on a wheel-dressing machine or lathe.

Trim off any superfluous abrasive and glue from the sides of the wheel and lay the wheel carefully on its side or hang it on a peg and allow the glue to set forty-eight hours before using. This is important and should not be overlooked, because glue will not set properly for polishing in less than forty-eight hours. Nor should wheels be dried at any other than normal room temperature. Drying or setting cannot be forced by heating the wheels after the head has been applied. If two or more coats are to be applied, allow each coat to dry before applying the next one.

Applying Paste Heads

Paste heads are used extensively for formed face wheels and for the finer grades of work where the wheels have to run true with the greatest precision possible. The formula for preparing, handling, and using glue varies with different

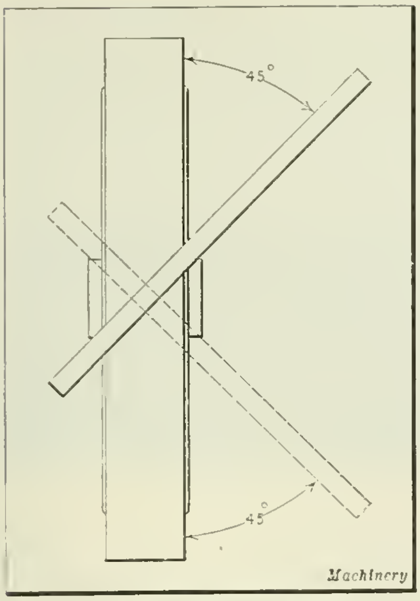


Fig. 2. Method of pounding Polishing Wheel Face to soften the Cushion

kinds of glue. One standard formula provides for adding two pounds of cold distilled water to one pound of dry ground glue. After this has soaked for three hours, bring it to a temperature of 150 degrees F. in the glue heater. When thoroughly melted, add one quart (about two pounds) of hot water, and pour into this slowly about six pounds of the abrasive to make a stiff paste. Stir constantly to prevent the abrasive from settling at the bottom. Allow the paste to cool just enough so that it can be applied to the wheel by the hands. (Other kinds of glue than that referred to in this formula may require more or less hot water and may take up more or less abrasive.)

For convenience have ready an ordinary enameled saucepan, wet the inside surface with warm water so that the paste will not adhere to it and pour into it enough of the paste to head the wheel. Have the wheel ready, either on a wheel-dressing machine, Fig. 1, or on an arbor mounted on two rigid centers so that it will rotate true. Dip the hands into warm water, take a handful of the paste from the saucepan, hold it against the face of the wheel at the top, and then slowly rotate the top of the wheel in a direction away from you, depositing the paste as evenly as possible to a depth of about 3/16 inch. The application should be accomplished in one complete revolution of the wheel. When the wheel is ready for work, the thickness of the head of paste should be from 1/16 to 1/8 inch, the life of the head being proportional to the thickness.

True down the surface by slowly rotating the wheel just one turn by hand against a flat piece of steel, if the face is to be flat. If the face of the wheel is specially formed to fit the contour of a shaped object, use a templet to fit this contour accurately. The steel and templet should be dipped in water before it is used, to prevent the glue from sticking to it, and it should be held against the wheel rigidly in the tool-holder of the wheel-dressing machine or on a rigid tool-rest, if only the arbor and centers are used. Trim the surplus paste from the sides and edges of the wheel, and put the wheel in a drying rack to set forty-eight hours before using.

A typical example of the use of paste heads on forming wheels for coarse work is the removing of flash from the handles of table knives and forks, which is a flexible grinding operation. For such work a grain as coarse as No. 36 is used. As a general rule, however, paste heads are used for the finer grades of work where flour abrasives are used, although this also depends somewhat on the finish required. For glazing table knife blades, paste heads are set up to a thickness of about 3/16 inch. This head is broken up to give a proper flexibility.

To "mellow" a wheel to obtain a soft cushion on a compress canvas or muslin wheel, after the wheel has first been set up with abrasive and glue, pound it thoroughly with a piece of 1½-inch pipe about 2 feet long. The blows should land on the face of the wheel on about a 45-degree diagonal across the face, as shown in Fig. 2. Stand the wheel on the floor or something solid, and after going around the wheel in one direction, reverse the position and go around in the other direction on the other diagonal. This will mellow the cushion to a depth of from ½ inch in the harder density to 1¼ inches in the softer density wheels, according to the force of the blow. This pounding will not damage the wheel. The operation should be repeated each time the wheels are reset until the desired softness is permanently secured, which requires from thirty to sixty days, depending on how much the wheels are in use.

Setting up Oil and Grease Wheels

In setting up wheels for oil or grease work, the cushion of the wheel should be given a coat of sizing on the sides to prevent the oil or grease from adhering to the sides of the wheels and working up underneath the abrasive and glue. Grease getting under the glue is frequently the cause of the abrasive head breaking out in spots.

Cleaning and Reheading Used Wheels

A practice that has long been followed in removing old heads of emery and other abrasives before recoating is to revolve the wheel on rollers running in water and soak off the glue, or remove it by scraping with an abrasive brick or applying mud. This practice is not recommended, and is particularly objectionable in the case of leather-covered wood wheels. Water impairs the usefulness of leather and swells the wood in leather-covered wheels, with the result that a wheel of this kind will warp and run out of true. The leather, when cleaned with an abrasive brick held in the hand, is likely to become uneven and the wheel useless. The general experience is that it is impossible to face a wheel true by using carborundum or other abrasive bricks held in the hand.

Used wheels should be removed and mounted in a lathe or wheel-dressing machine, Fig. 1, a carborundum or other abrasive brick being employed for removing the old emery. The grit of the abrasive in the dressing tool should be about two sizes coarser than that to be removed from the wheel face. For example, in dressing a wheel faced with No. 60 emery, a No. 46 brick should be used. In using any means for removing emery from old wheels, the objective striven for is a face that will run true, and it is not necessary to remove all the old emery if the wheel can be kept square without so doing. After reducing the old wheel to a condition where it can be reheaded in the same manner as when new, the methods already outlined for the setting up of a new wheel may be used in applying the new wheel head.

The fact should be constantly kept in mind that the wheel is merely the agent for carrying the cutting material, which is the abrasive, and if the wheel itself, when new, is put

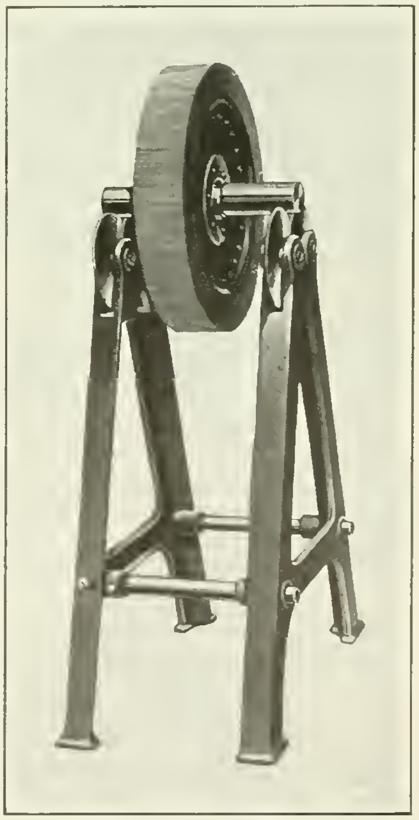


Fig. 3. Machine used for balancing Polishing Wheels

into the condition necessary for the work and kept in that condition by proper care and with the proper outfit of tools for handling it, all that remains to be done to that wheel is to dress off a light coat of the old abrasive and glue, down to the protective heads, and then reset it with a new heading. It is, however, difficult to impress these facts upon some polishers, for they are so used to the idea that all the abrasive must be removed and that the face of the wheel must be cut into to true up the wheel every so often, that they completely lose sight of the fact that it is possible to set the wheel into condition and keep it there practically forever, barring accidents.

If the wheels should become oil-soaked, they can be restored to a condition like new by removing all the glue and emery on the wheel-dressing machine or lathe, and revolving the wheel in a pan of gasoline until thoroughly saturated. Then the grease can be squeezed out by slowly turning the wheel and firmly pressing a flat piece of wood or iron against the face. Several repetitions of this, followed by running the wheel at high speed on a buffing lathe or a wheel-dressing machine to dry it, should remove all the old grease and make the wheel practically new.

Use of Arbor Press and Balancing Equipment

Polishing wheels used on tapered arbors should be carefully removed from the arbor on which they are mounted. They should never be driven off with a hammer or by pounding the end of the arbor on a block, for this batters the hub, ruins the taper, and throws the wheel out of true. With some forms of wheels this is especially likely to spring the wheels out of true. For this work the use of a deep-throat arbor press is recommended so that the wheels may lie flat on the bed of the press, thus preventing injury to the polishing cushion.

After the wheels have been set up and allowed to dry thoroughly, they should be returned to the polishing room and balanced in a good balancing machine. A satisfactory machine for this purpose is the type in which the shaft or arbor of the part to be balanced rests on two pairs of disks mounted in ball bearings (see Fig. 3). The practice of tacking lead weights to the side of a wheel to bring it into balance is not satisfactory. This is dangerous, and many serious accidents have occurred from the lead flying off. The system of putting metal tubes through the wheels near the face for the reception of lead wire is better, safer, and insures greater accuracy. Balancing requires a great deal of time, and must be done by a man who is especially experienced in this work. Accurate balance in polishing wheels is a necessity, because a wheel that is out of balance cannot make smooth contact with the work. It will chatter, and fine work cannot be produced with it.

* * *

COMMON FALLACY IN THE CALCULATION OF EXTENSION SPRINGS

By J. W. ROCKEFELLER, Jr.
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In computing the maximum fiber stress in a helical spring due to an imposed load, the following formula, as set forth in a variety of forms in many handbooks, is often used for springs made from round wire or rod.

$$F = \frac{WD}{0.4d^3} \qquad (1)$$

in which F = torsional fiber stress in pounds per square inch;
W = imposed weight, in pounds;
D = mean diameter of coil in inches; and
d = diameter of wire in inches.

The formula given above is an approximation deduced from the following general formula for fiber stress obtaining in torsion,

$$F = \frac{TR}{J} \qquad (2)$$

in which T = imposed torsional moment, in inch-pounds;
R = radius of rod or wire; and
J = polar moment of inertia of a cross-section through the rod or wire.

While the use of these formulas is permissible for the calculation of compression springs, it frequently happens that trouble results when the same basis is used for determining the safe load of extension springs having a hook at one or both ends. The reason that the formulas should not be applied to extension springs having a hook is that, quite apart from the torsional fiber stress obtaining in every coil, there exists at the base of each hook a fiber stress due to combined bending and tension. The magnitude of this stress is more than twice that in the coils. A close approximation of this stress may be made by using the following formula:

$$f = \frac{MR}{I} + \frac{W}{A} \qquad (3)$$

in which f = fiber stress due to bending and tension;
M = bending moment, in inch-pounds, to which the hook is subjected $\left(\frac{WD}{2}\right)$;
R = radius of wire, in inches;
W = weight imposed, in pounds;
I = moment of inertia of a cross-section of the wire about its neutral axis; and
A = area of wire cross-section, in square inches.

As a concrete example of the variation of Formulas two and three, consider the stresses in a spring made of 2-inch diameter wire, having a mean coil diameter of 6 inches, and supporting a load of 10,000 pounds.

The torsional fiber stress in the coils, by Formula (2) is:

$$F = \frac{30{,}000 \times 1}{1.5708} = 19{,}100 \text{ pounds per square inch.}$$

The fiber stress at the base of the hooks, by Formula (3) is:

$$f = \frac{30{,}000 \times 1}{0.7854} + \frac{10{,}000}{3.1416} = 41{,}380 \text{ pounds per square inch}$$

* * *

INVESTIGATION OF GAGE STEELS

The Gage Steel Committee of the Bureau of Standards is investigating three important problems in regard to the improvement of steel for gages, namely, resistance to wear, dimensional changes due to hardening, and time changes. As yet the investigation of the wearing qualities of gage steels has been confined to a study of the apparatus used for this work, and to the improvement of this apparatus so that all factors can be controlled in order to insure uniform standardized test conditions.

In testing for dimensional changes due to hardening, it was found that surface oxidation may easily result in a scale forming which causes a greater change in size than is expected. If the scale is removed, some metal is lost and the change recorded is less than that due to hardening. Thus the changes due to hardening may be completely hidden by the scaling effect. However, by allowing illuminating gas to flow into the furnace at a rate just sufficient to burn the air leaking in, oxidation is prevented.

The specimens on test are now being held and measured occasionally for dimensional changes due to time. Treatments are also planned to bring out the significant facts in relation to ageing. Sufficient time has not yet elapsed to permit any conclusions to be drawn. The complete report (known as Third Progress Report) may be obtained from the Gage Steel Committee, Bureau of Standards, Washington.

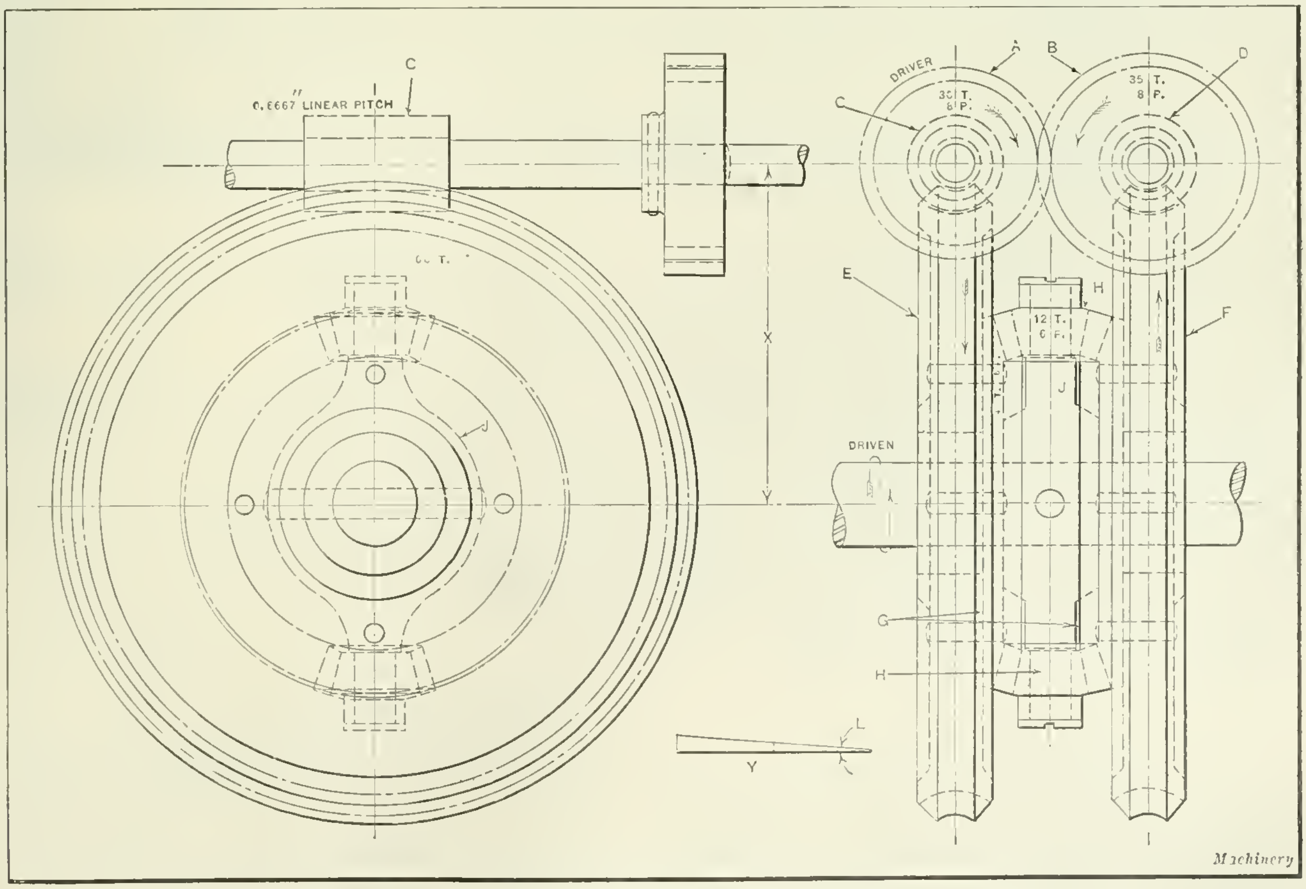
Letters on Practical Subjects

DIFFERENTIAL MECHANISM FOR LARGE SPEED REDUCTION

In machine design large reductions in speed are often obtained by the use of a differential mechanism, especially when the reducing unit must occupy a comparatively small amount of space. A differential mechanism in which a reduction of 840 to 1 is secured by using only two spur gears, two worms, two worm-wheels, two bevel gears, two bevel pinions and a yoke, is shown in the accompanying illustration. The reduction ratio of this gearing may be altered to suit conditions by simply varying the number of teeth in the two spur gears. Dimension *X* is approximately 7⅛ inches on this particular lay-out.

Spur gear *A* is the driving member of the differential unit. It is mounted on the same shaft as worm *C*, and through these two parts drives worm-wheel *E*. Gear *A* also meshes with gear *B*, and thus drives a shaft running parallel to that on which it is mounted. On the second shaft is a worm *D* by means of which power is transmitted to worm-wheel *F*. Gears *A* and *B* revolve in opposite directions, and as the thread of both worms is right-hand, worm-wheels *E* and *F* also rotate in opposite directions. Pinned to the adjacent sides of the two worm-wheels are bevel gears *G*, which, together with their respective worm-wheels, are free to turn on the driven shaft. These bevel gears mesh with two idler pinions on studs at opposite ends of driving yoke *J*, which is pinned to the driven shaft. The idler pinions are held on the studs by means of screws.

The large reduction obtained by this unit is due to giving spur gear *B* five more teeth than gear *A*. As a consequence, gear *B* makes only 30/35 revolution per revolution of gear *A*. The ratio of each set of worm-gearing is 60 to 1, and so for each revolution of gear *A*, worm-wheel *E* makes 1/60 revolution. The 30/35 revolution imparted to gear *B* at the same time causes worm-wheel *F* to turn 1/70 revolution



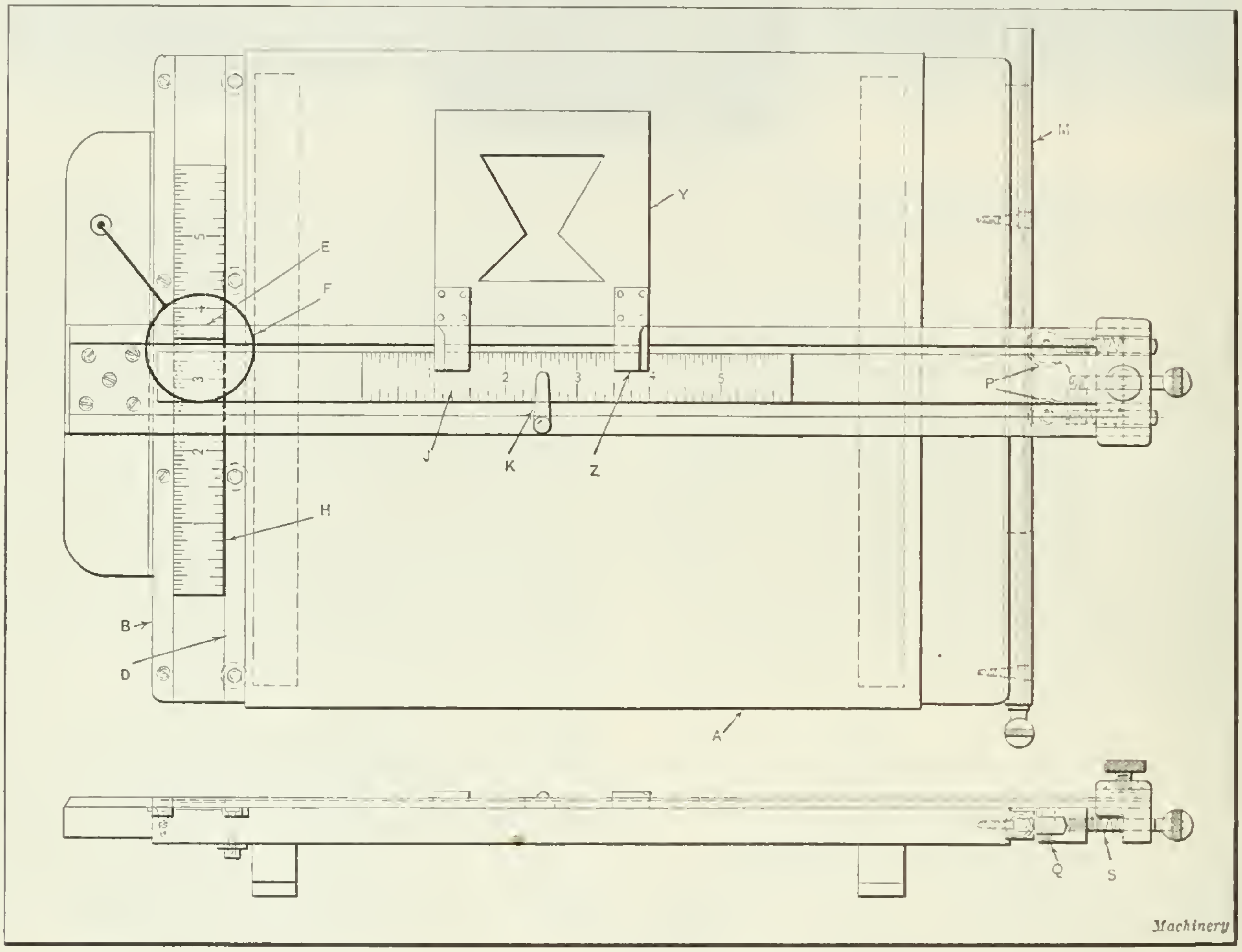
Geared Mechanism for obtaining a Speed Reduction of 840 to 1 within a Small Space in the opposite direction to that in which worm-wheel *E* is revolved. Because of the two worm-wheels revolving in opposite directions, the result on yoke *J* is the same as if worm-wheel *F* were held stationary and worm-wheel *E* were moved the difference between 1/60 and 1/70 revolution. This would mean a forward movement of worm-wheel *E* of 1/420 revolution.

As the center of driving yoke *J* is located half way between bevel gears *G*, the actual movement of the yoke per revolution of gear *A* will be only one-half the difference between the forward and backward movements of the two worm-wheels, or 1/840 revolution. This can be easily proved by constructing a triangle as shown at *Y*, in which the line adjacent to angle *L* represents the pitch diameter of pinions *H*, and the length of the opposite side equals the distance that a point on the pitch circle of the bevel gear on worm-wheel *E* would move during 1/420 revolution. Then if the adjacent side is bisected and a perpendicular is erected at that point, the length of the perpendicular will be one-half the length of the opposite side of the triangle; this perpendicular line will equal the distance a point on the center line of the yoke, located from the center of the driven shaft a distance equal to the pitch radius of bevel gears *G*, will move during the movement of the bevel gear on worm-wheel *E*. This yoke movement equals 1/840 revolution.

Fitchburg, Mass. E. E. Lakso

DRAFTING DEVICE

A drafting device that can be made in sizes especially suited to the needs of the field engineer or in larger sizes adapted for general use in the drafting-room is shown in the accompanying illustration. The T-square can be moved up and down freely and can be readily detached from the drawing-board. The construction of the device is such that the T-square is held in contact with the side of the board, thus insuring accuracy in the parallelism of all lines drawn along the guiding edge of the T-square blade.



A Drafting Device of Compact and Convenient Design

While the general construction of the device is shown quite clearly in the illustration, there are a few points that may require a brief explanation. The left-hand edge of the drawing-board *A* is recessed to receive the guide strip *B* and the adjacent strip *D*, which is slightly tapered. Both strips *B* and *D* are made from sheet brass or aluminum 0.125 inch thick, and are set into recesses so that they are flush with the top of the board. The steel scale slides between pieces *B* and *D*. The tapered strip *D* is adjusted so that the scale can be moved up or down by the fingers without any perceptible side motion. Scales *H* and *J* for a small or medium size outfit may be the regular Brown & Sharpe 6-inch size, 11/16 inch wide, and 0.050 inch thick. Longer scales should be employed for outfits of larger sizes. The position of the scales can be changed in the grooves, so that ⅛- and 1/16-inch or 1/32- and 1/64-inch graduations will be in the working position. Metric scales can also be used when necessary.

A recess 11/16 inch wide and 0.050 inch deep is cut in the T-square blade to receive scale *J*. This scale must slide freely without any side play and it must be flush with the top of the T-square blade. A spring *K* adjusted to the proper tension holds this scale in place to prevent it from being accidentally moved in the groove.

A slot 1/16-inch deep at the right-hand end of the drawing-board receives the T-square retainer guide *M*. This guide is made from square, cold-rolled steel or brass rod, and has a vee planed in one side to form a track for the two rolls *P*. The guide *M* is slotted in two places to allow it to be extended two inches below the lower edge of the board when lines are to be drawn close to this edge. The rolls *P* of the T-square retainer are held in position by screws *Q*, and the required tension is obtained by means of the two helical springs *S*.

The triangle *Y* is of unusual design, being made square, so that all of the four sides can be used, and cut out in the center to provide pencil guiding edges located at angles of 45, 30, and 60 degrees with the edge of the T-square blade. This triangle can be made from vulcanite or any suitable composition, and should be about 0.1 inch thicker than the blade of the T-square so that the two indicators *Z*, which are made from the same material, will slide over the top of the blade. These indicators are fastened to the triangle by means of four small screws or rivets. The working edges of these indicators, as well as the edge of the T-square at *E*, are beveled to facilitate the setting of the T-square and triangle by means of the graduated scales. A small magnifying glass *F* may be fastened to the head of the T-square as shown, so that it can be swung into position over the beveled parts *E* when accurate location of the T-square blade is necessary.

Bridgeport, Conn. B. R. WICKS

MAKING AND USING A PRICK-PUNCH INDICATOR

Great care is required in laying out drill jigs, templets, etc., when the accurate spacing of holes is necessary. While the button system of locating holes is used by nearly all toolmakers when very accurate results are required, the method is a slow and tiresome one. Accurately spaced prick-punch marks can often be used to locate holes. This method is quicker than the button method, and for certain classes of work will give sufficiently accurate results. Dividers are sometimes used to check the accuracy of prick-punch lay-outs, but this permits a chance for inaccuracies to develop, particularly when springy dividers are used.

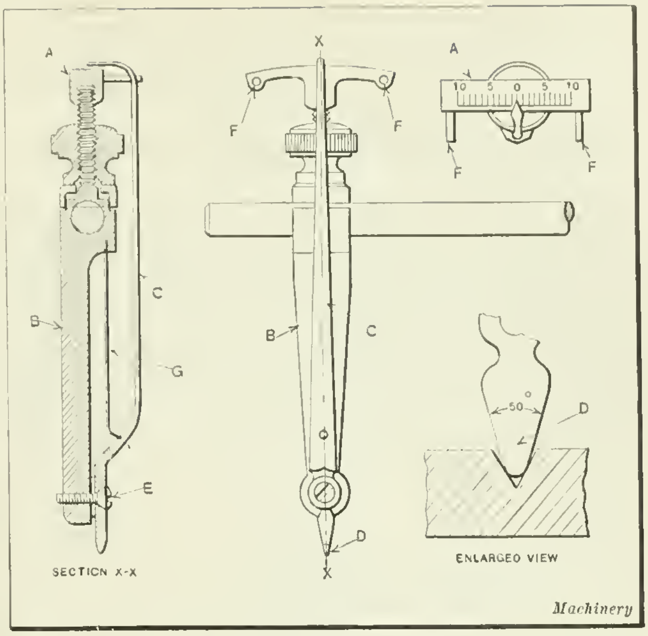


Fig. 2. Prick-punch Indicator

The prick-punch indicator described in this article will enable anyone to lay out accurately and check for accuracy any common prick-punch lay-out. The design of the indicator is such that it can be used with the ordinary type of metal beam dividers. A special head *B* of the same general dimensions as the end head of the beam dividers is made up as shown in Fig. 2. The screw portion of the head is made considerably longer than on the regular divider point, and on the top of this extended screw is located the graduated head *A* of the instrument. An indicator needle *C* made of thin steel spring stock and terminating in a rounded point *D*, as shown in the enlarged sectional view in the lower right-hand corner of the illustration, is attached to head *B* by the small screw *E*. Screw *E* serves as a pivot for needle *C*. The foot or end of the needle should be made to the exact shape shown in the enlarged view. If a pointed end were used instead of a rounded one, inaccuracies would occur.

The graduated head *A* has two small pins *F* in the ends of the head segments, which limit the travel of the needle point. The head is graduated in ten divisions on each side of the zero line, the length of the needle and the position of the pivot screw *E* being such that each graduation represents a movement of 0.001 inch at the point where the foot *D* is in contact with the prick-punch mark. A piece of music wire *G* is fastened to part *B* for the purpose of centralizing needle *C* so that its indicating point will normally rest on the zero mark.

The importance of carefully forming the foot *D* to the shape indicated cannot be over-emphasized. As most toolmakers and machinists grind their prick-punches to an included angle of 60 degrees or more, the angle of the foot must be somewhat less. An angle of 50 degrees is about right for use in prick marks made with a punch ground to the usual 60-degree angle. The rounded or spherical end of foot *D* allows this member to bear on all sides of the prick-punch mark and not on the bottom.

In Fig. 3, the indicator is shown in position for checking the distance between prick-punch marks *H* and *J*. The indicator can also be used to check the spacing of the six prick-punch marks shown. For instance the distance between prick marks *H* and *K* can be checked, the same as the distance between prick marks *H* and *J*.

Two methods can be used in setting the fixed and the indicating points to check a given dimension. One is to make a special setting tool from a 12-inch length of square key stock. This piece of stock is fitted with a fixed and a sliding head, as shown in the upper view of Fig. 1. Both the fixed and the sliding head have accurate centers *M* in which the fixed and indicating points of the indicator are placed in making a setting. The centers *M* in the blocks are so located that

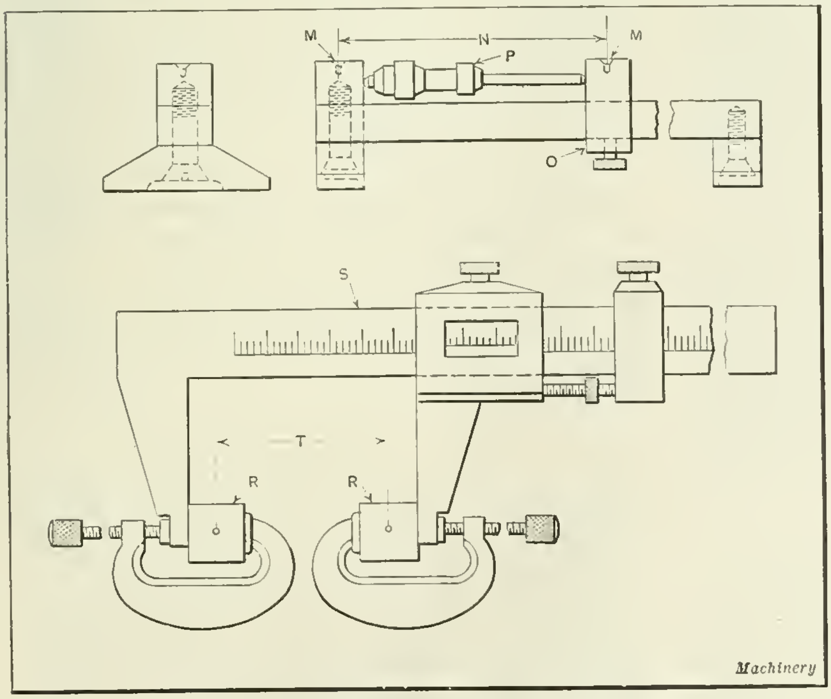


Fig. 1. Methods of setting the Indicator to a Given Dimension

½ inch must be added to the reading of the inside micrometer *P* to obtain the exact dimension *N*. An ordinary steel scale can, of course, be used in place of the inside micrometer when a high degree of accuracy is not required.

Another method of setting the indicator is to use two ½-inch square tool-steel blocks such as shown at *R* in the lower view of Fig. 1 in conjunction with a vernier caliper *S*. The sum of ½ inch must, of course, be added to the vernier reading to obtain the actual distance *T* between the two prick-punch marks in the blocks clamped to the measuring ends of the micrometer. The prick-punched lay-out which has been checked with an indicator as described, is accurately located on the faceplate of the lathe for drilling and boring by employing the ordinary type of center indicator. When the needle of the center indicator shows no movement, the workman can be assured that the piece is accurately centered for drilling. This type of indicator eliminates the necessity for drilling and tapping small holes previous to the regular drilling operation, as is necessary when the button method is employed.

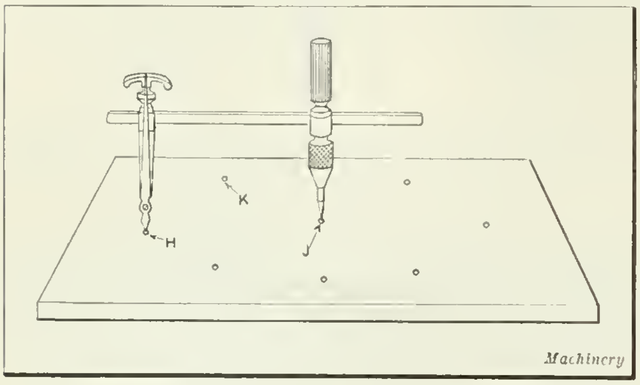


Fig. 3. Method of checking Spacing between Prick-punch Marks

Allentown, Pa. Joe V. Romig

THE USE OF PHOTOSTAT PRINTS

A mistaken idea regarding the cost of photostat prints seems to be prevalent in many drafting-rooms and engineering departments. The opinion seems to be quite general that the photostat method of copying such matter as cannot be readily blueprinted is in use only by the Government and large corporations. There is no doubt that the photostat process is invaluable for making copies from pages of catalogues and untraced drawings. In the writer's opinion, however, the greatest value of this process in industrial work is in making standard size reproductions of large or assorted sizes of drawings. Photostat prints, thus made to some standard size, can be readily bound or conveniently carried in loose-leaf form.

During the war a certain firm regularly made more than 100 photostat prints daily. These prints were all 18 by 12 inches in size, and the average cost was from ten to fifteen cents each. At the time these prints were made the chemicals used in the photostat process were high in price, but the cost is somewhat lower now, and even though the cost of photostat prints is still somewhat higher than that of blueprints, the advantages of the former process as stated in the preceding will in many cases more than offset the difference in cost. S. N. Bacon

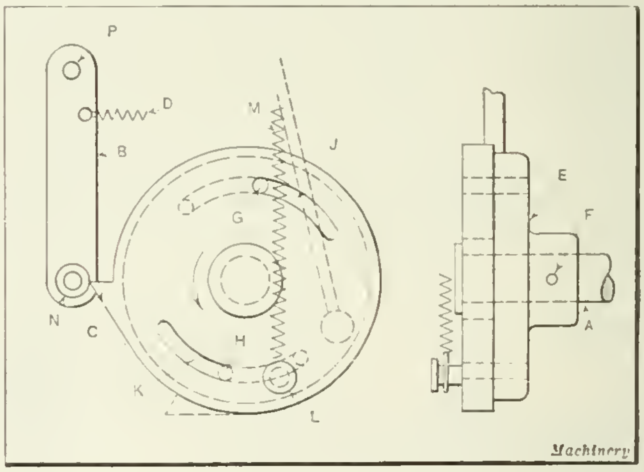
STARTING AND STOPPING DEVICE

It is an easy matter to provide a means of stopping a machine with its own power by the use of a cam or some similar mechanical device, but it is a more difficult problem to design a device that will automatically stop a machine and start it again so that it is only momentarily brought to a full stop. With the usual type of device designed simply to shut off the power, there is no stored up energy that can be utilized to start the machine again without attention on the part of the operator. In the accompanying illustration is shown a simple and efficient device for shutting off the power momentarily in a purely automatic manner.

The shaft *A* is a part of the machine that rotates while the machine is in operation. When it is desired to stop the motive power, latch *B* is moved to the left, pivoting about pin *P*. The machine is started again by moving latch *B* back to the right-hand position. The problem is to provide a means of throwing latch *B* to the left or stopping position and then back again to the running position without attention on the part of the operator. The latch can be readily moved to the left by means of a cam, such as shown at *C*, but the instant that the cam has so acted the machine will stop, and the cam will be left in such a position that the lever cannot be moved back to the starting position, either through the action of a spring, such as shown at *D*, or by other means.

To overcome this difficulty, shaft *A* was provided with a flange member *E* secured by the pin *F*. The cam member *C* is free to turn on shaft *A*, but its movement relative to flange *E* is limited by two pins *G* and *H*, which are driven into flange *E* and allowed to project through the slots *J* and *K* in the cam member. On the cam member is a stud *L* to which is secured one end of a spring *M*, the other end being secured to some part of the machine.

When shaft *A* travels in the direction indicated by the arrow, the flange *E* will drive the cam member *C* in the same direction. As the pin *L* reaches its highest point and begins its descent, it will act against the pressure exerted by spring *M* until the instant that pin *L* passes a vertical line through the center of the shaft. At this point spring *M* will accelerate the movement of the cam member and not only push lever *B* to the left, thus bringing the machine to a stop, but will also carry the point of the cam past the roller *N*, so that lever *B* will be returned to its original position by the action of spring *D*. The machine will thus be started automatically after having been stopped for an instant.



Automatic Starting and Stopping Device

Poughkeepsie, N. Y. J. J. Thompson

* * *

The production of alloy steel increased almost tenfold between 1909 and 1920. In 1909 the total production of alloy steel was 181,000 gross tons, while in 1920 it was 1,660,000 gross tons. The production fell off in 1921 due to the industrial depression, but it is of interest to note that it did not fall off quite as much, proportionately, as the total tonnage of all classes of steel. From 1918 to 1921, inclusive, the production of alloy steels averaged about 4 per cent of the total steel production of the country. In 1909, it was only 0.75 per cent.

Questions and Answers

WAVY LINES IN DIES

J. H. B.—What would be the simplest way of cutting wavy lines in dies for postage stamp cancellation machines to produce a wavy canceling line on the stamp and envelope?

PROPER SUBJECT MATTER FOR A TRADEMARK

S. E. E. Co.—Will you please tell me what constitutes a proper subject matter for a U. S. trademark?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

A trademark is an arbitrary sign, word, or symbol used to distinguish one manufacturer's product from that of another, and to impress a particular article on the mind of the public. A trademark must not in any way be descriptive of the product nor should it be in the least deceptive. For instance, if a trademark for a soap were claimed on the word "Magnetic," the claim would be rejected on two grounds. First, because soap could not be magnetic, and so the word would be deceptive and misleading, and second, because the term would be descriptive if correctly employed. A proper name, geographical term, or the name of cities, etc., also cannot be used as trademarks.

The first letters in the words of a company's name are frequently used with the abbreviation of company. In your case the coined word "Seeco" would result, and as this word is arbitrary and meaningless, it would be proper subject matter for a trademark, provided it had not been used by another prior to your adoption and use of it.

HORSEPOWER TRANSMITTED BY WORM GEARING

S. D. J.—What general rule or formula is used for determining the horsepower transmitted by worm-gearing and to what extent, if any, is the power-transmitting capacity affected by the number of threads on the worm?

In determining the allowable load for worm-gearing, the danger of overheating and of abrasion are usually of greater importance than the strength, because if the gearing is so proportioned as to prevent abrasion and overheating, the strength will ordinarily be greater than is required merely to withstand the stresses due to the load. Overheating is the cause of most worm-gear failures. It indicates that the frictional loss is so great that the heat is generated faster than it can be dissipated; consequently the action of the lubricant becomes less effective as the temperature rises, which, in turn, causes a further increase in frictional resistance. Finally, the oil film between the surfaces and contact is no longer maintained and abrasion begins. It is evident that there is less danger of overheating and abrasion with lower velocities and intermittent service, and also when a lubricant of good quality is used.

In designing worm drives, the worm diameter should be as small as possible to reduce the velocity. If the worm diameter is unnecessarily large, the gearing may become hot and start to cut. Another important point is to use a multiple-threaded worm in preference to a single-threaded worm whenever conditions permit, to increase efficiency.

For determining the power that worm-gearing will transmit without danger of excessive heating or abrasion, the Foote Bros. Gear & Machine Co. recommends the use of the Lewis formula for spur gears, the calculations being based on the velocity of the worm-gear. For instance, when using the formula for spur gears given on page 202 of November MACHINERY, as Formula (2), in the article "Mechanical Transmission of Power," insert the velocity of the worm-gear in feet per minute, its diametral pitch, and face width. This width, as measured along the pitch circle may be determined as follows: Multiply the pitch radius of the worm by a value L (see the table on page 62 of MACHINERY'S HANDBOOK) corresponding to the face angle of the worm-wheel.

It will be noted that the application of the Lewis spur gear formula to worm-gearing does not allow for the kind of worm used, that is, whether it is single- or multiple-threaded. There is, however, an increase in the efficiency of worm-gearing as the helix angle of the worm-thread is increased, although this does not amount to much for angles larger than 25 or 30 degrees. If the coefficient of friction is, say, 0.040 and the helix angle of the worm is 10 degrees, the efficiency will be about 0.81 per cent, whereas if the helix angle is increased to 20 degrees, the efficiency will be about 0.89 per cent. The frictional loss per single revolution of a single-threaded worm will be about the same as for a double-threaded worm, but since the latter rotates the worm-wheel at twice the velocity, double the power may be transmitted for approximately the same frictional loss, thus increasing the efficiency.

In actual practice, the gain through the use of multiple-threaded worms, as compared with single threads, varies according to the helix angles, as previously intimated, and differences in efficiency are also much less for the lower coefficients of friction. The latter, in turn, vary according to the quality of lubrication, and the mechanical excellence of the gearing or the grade of workmanship. These factors are subject to considerable variation, but since their effect on the amount of power transmitted (under average conditions regarding helix angles and lubrication), would not be excessive, the helix angle of the thread and the theoretical efficiency of the gearing are disregarded, in order to make use of the comparatively simple Lewis formula. Moreover, this formula as applied to worm-gearing provides a margin of safety which covers all reasonable variations in practice. Thus, the power-transmitting capacity obtained by this formula applies to single-threaded worms having at least adequate grease lubrication. Consequently, any increase of efficiency due to the use of a multiple-threaded worm and possible oil bath lubrication simply provides an overload capacity or a greater factor of safety than allowed for by the formula.

Frequently the safe working load on the teeth is desired rather than the horsepower that may be transmitted. The working load may be determined by multiplying the number of horsepower (as obtained by the Lewis formula) by 33,000 and dividing the product by the velocity of the worm-wheel in feet per minute.

The efficiency of worm-gearing (neglecting bearing losses) may be obtained accurately enough for practical purposes by dividing the lead by the lead plus the product of the coefficient of friction and the pitch circumference of the worm. The efficiency may also be obtained by dividing the tangent of the helix angle (measured perpendicular to the axis of the worm) by the tangent of the helix angle plus the coefficient of friction.

When the coefficient of friction equals the tangent of the helix angle, the gearing is self-locking and the worm cannot be rotated by the wheel. Owing to friction in the bearings, the gearing might be non-reversible or self-locking for larger helix angles than indicated by this rule.

Economics of the Machine Tool Industry*

By ERNEST F. DuBRUL, General Manager, National Machine Tool Builders' Association

FOR many centuries even the most progressive nations had to apply most of their muscle power to producing food, shelter, and clothing, and so did not have much time to produce comforts or luxuries. About 1760 began the series of great industrial inventions that changed hand industry into machine industry. While these inventions increased the supply of manufactured goods, food production continued to require mainly muscle power for another eighty years, until McCormick's inventions supplanted, by mechanical appliances, the muscle power and skill of many agricultural laborers. One man thereafter could raise food for many besides himself and his family, surplus labor was released from farming, and manufacturing began to grow rapidly. Increasing efficiency of farm machinery will continue to release more men from the necessity of raising food, and allow them to earn better livings working in factories than they could earn on less productive farms.

An impression of the rapid growth in productivity may be obtained from a comparison of the estimated value of manufactures, which in 1812 was $170,000,000 for the United States, whereas in 1919 it was over $62,000,000,000. Of this total, nearly one billion represented industrial or shop machinery alone, not counting electrical equipment, automotive or other vehicles, tractors, agricultural machinery, railway cars, and locomotives. Of the industrial machinery, machine tools form the largest class, which is about twice as large in value as the next largest class—textile machinery.

Basic Position of Machine Tool Industry

Because the blacksmith made the tools for all the other workers who built the temple of Solomon, the legend is that King Solomon honored the blacksmith above all the other workers. The modern machine tool builder now stands in that blacksmith's place, producing the master tools for all other crafts.

In the following an outline picture will be given of the machine tool industry, by an analysis of the statistics of the census of manufacture of 1919. First, let us see how the shops that make the master tools compare in relative size with all the factories that make all the goods the country produces. The census gives the number of establishments, capital employed, value of the product, costs of material, fuel, power, wages, salaries, contract work, rents, taxes, number of wage-earners, and number of salaried employes.

Analysis of Census Figures

By analyzing the figures of the census we find that the average machine tool shop is about four times as large as the average factory of all industries as judged by the items of capital, number of wage-earners, added value, wages and salaries. As to material used, however, the figures are more moderate, because the machine tool builder takes relatively crude material, and with skilled labor and inventive brains transforms it into a product of high utility and value.

The size of his shop shows the machine tool man to be a good manager, and other things confirm this. He paid his men better than the average factory employe was paid elsewhere, but his salary roll was considerably less in proportion, and the number of supervising personnel is also proportionately smaller. While salaries formed 27.3 per cent of the payroll of the average shop, they are only 21 per cent of the payroll of the machine tool shop.

The item of value added by manufacturing processes is the index of manufacturing activity. This item excludes the value of the material from the total value. The manufacturer's function is to convert material into finished product. Of this added value, the machine tool salary roll was only 11 per cent while the average for all factories was 16 per cent, so evidently he was not extravagant in that particular. As to federal taxes, the machine tool builder paid more than his share, whether figured on "per shop" basis or on "per wage-earner" basis, or as a percentage of what was left after deducting the cost of material and wages.

After taking out of the total value all the amounts specified, there still remains a balance. This is designated as "residue," for want of a better term. As the census figures do not go into further detail, we can only say that this residue includes costs like depreciation, obsolescence, insurance, advertising, repairs, interest, legal and patent costs, auditing, traveling, and all other expenses not covered by the specific expenses mentioned. It would be proper to deduct from this an allowance for interest on capital invested, which in 1919, at the going rate, was easily 7 per cent. This would allow the average shop $19,720, and the machine tool shop $82,361, although the machine tool builder used $600 less capital per wage-earner than the average shop.

Value Added by Manufacturing Processes

The average manufacturer took $4100 worth of material and fuel per wage-earner in 1919, and by processing, added to it $2752 worth of utility, or 66 per cent. But the creative machine tool builder took $1100 worth of material per wage-earner, and added $2887 or 262 per cent of utility to it. As the real function of all manufacturing is to add utility, it would seem fair to compare them by using, as a base, the value added. To produce $100 of added value at the market price of his goods, the average manufacturer employed $177 of capital against the machine tool builder's $150. The average manufacturer used $149 worth of material against the machine tool builder's $38. It cost them both about the same for the expenses specified, except that federal taxes took $3 more out of the machine tool builder. If now we allot 7 per cent interest on the capital invested in each case, the average manufacturer had a net residue somewhat greater than the machine tool builder.

Influence of Size of Shop

If the machine tool shops are classified according to the annual value of their product, some interesting conclusions may be drawn. The small residue per wage-earner left in shops below the $100,000 line is hardly enough to pay interest, to say nothing of allowing for other expenses and profit. The men who have these small shops seem to be taking a chance that they can ill afford. Yet 44 per cent of the machine tool builders were doing that very thing. In the same classes, under "All Industries" there was a bigger percentage of small shops, but they apparently had a bigger residue per wage-earner, indicating a better chance to succeed on a small scale in shops other than machine tool shops. It is also worth noting that in each class, the residue per wage-earner is less in machine tool shops than the average for manufacturing plants.

The accompanying table throws some interesting light on the concentration of industry in large establishments.

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*Abstract of a paper read before the Philadelphia Section of the American Society of Mechanical Engineers, February 27, 1923.

While there are many small shops, the greatest bulk of production is in shops turning out $1,000,000 worth of product or more. While the shops turning out less than $100,000 per year in all industries are nearly 80 per cent of the general total, they employ only 12 per cent of the wage-earners, and produce less than 10 per cent of the added value. The smaller machine tool shops, almost 44 per cent of the number, produce only 3 per cent of the added value with 4 per cent of the wage-earners. About 70 per cent of the added value is produced in about 13 per cent of the machine tool shops that averaged $2,000,000 of added value, and $3,000,000 of capital. Every one of these concerns was started on a small scale, but today the machine tool business has reached such magnitude that a small business is greatly handicapped. If a man has only a little capital, he had better hunt somewhere else for a place to exercise his talents, rather than start a new machine tool shop.

Problems of Management of Machine Tool Shops

The fluctuating nature of the demand for machine tools creates serious problems. It is evident that the more regular an industry's demand, the lower can be its costs and the easier its managerial problems. The peculiarities of human nature, as manifested in business cycles, compel the builder of machine tools to face relatively short and sharp peaks of activity, followed by relatively long and deep depressions. The industry, therefore, has a naturally bad load factor, for some very human reasons. The first is that most people do not look very far ahead, and most machine tool users are not different in that particular. Therefore, comparatively few users forecast their machine tool requirements to any great extent. In a period of depression, the user's shop is more or less idle, and he has more than enough machinery to supply the restricted demand for his own goods. He is mentally so depressed by dull business that he cannot bring himself to even think of a time just a few months ahead when his business will be more active, and when the natural growth of business will demand more of his goods than he was able to make in his last boom. Not forecasting what the future has in store, and how long the depression in his own business will last, he simply will not spend money on plant improvements when he could be making them to the best advantage.

COMPARISON BETWEEN FACTORIES OF DIFFERENT SIZES IN MACHINE TOOL AND ALL INDUSTRIES

Basis of Comparison	All Industries						Machine Tool Industry					
	Size of Plant, by Value of Product					Total, Per Cent	Size of Plant, by Value of Product					Total, Per Cent
	$20,000 or Less	$20,000 to $100,000	$100,000 to $500,000	$500,000 to $1,000,000	Over $1,000,000		$20,000 or Less	$20,000 to $100,000	$100,000 to $500,000	$500,000 to $1,000,000	Over $1,000,000	
No. of establishments, per cent......	52.7	26.8	13.7	3.2	3.6	100	16.4	27.3	33.2	10.2	12.9	100
No. of wage-earners, per cent.......	3.2	8.7	18.9	12.3	56.9	100	0.5	3.7	15.3	13.6	66.9	100
Capital employed, per cent..........	1.8	5.7	14.4	10.4	67.7	100	0.3	2.8	15.0	13.1	68.8	100
Value of product, per cent..........	1.8	5.7	14.4	10.4	67.7	100	0.3	2.8	15.0	13.1	68.8	100
Material and power, per cent........	1.2	4.9	13.0	9.6	71.3	100	0.4	3.5	17.3	13.2	65.6	100
Value added by manufact., per cent.	2.6	7.0	16.6	11.5	62.3	100	0.3	2.6	14.0	13.0	70.1	100
Wages paid, per cent...............	3.2	8.7	18.9	12.3	56.9	100	0.5	3.7	15.3	13.6	66.9	100
Salaries, rents, contract work, federal and state taxes, per cent...	0.1	1.8	12.7	12.8	72.6	100	2.1	5.7	14.9	11.0	66.3	100
Residue (net), per cent.............	2.3	5.8	15.2	11.2	65.5	100	0.0	1.3	12.4	12.1	74.2	100

Machinery

Only as his orders become decidedly plentiful, does the user of machine tools think of replacing old equipment or adding new equipment. The necessity for more production rather than the desire to lower costs seems to lead most men to buy new machines. Because the newer types are of greater productive capacity than the old ones, cost reduction follows, but this seems to be merely an incidental benefit in the buyer's mind. Only when his own orders press him does he order new equipment, hesitatingly at first, then with greater confidence, then with insistence, and at the height of a boom, perhaps with reckless abandonment of caution. When he realizes that the end of his own boom is in sight, he not only stops ordering machinery, but may even try to cancel orders that were previously given.

A Business of Booms and Depressions

Consider now the difficulties of the machine tool builder in trying to regulate his operations. At the height of his own previous boom, he had as full a force of men as he could get, working night and day. He had also placed a lot of contracts for castings and other material, far in advance, in large quantity, at high prices, to be able to supply his customers' wants without delay. Even though he had been quoting six to eighteen months delivery, his orders had been piling in on him with increasing speed. When his orders began to fall off, he had this large inventory thrown on his shoulders. Then he received many cancellations from people who should have been compelled to live up to their contracts. If he was unwise enough to accept them, he found himself with large inventories in all stages of completion, but without sales.

Being of the adventurous rather than of the prudent type, and of the inventive rather than of the commercial turn of mind, he had not given much consideration to the progress of the business cycle. As the economics of the cycle had not been pointed out to him, he did not realize that his industry would be among the first to slump in a cycle, and that the slump in machine tool orders is merely one of the signs of coming trouble elsewhere. He took counsel of hope rather than of prudence. It had cost him so much in money and effort to get his working force together that he hated to break it up. If his product was not of a type built to order, he kept on working and built stock instead of shutting down his plant. Then, too, he had a goodly share of that human sympathy that leads an employer to keep his men employed as long as possible rather than to throw them out of work. Looking back now, he realizes that it would have been better both for his men and for himself, to have shut down as his orders were filled, and to have waited to build his stock during the depression rather than at the crest of a boom.

When his own financial strength was threatened, even the most adventurous and sympathetic could no longer keep on producing, at high costs, machines for which there was no sale at any price. So the industry finally had to do late what it should have done early in the slump, that is, shut down and wait for improvement in conditions in other lines to revive the demand for machine tools.

The Effect of a Business Depression on Machine Tools

Pressure of creditors compels the financially weak to sacrifice goods to get money with which to pay their debts. A machine tool builder caught short of cash in a depression is in an extremely dangerous position. Clearing a stock of machine tools by a bargain sale is decidedly different from clearing goods that can be sold to millions at a bargain price. Even small distress stocks can be moved only at ruinous prices. Potential users of a given size and make of machine are few and scattered, even in times of active demand. In a depression, demand from even these few potential users shrinks to a small percentage of what it was at the height of the boom.

Not only is the period of carry-over likely to be long, but another danger of carrying large stocks must be reckoned with. That danger lies in obsolescence of designs. Necessity is the mother of invention, and the necessity of getting work for idle shops always produces a goodly number of new and improved designs after a depression has lasted for some time. When these are brought forth, their greater utility to the user kills the demand for the older types. In a depression, machines of new design can generally be made for less than the old types had cost in the boom. Even if not obsolescent, the replacement cost of the older type is less in a depression than in a boom. Some competitor who has no knowledge of unchangeable economic facts is almost certain to conceive the bright idea that by making very low prices he can get a much larger participation out of a dull market than his natural participation had been in a more active market. He thinks he can thereby carry some of his overhead at his competitors' expense. But as the competitors are not asleep, this bright idea fails to bring the anticipated results. All have a natural desire to keep their own places in the sun, and they meet his low prices and all get that much less to carry overhead with. While all these factors lead to great losses in a depression, the low prices do not lead to any appreciable stimulation of sales.

Low Prices do not Stimulate Machine Tool Demand

For fifteen months in the last two years, machine tool volume was down to less than 15 per cent of what it had been in the first quarter of 1920. For thirty-two months past, the demand has averaged about 23 per cent of that figure. In some cases, prices were made that would just about cover material and labor, in attempting to coax out orders enough to hold a force of good men together; but it was probably fortunate for some that their customers were not so keen for bargains as to fill up their shops at the low prices. Some people think that because the demand for cheap automobiles can be stimulated by slight reductions in price, the demand for machine tools acts in the same way; but there is a difference. The cheaper the automobile, the wider is the stratum of demand it can tap, until a saturation point is reached. On the other hand, a man who has just gorged himself with an elaborate dinner, cannot be coaxed by bargain prices to sit down immediately to another one. Machine tool buyers, in every boom, simply become fed up. Then the machine tool builders must wait in patience until their customers regain their appetites for more machines.

Necessity for Reserves in the Machine Tool Business

Because of these long periods of depressions through which the machine tool builder must carry his plant and organization, he must put a heavy "stand-by charge" on his goods. He must cover this cost of necessary idleness over which he has no control, by accumulating a reserve in good times out of which to draw in bad times. That reserve is cost, not profit. If he does not have such a reserve, he goes out of business by the bankruptcy route. Investigation shows that several representative machine tool companies did not earn quite 9 per cent on their investment for ten years preceding the war, although they made a large part of the total output. All of those earnings could not be taken out in cash dividends. Most of the earnings were reserves to carry over depressions.

Before the war, machine tool prices were very low, compared to the utility they gave their buyers. The prices advanced with the war, but advanced far less than prices of most goods. The earnings of the industry were good, but because of larger production, not because of excessive prices. The tax laws penalized the industry unjustly. The machine tool builders financed their own expansion, instead of asking the Government to do it. They now find themselves with expanded capacity that is much too large for any demand likely to arise in a few years. The pre-war demand was largely foreign, and is now very small. Likewise the rapid growth of the automobile industry required many machine tools that have now been supplied. The second-hand market has been glutted with all sorts of tools from dismantled war shops. All these factors have combined to make the machine tool business a very difficult one for nearly three years.

After the last boom, abuses by machine tool buyers became so common that the industry is now determined that in order to protect the industry and its honorable, considerate customers, steps must be taken to make available to the industry full information regarding those who use unfair methods of various sorts. The responsible, reliable machine tool builder will hereafter take an order to be a contract, not a buyer's option subject to cancellation. He believes in a price that is right all around, right for the customer, right for his own stockholders, for his employes, and for himself. He believes in the same price for all his customers, without discriminatory shading.

Planning for the Future

As a result of the depression of 1921 and 1922, the wide awake machine tool builder is giving close attention to the economics of his industry, and the nature of his demand. He is contributing statistics whereby the stages of his cycle are disclosed. In his mind he is correlating his shop as a part of the industry, and his industry as a part of the big industrial machine that turns out goods of all kinds for the world's comfort. He realizes that his is one of the intermittent gears in the machine, and that as long as the other elements of the machine compel him to work so much more slowly at times, he must regulate his finances so as not to get caught in a squeeze. Such correlation will make a better industry with sounder, saner conditions than the machine tool builder has ever known, either in booms or depressions.

* * *

MACHINE TOOL MEETING IN PHILADELPHIA

A meeting was held on February 27 at the Engineers' Club, Philadelphia, under the joint auspices of the Engineers' Club, the Philadelphia section of the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. At this meeting four papers of special interest were presented, as follows: "The Influence of Differences in Design of Milling Cutters on Power Consumption and Capacity," by James A. Hall, associate professor, Brown University, and Benjamin P. Graves, milling machine engineer, Brown & Sharpe Mfg. Co.; "The Design and Manufacture of Large Machine Tools," by George H. Benzon, Jr., engineer, William Sellers & Co., Inc.; "The History of the Machine Tool and its Effect on Present-day Civilization," by Dexter S. Kimball, Cornell University; and "Some Features of the Economic Situation of the Machine Tool Industry," by Ernest F. DuBrul, general manager, National Machine Tool Builders' Association.

* * *

According to Technical Paper No. 287, recently issued by the United States Bureau of Mines, the aluminum copper alloy containing 92 per cent of aluminum and 8 per cent of copper, known in the trade as No. 12, will average an ultimate strength of 18,000 pounds per square inch and have an elongation of from 1 to 1.5 per cent in 2 inches.

PRODUCTION OF MACHINE TOOLS IN 1921

(COMPILED BY THE BUREAU OF CENSUS, WASHINGTON, D. C.)

	Number of Machines	Value
Total value for the United States	.....	$67,729,363
Stste Totals		
Ohio	.....	19,399,794
New York	.....	8,952,833
Rhode Island	.....	6,410,844
Pennsylvania	.....	5,927,283
Connecticut	.....	5,418,035
Illinois	.....	4,670,337
Massachusetts	.....	3,588,172
Michigan	.....	3,004,750
Wisconsin	.....	2,399,939
Indiana	.....	2,291,277
New Jersey	.....	2,197,488
Vermont	.....	1,611,440
All other states	.....	1,857,171
Totals for Different Types of Machine Tools		
Bending machines	54	164,315
Boring machines		
Horizontal	632	1,340,106
Pennsylvania	304	554,976
Ohio	58	478,289
All other states	270	306,841
Vertical	266	1,840,792
Ohio	100	590,711
Pennsylvania	44	489,847
Connecticut	93	472,621
All other states	29	287,613
Broaching machines	530	616,933
Drilling machines		
Multiple-spindle	676	1,106,097
Ohio	42	199,151
Michigan	35	58,086
All other states	599	848,860
Radial	722	1,360,233
Ohio	613	1,103,349
All other states	109	256,884
Sensitive	1,428	227,601
Ohio	283	36,969
All other states	1,145	190,632
Upright	1,677	603,156
Illinois	932	295,925
Ohio	324	217,553
All other states	421	89,678
Gear-cutting machines		
Automatic	656	1,445,672
Disk type	32	70,047
Generating type	146	182.524
Other types	6	38,424
Grinding machines		
Plain	1,789	1,666,101
Massachusetts	627	1,144,842
All other states	1.162	521,259
Universal	692	656,184
Surface	271	337,620
Massachusetts	93	147,290
Connecticut	20	100,126
All other states	158	90,204
Cutter, tool and knife	435	319,396
Massachusetts	129	78,369
Ohio	80	73,759
Connecticut	71	53,201
All other states	155	114,067
Internal	276	345,029
Other types	208	69,136
Wisconsin	179	50,996
Connecticut	14	10,453
All other states	15	7,687
Hammers		
Drop	502	120,139
Pneumatic	2,607	814,394
Other types	541	179,171
Lathes		
Engine	5,117	5,229,884
Ohio	2,060	3,112,191
Indiana	1,346	396,707
New York	381	277,739
Massachusetts	106	229,471
Illinois	350	226.578
Pennsylvania	67	56,892
All other states	807	930,306
Bench	1,095	393,112
Massachusetts	305	131,852
Illinois	423	123,946
Connecticut	56	21,995
All other states	311	115,319
Turret	1,077	1,580,842
Ohio	594	786,014
Indiana	237	394,612
All other states	246	400,216
Other types	333	1,440,017
Planers	194	1,271,824
Ohio	95	542,113
Pennsylvania	27	154,662
All other states	72	575,049
Milling machines, hand feed	468	233,945
Connecticut	324	120,643
All other states	144	113,302
Milling machines, power feed		
Plain	536	812,346
Ohio	232	361,116
All other states	304	451,230
Universal	594	1,092,234
Ohio	220	364,939
All other states	374	727,295
Vertical	212	415,275
Ohio	110	243,600
All other states	102	171,675
Lincoln type	32	32,997
Planer type	173	696,685
Other types	258	539,776
Ohio	36	40,125
All other states	222	499,651
Pipe machines	1,192	570,509
Ohio	631	349,497
All other states	561	221,012
Portable tools		
Drilling	20,809	1,886,978
Ohio	5,814	956,918
Michigan	10,557	453,560
All other states	4,438	476,500
Other types	411,642	2,593,633
Presses		
Punching	20,045	7,284,166
New York	14,325	5,147,848
Ohio	3,716	1,467,893
Wisconsin	185	67,936
All other states	1,819	600,489
Other types	3,783	1,643,244
Screw machines	2,661	2,839,667
Ohio	560	609.435
All other states	2,101	2,230,232
Shapers	1,418	1,020,342
Ohio	822	485,770
Connecticut	256	156,597
Pennsylvania	6	16,250
All other states	334	361,725
Shears	3,347	906,722
Ohio	289	229,711
Wisconsin	50	105,038
Illinois	24	42,852
All other states	2,984	529,121
All other machine tools	.....	5,486,336
Connecticut	.....	1,256,578
Ohio	.....	702,922
Pennsylvania	.....	407,719
New York	.....	176,934
Illinois	.....	101,344
Missouri	.....	100,696
Michigan	.....	95,268
Massachusetts	.....	63,854
All other states	.....	2,581,021
Parts and attachments	.....	8,936,547
All other products	.....	7,319,212

Machinery

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e Machine-building Industries

th of January, the definite upward trend in continued in practically all fields. The machine dustry followed this trend. Business in this field dily increased for the last six months, until in sevses, it is now fully equal to, or greater than, pre-war ness. Even when compared with business during the ak period, the progress is satisfactory. New orders in he industry during January averaged, as expressed in dollars, nearly one-half the average monthly business of the first three months in 1920. But as prices are much lower now than they were then, the actual volume of business, expressed in number of machines sold, is over 50 per cent of the peak volume.

This new business is well distributed over different industries, and with few exceptions machine tool builders agree that January was their best month in two years. Several dealers state that the machine tool business is better than 50 per cent of normal. The demand for new machines is increasing, and the call for second-hand machines is falling off—a decidedly good sign. Unfortunately, there are still a few shops for whose product the demand is very limited, as present manufacturing activity produces no demand for certain special lines of machine tools. On the other hand, shops manufacturing heavy machinery, especially for railroad and locomotive shops, are quite busy, and in both the machine tool and the small tool fields the automobile industry is one of the most active buyers. Generally speaking, the small tool plants operate at from 50 to 70 per cent capacity. Some of the manufacturers in this field state that if their plants are occupied at two-thirds capacity, they consider their business normal.

The difficulties that harass the manufacturer and shipper today are due primarily to car shortage and lack of coal, especially in New England. There is also a scarcity of good machinists and toolmakers, which is more and more definitely felt as the shops grow busier. A decided labor shortage is developing in those parts of the country where the steel industry is concentrated, and a tendency to compete actively for labor is in evidence. The great necessity for a definite program for training machine shop workers becomes more and more apparent.

The Iron and Steel Industry

Activity in the iron and steel industry points to continued activity in the machine building industries for a considerable period. There were only two months during the busy year of 1920 when the average daily production of pig iron exceeded the average for January, 1923. The prewar peak production was 91,000 tons a day, and the January figure was 104,000 tons, which is not far short of peak production for any one month, which was 114,000 tons a day. As a matter of fact, in 1917, when the production of pig iron was forced to the utmost because of the war, the average daily production was only a trifle in excess of that in January. This is the most definite sign of returning normal business in the machine building, machine tool, and small tool fields, to which we can point.

The demand for steel grows steadily, and is more generally distributed than at any other time in recent years. Electrical machinery manufacturers, railroads, automobile companies, and the building construction industries are all pressing the mills for deliveries. Orders for steel railway cars are the heaviest since 1916, and a continuance in the building boom this spring is forecasted by the increased sale of fabricated steels. The United States Steel Corporation is working at over 88 per cent capacity—the highest in several years. The operations are not expanding as fast as the steel manufacturers desire, to take care of the heavy volume of orders placed, because there is a marked shortage of labor in the steel districts. Slight increases in prices have been made, and in some districts pig iron has advanced. We mentioned in February MACHINERY that, in view of possible price advances, this was a good time to place orders for materials, and subsequent events have justified this statement.

Tractors and Farm Machinery

One of the quietest fields is that of farm implements and machinery. Not much improvement can be seen in these industries, and the tractor business is comparatively slow There are definite indications, however, of a fair amount of buying by the farmers this spring, which will deplete the stocks now on hand and make it possible for the farm implement and machinery industry to start manufacturing for new demands. In many cases, dealers' orders for 1923 are far ahead of present factory schedules, which necessarily means increased activity in the agricultural machinery shops before long.

The Automobile Industry

Automobile production continues to be heavy—in fact, it is heavier than ever before at this time of the year. Ford is maintaining a production of over 100,000 cars a month, and other automobile builders are equally optimistic. The production schedule of the Studebaker Corporation calls for 48,000 cars for the second quarter of the year, as against 35,000 cars during the first three months. This company expects to build 150,000 cars in 1923, as compared with 110,000 cars in 1922.

On the basis of an average expenditure of $600 by each car owner annually, and 13,000,000 motor vehicles registered in the United States at the end of 1923, George W. Hinman of Chicago estimates that $7,800,000,000 will be spent on automobiles this year. This is twice the cost of our national government, and gives an impressive exhibit of the proportions of the automobile industry.

The Business Outlook

A review of authoritative business opinions as to the industrial outlook at this time may be of interest. The Federal Reserve Bank of Cleveland says, "Business has discarded most of its hesitating attitude. In its place is a spirit of confidence. Aside from the foreign situation there is little in the conditions outside of business that will prevent the continuance of good business. In many ways this will be a critical year, a year when effective management, sales efforts, better salesmen, more intensive training, and harder and more conscientious work will be necessary."

The Department of Commerce states that "well sustained business and industrial activity is shown by the figures compiled by the Department." These Commerce Reports indicate, particularly, continued activity in the textile field, building, and pig iron production, and improvements in the transportation situation and coal production, with but a slight decline from last summer's peak in the output of the automobile industry. "On the whole a bright outlook for the immediate future, so far as domestic trade and industry is concerned, is seen by the Department in these statistics. The disturbed foreign situation has so far appeared to have but little effect."

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Heald Internal Grinding Machines. Heald Machine Co., 16 New Bond St., Worcester, Mass. 569
Blanchard Automatic Surface Grinding Machine. Blanchard Machine Co., 64 State St., Cambridge, Mass. 570
Ohio "Dreadnaught" Crank Shaper. Ohio Machine Tool Co., Kenton, Ohio 571
Hartness Modified Screw Thread Comparator. Jones & Lamson Machine Co., Springfield, Vt. 571
Oliver Band-sawing Machine. Oliver Machinery Co., Grand Rapids, Mich. 572
Piston Turning, Facing, Grooving, and Grinding Machine. Production Machinery Co., Jackson, Mich. 573
Taylor & Fenn Motor-driven Bore-grinding Machine. Taylor & Fenn Co., Hartford, Conn. 573
Murchey Self-opening Die-head. Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich. 573
S K F Spherical Type Roller Bearing. S K F Industries, Inc., 165 Broadway, New York City 574
National Automatic-feed Semi-hot Bolt and Rivet Header. National Machinery Co., Tiffin, Ohio 575
Ames Dial Gage. B. C. Ames Co., Waltham, Mass. 576
Kingsbury Automatic Drilling Machine. Kingsbury Mfg. Co., Keene, N. H. 577
Syracuse Belt-sander and Grinder. Porter-Cable Machine Co., 1708-12 N. Salina St., Syracuse, N. Y. 577
Van Norman High-speed Milling Attachment. Van Norman Machine Tool Co., 180 Wilbraham Ave., Springfield, Mass. 577
Turner Blow-torch. Turner Brass Works, Sycamore, Ill. 578
Temperature and Pressure Regulator. Combustion Control Co., Otis Bldg., Philadelphia, Pa. 578
Starrett Stainless Steel Rule and Mill Gages. L. S. Starrett Co., Athol, Mass. 579
Simonds Welded High-speed Steel Knives. Simonds Saw & Steel Co., Fitchburg, Mass. 579
Brown & Sharpe Stainless Steel Rule. Brown & Sharpe Mfg. Co., Providence, R. I. 579

Heald Internal Grinding Machines

An automatically operated internal grinding machine with a hydraulic table drive, a new wheel-head drive for application to several types of internal grinding machines, and two automatic and hand-feed internal grinding machines equipped with two wheel-heads have all been added to the line of grinding equipment manufactured by the Heald Machine Co., 16 New Bond St., Worcester, Mass. The first mentioned of these new products is the No. 72 machine illustrated in Fig. 1. In this machine the table travels in a vee and flat way, the hydraulic drive being actuated by oil. Any speed from nothing to maximum may be instantly obtained. The hydraulic mechanism is controlled by an automatic valve located at the front of the base. By means of a stop, it is possible to maintain or return to any particular speed without even looking at the speed-change lever. No gears are used in the construction of the machine.

The lower part of the base serves as an oil reservoir, and is completely enclosed. By this construction the weight of the oil supply adds to the stability of the equipment. The work-head has a hardened and ground steel spindle running in dustproof, adjustable bronze bearings. A friction clutch on the inside of the spindle driving pulley is engaged by a lever, and the water supply is either started or stopped simultaneously with the operation of this lever. The work-head is mounted on a bridge, which, in turn, is bolted directly to the base. The head can be swiveled up to 45 degrees for grinding tapers, and is graduated in degrees and taper per foot. There are five changes of work speeds.

The cross-slide carries the wheel-head and a flexible idler drive. A positive stop is provided on the slide to enable the operator to grind to any given size without watching the dial, and the slide is also arranged with a fine adjustment to compensate for wheel wear. A close-up view of the wheel-head and flexible idler drive is shown in Fig. 3. This drive is applicable to the Nos. 70, 72, 75, 80, and 85 machines

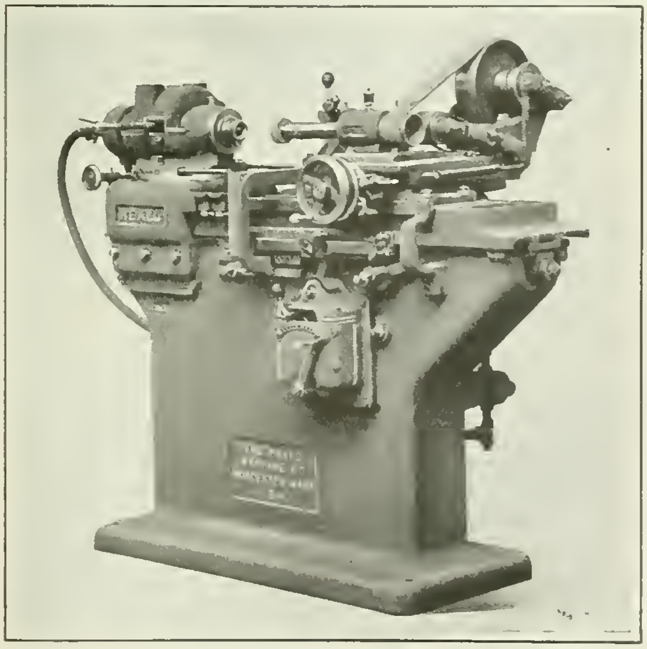


Fig. 1. Heald Internal Grinding Machine equipped with Hydraulic Drive for the Table

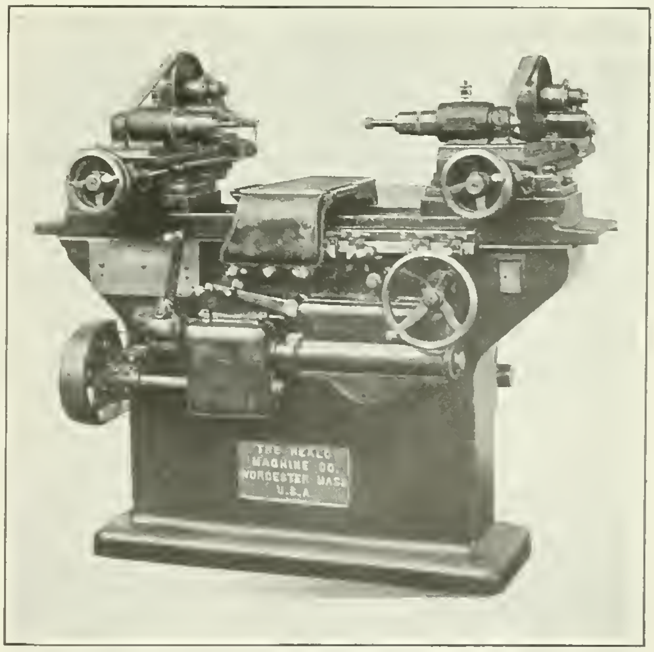


Fig. 2. Power-feed Internal Grinding Machine arranged for grinding Both Ends of Cluster Gears, etc.

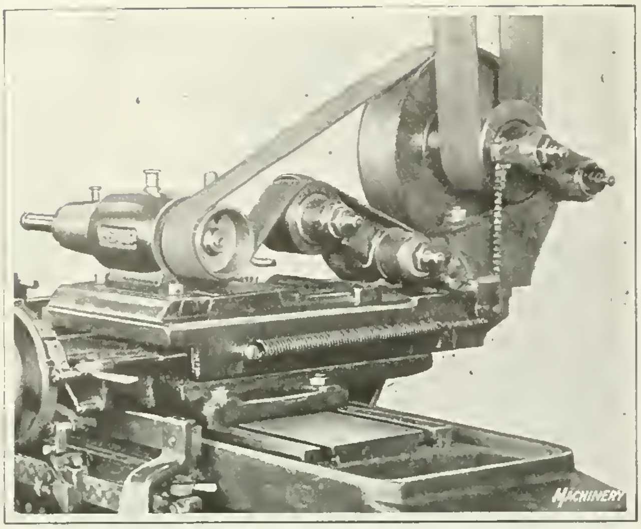


Fig. 3. Close-up View of Wheel-head provided with New Type of Idler Drive

manufactured by this concern. The flexible idler is interchangeable with the old style of idlers.

The advantage claimed for this wheel-head drive is greatly increased production. In one particular case, a piece of Shelby steel tubing, 2½ inches in diameter by 9 inches in length, having a wall thickness of ⅛ inch, formerly required twenty minutes for finishing. With the same method of holding the piece and the machine tended by the same operator, the new drive is said to have cut this time down to eight minutes. The width of the belt connecting the driving shaft to the large pulley has been increased from 2 inches to 3 inches, and the belt connecting the large pulley to the wheel-head pulley from 1½ inches to 2½ inches. The arc of contact on the wheel-head belt has also been increased from 45 per cent to 85 per cent, by employing a spring-tension belt-tightener, which not only gives additional belt traction, but also reduces the strain on the wheel-head bearings.

The wheel-head can be furnished in nineteen sizes for the No. 72 machine. The different sizes are interchangeable, so that the operator may have the proper size of spindle for the job in hand. The wheel-truing device is of a design which insures grinding a hole to any predetermined size without gaging. The device can be quickly dropped into and out of the truing position. The machine swings work up to 15 inches in diameter, and grinds to 11 inches in depth. Work up to 12 inches in diameter can be swung inside the standard water guard.

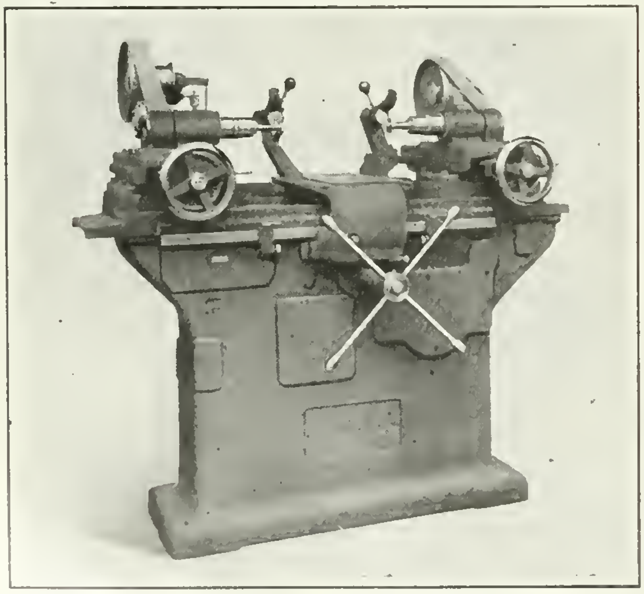


Fig. 4. Hand-feed Type of Machine also equipped with Two Wheel-heads like the Machine in Fig. 2

The automatic and hand-feed internal grinding machines, equipped with two wheel-heads for grinding the hole in cluster gears and similar parts where both ends of the hole must be in line, are illustrated in Figs. 2 and 4. The two heads are mounted on opposite ends of a special table, at the middle of which there is a bridge. The work is held and revolved in a special fixture, which rests on this bridge. Each wheel-head has an individual drive and adjustment to permit grinding from both ends of similar or different holes with or without shoulders. The power-feed machine is generally preferred for long holes without shoulders, while the hand-feed machine is found especially satisfactory for short holes. The heads are equipped with the idler drive shown in Fig. 3. The diamond truing device is illustrated on the hand-feed machine. It is of the swinging type, which permits of truing the wheel without disturbing its relation to the work. These machines are being used for grinding bearing cages, automobile wheel hubs, and countershafts, in addition to cluster gears.

BLANCHARD AUTOMATIC SURFACE GRINDING MACHINE

A surface grinding machine that automatically grinds work to size, measures it, controls the adjustment of the wheel-head, and finally unloads and demagnetizes the work, without any attention on the part of the operator, is being placed on the market by the Blanchard Machine Co., 64 State St., Cambridge, Mass. It is known as the No. 16-A automatic surface grinding machine. An automatic washing equipment may also be provided, so that the work will be delivered to holding receptacles washed as well as demagnetized. The operator's duty consists simply of standing at the loading station and laying the work on the continuously revolving magnetic chuck.

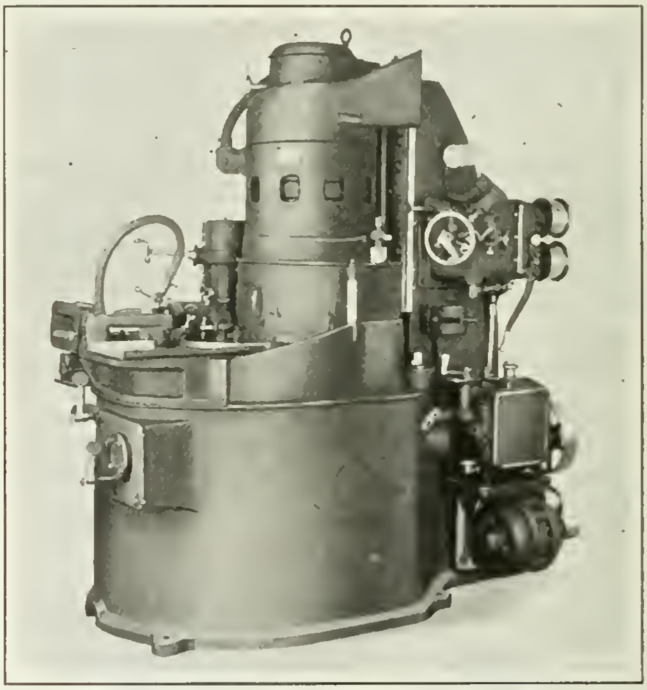


Fig. 1. Blanchard Automatic Surface Grinding Machine

The operation will be understood by following the course of a piece through the machine. At the position where the piece is laid on the magnetic chuck, there is no magnetism, the work starting around with the chuck by being held on it by its own weight. Just before the piece reaches the water guards it is held magnetically on the chuck, and as it passes through an opening in the guards it is carried under the grinding wheel. The latter has been accurately adjusted to the proper height by preceding pieces. The piece is ground to size as it passes under the wheel, and it is then

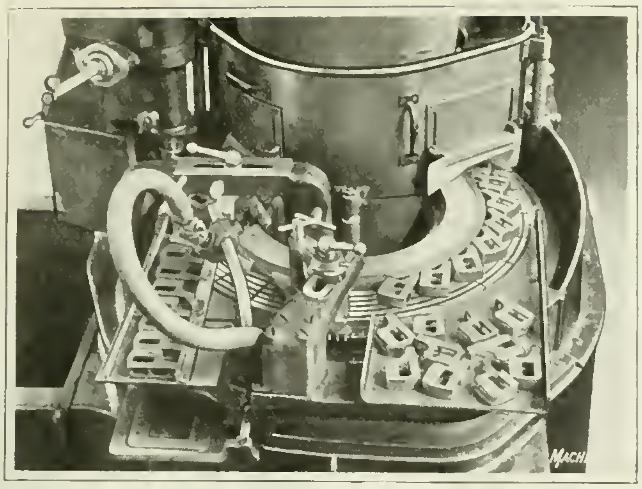


Fig. 2. Close-up View of the Position where Work is placed on the Magnetic Chuck

carried through the water guards and under a caliper, which automatically sets the grinding wheel to compensate for any wear that has occurred.

When the caliper has been passed, the part of the chuck on which the particular piece is being carried again becomes non-magnetic, thus permitting the piece to leave the chuck. It then passes through a demagnetizer and down a chute to suitable receptacles. When the piece has been removed, this part of the chuck surface is washed with water and then cleaned, so that it is clean and dry when it again reaches the loading position.

In this continuous grinding operation, the pieces are placed one after another on the chuck to form a continuous chain of work, as illustrated in Fig. 2. When grinding up to 1200 surfaces per hour, only one operator is necessary per machine, but when producing a greater quantity, one helper may be needed part of the time. One helper can serve three or more machines.

The magnetic chuck is of one-piece steel construction, and absolutely waterproof. Magnetization of the chuck under the wheel and caliper only is accomplished in a simple manner, without the use of sliding or moving contacts. The wheel-spindle is supported on ball bearings throughout, and is heavily constructed. The demagnetizer is connected to the motor circuit, and thus starts and stops with the motor. All controls are placed within convenient reach of the operator, and all important bearings and gears are lubricated by oil baths. Water guards prevent splashing and spraying of the coolant. The base forms a tank for 180 gallons of coolant, and also acts as a settling tank from which chips may be removed while the machine is in operation.

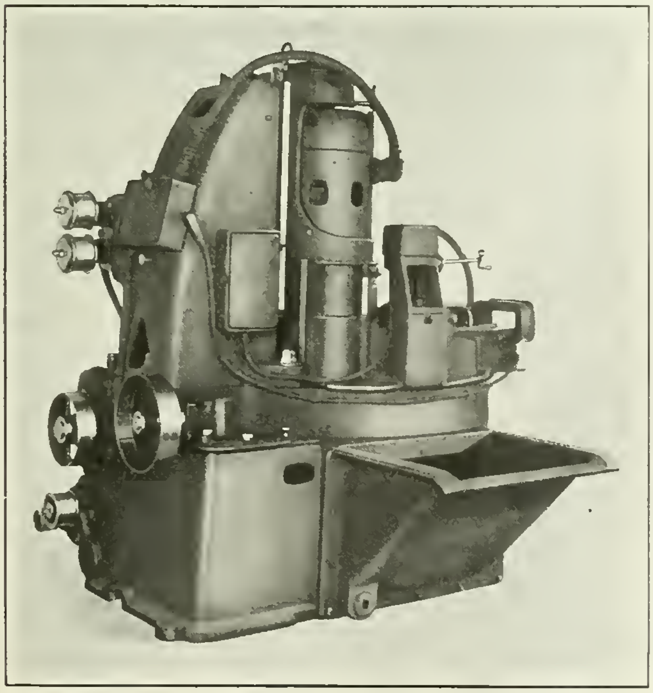
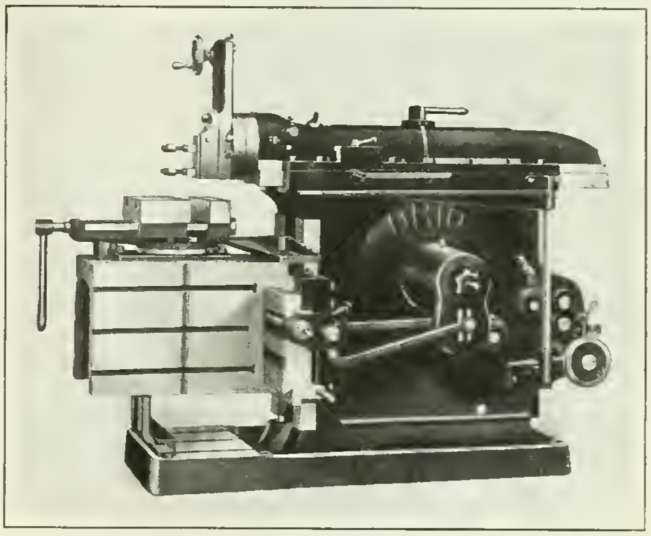


Fig. 3. Rear View of the Automatic Machine illustrated in Fig. 1

OHIO "DREADNAUGHT" CRANK SHAPER

Particularly severe work in which metal must be removed rapidly and accurately is the class of service for which the "Dreadnaught" shaper, here illustrated, has been developed by the Ohio Machine Tool Co., Kenton, Ohio. It is claimed that the maximum width and depth of cut can be taken at each stroke without stalling the machine, as the column, rail, ram, and other important parts have been generously proportioned to meet this requirement. The machine has a stroke of 32 inches, and is equipped with a large diameter pulley having a wide face.

The back-gear ratio is 28 to 1, and the crank-arm is 42½ inches long. The latter dimension brings the center of the bull gear considerably above the center of the crank-arm, which is said to be a factor in obtaining the high power of the machine. The ram bearing is square, and cannot wedge into the column bearing, as the ram bearing surface is sufficiently high to resist the pressure exerted. This bearing of the ram is 2½ inches high, while the width of the ram is 13 inches, and its length 62 inches, not including the harp or tool-box. The front end of the ram is 11 inches outside diameter. The design of the machine is such that even on full strokes a large proportion of the ram remains in contact with the column bearing. All control levers are located on the operator's side of the shaper, so as to permit quick set-ups and adjustments. The machine can be arranged with either a single-pulley belt or a motor drive. The down power-feed mechanism shown on the machine is an extra attachment.



"Dreadnaught" Heavy-duty 32-inch Crank Shaper

HARTNESS MODIFIED SCREW THREAD COMPARATOR

A slight modification has been made in the Hartness screw thread comparator manufactured by the Jones & Lamson Machine Co., Springfield, Vt., to adapt it for the inspection of gears and other parts having irregular profiles, in addition to the inspection of screw threads. The capacity of the comparator is also increased so as to accommodate both small- and large-diameter threaded parts and gears up to 20 inches in diameter. With gears or large profiles where a low-power lens is necessary, the shadow is projected on a 20- by 24-inch mirror, which is silvered on its front face and

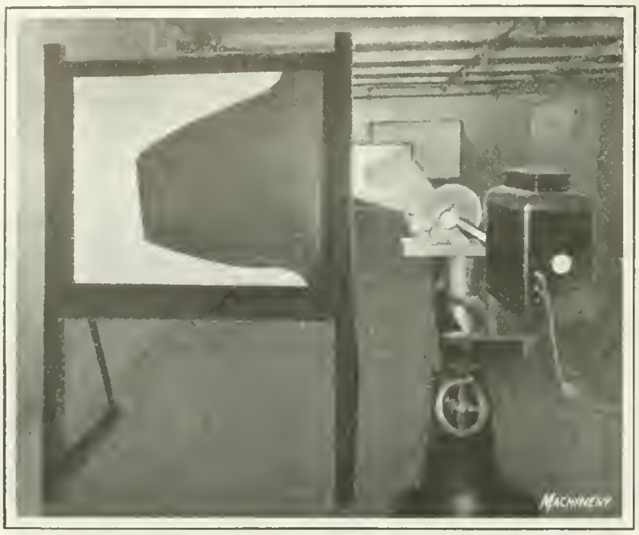


Fig. 1. Using a Modified Hartness Screw Thread Comparator in studying a Tooth Profile

then reflected back to a 36- by 44-inch ground glass screen at the side of the machine. With this arrangement, as the operator manipulates the work, he has the advantage of observing a large shadow at a convenient distance from his eye. Thus he may readily study the profile of the work, as illustrated in Fig. 1, or the rolling action of gear teeth, as shown in Fig. 2. The photographs from which these illustrations were reproduced were necessarily somewhat indistinct because of the dimly lighted room in which the equipment is used.

The machine is built with a work-table, 18 inches long by 7 inches wide, which can be compounded 45 degrees either side of the center. The entire light source and lens system is in a self-contained unit, which rides vertically on a 5-inch diameter column, the movements of the unit being controlled by a rack and pinion device. The machine is equipped with a fixture for mounting centered work, taps, gages, or hobs. When a hob tooth is projected into a true outline on the screen, any error in form can be readily detected. A size block may then be inserted between a stop in the carriage and a micrometer anvil in the base. Then a tooth spaced equal to the thickness of the size block should fall into the outline on the screen. If the lead is long or short, the shadow will be displaced from the outline an amount equal to the error in pitch.

Production screws are inspected in the same manner as on the original Hartness screw thread micrometer, that is, with the screws mounted in cradles and the thread projected into a tolerance chart which is located five feet from the operator, and which is enlarged 200 times. The machine may be supplied with either an incandescent lamp or a carbon arc for use as a light source. Specially designed lenses are necessary to meet this problem of projecting irregular shaped opaque objects on a screen. These lenses can be supplied in three powers.

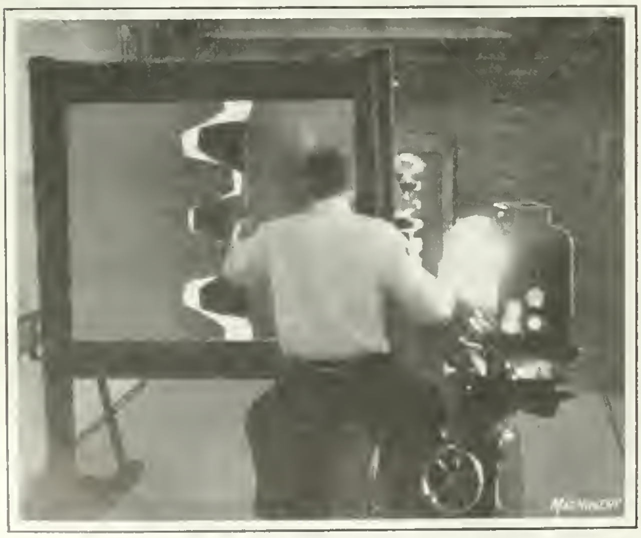


Fig. 2. Method of observing the Rolling Action of Gear Teeth by Means of the Comparator

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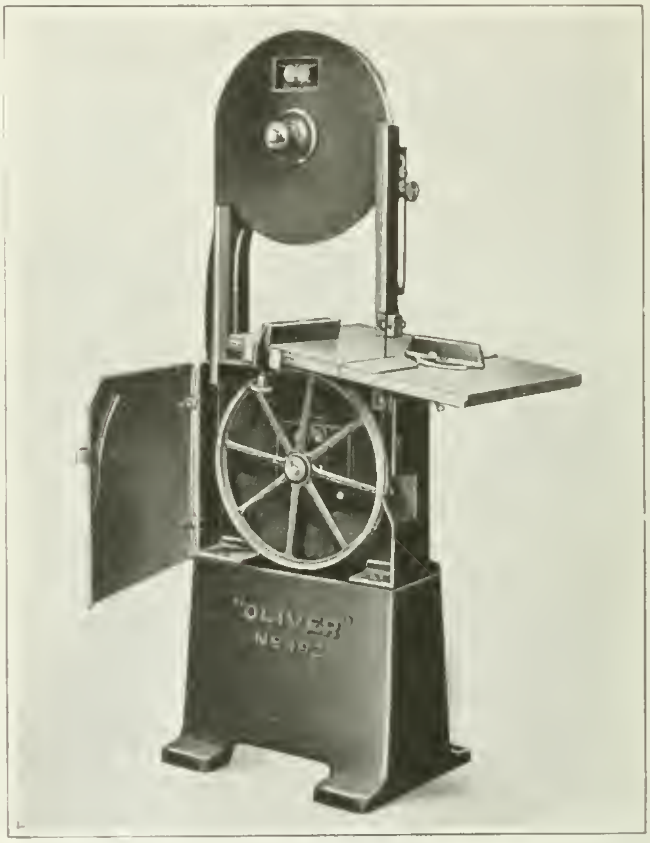
OLIVER BAND-SAWING MACHINE

A large cast-iron tilting table, miter cross-cut gage, and parallel ripping fence are special features of the No. 192 band-sawing machine built by the Oliver Machinery Co., Grand Rapids, Mich. This machine is an 18-inch size, being equipped with wheels 18 inches in diameter, and having a clearance space of 18 inches between the saw and the column. The machine may be supplied with either a belt or motor drive, and in either case it is a self-contained portable equipment. Current for a motor-driven machine may be obtained from any lamp socket. The motor is of 1/3-horsepower capacity, runs at a speed of 1800 revolutions per minute, and is mounted on a bracket attached to the left-hand side of the machine. The lower wheel shaft is driven through reduction gearing, directly connected to the driving shaft.



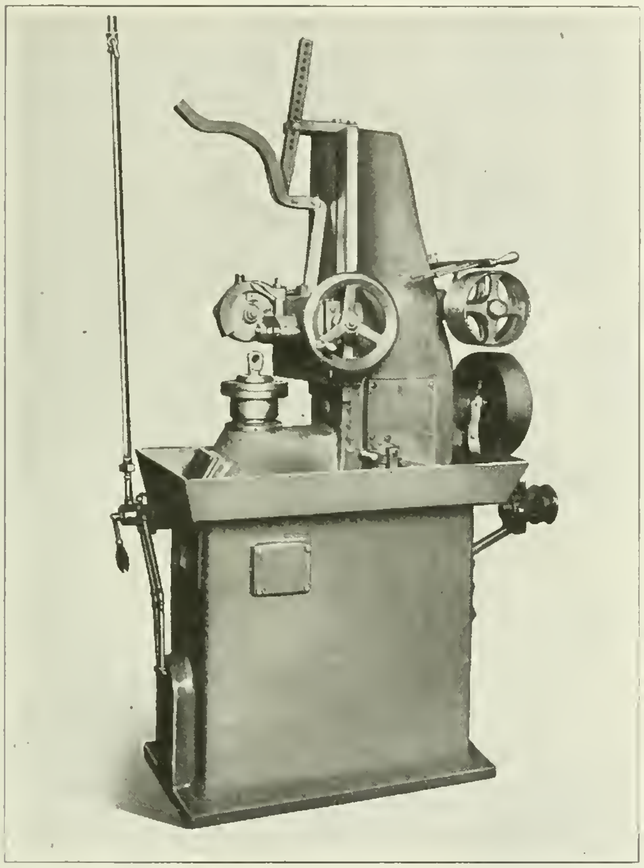
Oliver Portable Band-sawing Machine

Saws up to 1/2 inch in width are ordinarily used on this equipment, and by using the gages, work up to 11 inches in width may be ripped, and work to 8 inches in width may be cut off and mitered. The table can be tilted up to 45 degrees. Frictionless roller guides are furnished both above and below the table. The machine is adequately guarded by means of a hinged steel door which covers the lower wheel, two circular steel guards which cover both sides of the upper wheel, a U-shaped steel guard which encases the rear part of the saw, and a U-shaped cast-iron guard which covers the front part of the saw that is not actually cutting. The last-named guard is adjustable in relation to the guide post. The machine can also be furnished without the floor base, for mounting on a bench.

PISTON TURNING, FACING, GROOVING AND GRINDING MACHINE

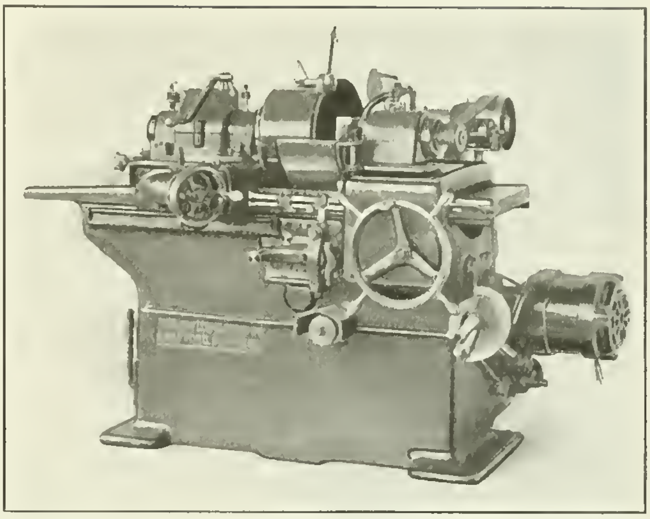
Various operations necessary in manufacturing automobile pistons may be accomplished on a machine now being brought out by the Production Machinery Co., Jackson, Mich. As illustrated, the machine is set up for taking a finishing cut on the closed end of a piston by employing an ordinary tool, and afterward grinding a highly finished surface on this end of the piston by using a grinding head. However, the machine can also be used for boring and facing the open end of the piston, rough- and finish-turning the walls, rough-facing the closed end, and rough- and finish-grooving. It may also be employed for machining fan pulleys, wheel hubs, etc.

All the mechanism pertaining to the operation of the machine comprises one unit. The speed-change mechanism, clutches, spindles, and driving mechanism are contained in the upper half of the machine, which comes apart just below the chip pan. By means of this construction, four or five machine heads can be placed on one base, when such an installation is desirable. Each of the heads so mounted will operate independently of the others. The machine may be supplied for either a direct lineshaft or motor drive.



Machine built by the Production Machinery Co. for manufacturing Pistons

The main driving shaft is located at the back of the machine, and is driven through a clutch pulley. From this shaft power is transmitted to the work-spindle through sliding change-gears that provide six speeds for this spindle. The latter is equipped with a Logansport air chuck. The machine may be furnished with either hand- or power-feed for the cutter-head, the hand-feed being employed on the machine illustrated. With the facing and grinding set-up shown on the machine, the head is fed by hand in one direction to traverse the facing tool over the work, and then fed in the opposite direction to bring the grinding wheel into action. This wheel is driven by a separate belt from the back of the machine. The main spindle bearing is bronze-bushed, and the thrust is taken by a ball bearing.



Taylor & Fenn Motor-driven Bore-grinding Machine of Improved Design

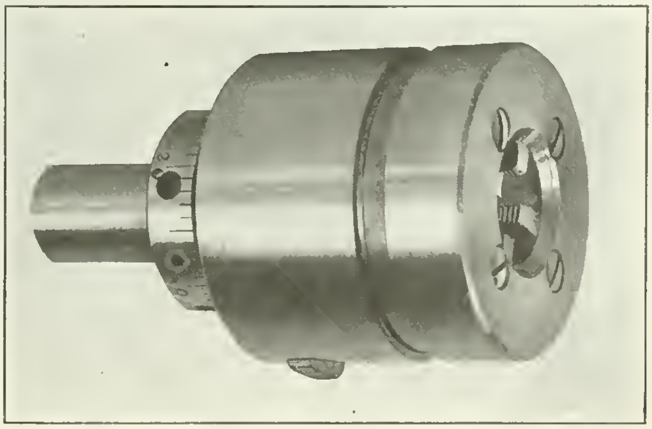
TAYLOR & FENN MOTOR-DRIVEN BORE-GRINDING MACHINE

A direct motor-driven bore-grinding machine of improved design is being placed on the market by the Taylor & Fenn Co., Hartford, Conn. In this machine the rotor is mounted on the driving shaft in place of the pulley supplied when the machine is driven by belt. The stator is supported by a special bracket securely attached to the change-gear box. By this construction, a compact and simple motor drive is obtained without requiring additional floor space. The complete equipment consists of a machine, motor, switch, and enclosed connecting wires. The driving shaft runs in ball bearings of heavy type, which are fully enclosed, and it is automatically lubricated.

An alternating-current motor of 5-horsepower capacity, running at a speed of 1200 revolutions per minute, is generally furnished. However, a motor of the direct-current type may also be supplied. Among the improvements made to the bore-grinding machine itself since it was first placed on the market is a control mechanism which insures a positive and accurate table reverse. The splash guards, with which the machine is equipped are of a new design and are ample to take care of a large volume of water.

MURCHEY SELF-OPENING DIE-HEAD

A Type O self-opening die-head of simple construction, especially adapted for use on automatic multiple screw machines, single-spindle screw machines, and automatic threading machines, is being placed on the market by the Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich. This die-head is made in six sizes to accommodate work from 1/4 to 1 1/2 inches in diameter, but larger sizes can also be furnished. Adjustments to 0.001 inch can be made by merely



Murchey Self-opening Die-head for Automatic Screw Machines loosening a set-screw on the ring and turning the ring. The operator can see clearly just what contraction or expansion has been made, and thus accuracy of settings is assured.

Every part in the die-head is carburized, hardened, and ground. The die trips instantly and positively, a trip with large bearing surfaces being provided so that constant tripping will not affect its efficiency. The hobbed chasers furnished with the die-head are said to insure threads accurate in lead and pitch. These chasers are made from high-speed steel and are specially treated during the cutting and hardening operations. The chasers and other working parts are enclosed to prevent chips from getting into the die-head and clogging its action. The chasers are backed against a hardened and ground steel ring, and their clearance is not affected by grinding or sharpening. The chaser slots are held within limits of 0.0005 inch.

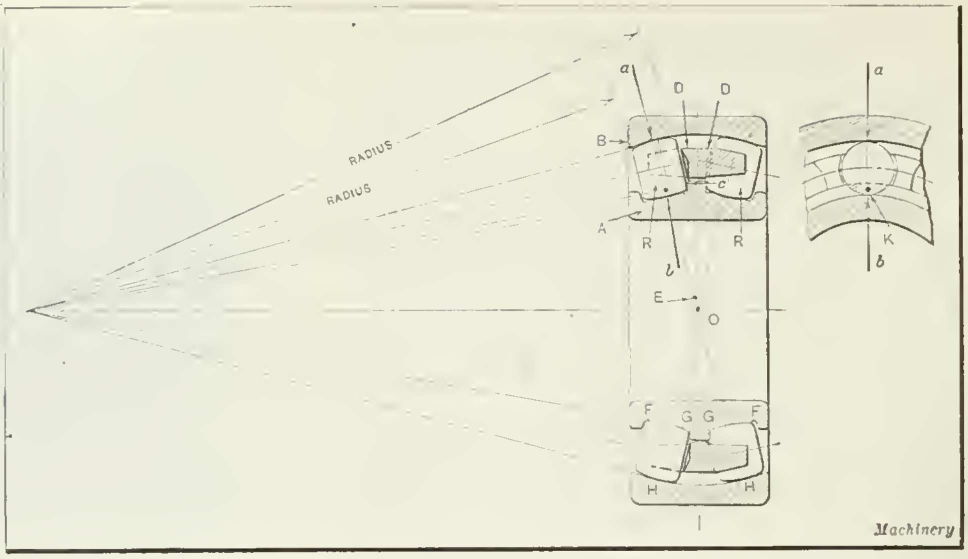


Fig. 2. Sectional View, showing Details of Construction of the Spherical-type Roller Bearing

S K F SPHERICAL TYPE ROLLER BEARING

A roller bearing that differs markedly from conventional types has recently been placed on the market by the S K F Industries Inc., 165 Broadway, New York City. This new design was developed to meet the demand for a bearing that would embody the desirable characteristics of both ball and roller bearings. Its especial field of application is heavy-duty service, such as is required of steam and electric railway journal boxes, railway motors, rolling and tube mills, flywheels, and hoisting machinery. In 1918 the S K F Co. of Gothenburg, Sweden, undertook to study the needs of this class of equipment, making extensive tests on different designs of bearings. The spherical type roller bearing illustrated in Fig. 1 is the result of this research.

Referring to the sectional view of the bearing, shown in Fig. 2, it is intended that the inner race *A* be secured to a shaft or journal according to the usual methods employed with ball bearings operating under corresponding load and speed conditions. The outer race *B* is ground spherical on the inner surface from the center point *O* of the bearing. This race should be mounted in a housing in the same way that a ball bearing is usually mounted, a slight clearance being normally provided to facilitate creeping of the race in the housing while in service. The bearing is a self-contained and self-aligning unit, internal adjustment being required of the bearing when it is being installed. The spherical surface of the outer race provides for self-alignment to compensate for shaft deflections and inaccuracies in machining and locating the housings.

The rollers *R* are barrel-shaped, and their largest diameter is toward the inboard end. On the inner race each roller contacts with a groove *FG* throughout its length, and so line contact of the roller bearing is established. On the outer race, the roller contacts at point *H*, and owing to the closeness of the roller curvature of radius *EH* with the race curvature of radius *OH*, the contact is intimate and comparable with that of the typical deep-groove type of ball bearing provided with a ball of very large diameter. Owing to the elasticity of these parts and the consequent deformation under load, there is a substantial area of contact between the rollers and the outer race. From this it will be seen that the spherical type roller bearing embodies the theoretical characteristics of both the point contact of the ball bearing and the line contact of the roller bearing.

Parallelism of the axes of the rollers with the axis of the shaft on which the bearing is mounted is maintained in a positive manner by means of a guiding flange on the inner race at *G*. Both sides of the flange and the ends of the rollers have ground spherical surfaces, with the center of their radius located at the point of intersection of the shaft axis and the axes of the rollers. Since the guiding flange and the roller ends have the same center and curvature, they contact over the area shown at *K* in the end view.

Arrows *a* and *b* represent the resultant forces on the roller from the outer and inner races respectively. They are inclined toward each other at a slight angle, which is the included angle of a cone circumscribing the roller. This means that there is a wedging force holding the roller in contact with the guiding flange and developing a reaction *c* at the center of the area of contact with the guiding flange. As soon as a roller skews in the slightest degree, there is no longer a contact area between the end of the roller and the guiding flange, the contact being then at a single point

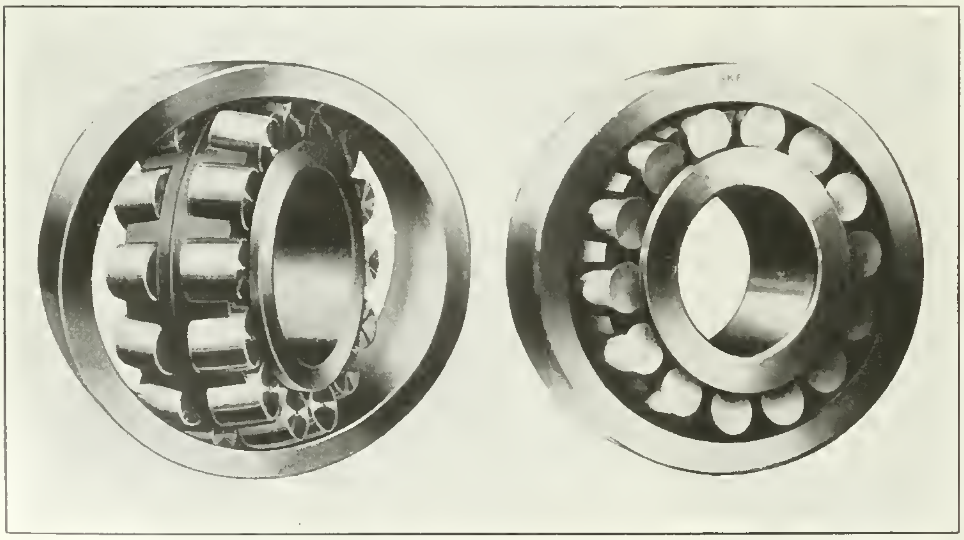


Fig. 1. S K F Spherical-type Roller Bearing

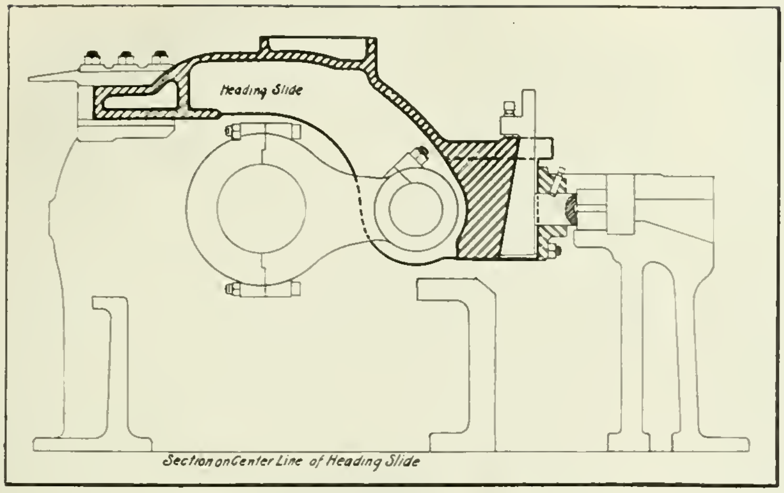


Fig. 1. Diagram of the Heading Slide and Bolster Plate Construction of the National Bolt and Rivet Header

on the edge of the roller. Then force *c*, together with the resultant of the inner and outer race reactions *a* and *b*, forms a couple which counteracts the skewing tendency and returns the roller to its proper position. The rollers are maintained in the proper relation with the shaft axis by this action.

Retainers *D* are carried on the land of the inner race, and serve only to prevent adjacent rollers from contacting with each other. The retainers are usually made of bronze, and are so designed that they hold the rollers from dropping out when the inner race is deflected relative to the outer race to permit of cleaning.

It is said that in equivalent sizes the spherical roller bearing has about twice the load capacity of the corresponding ball bearing. The thrust capacity is obtained by the angular contact of the load reactions *a* and *b*, and is not dependent on the guiding flange reaction *c*. The lubrication is similar to that of ball bearings under similar load and speed conditions. Oil is considered preferable, but grease may be used where conditions of design require it.

NATIONAL AUTOMATIC-FEED SEMI-HOT BOLT AND RIVET HEADER

After a thorough analysis of the factors contributing to the efficiency of automatically fed bolt and rivet headers, the National Machinery Co., Tiffin, Ohio, has developed an improved machine of radical design, which is now being placed on the market. This new machine is shown in Fig. 2. In the previous designs the amount of side pressure thrown on the gripping dies depended entirely upon the extent to which the operator introduced shimming or packing directly in back of the dies. As the relief devices were inoperative when the toggles were in the closed position, this packing resulted in destructive battering of the gripping die surfaces, and caused the edges of the impression to upset or turn in, thus necessitating frequent die changes. On the new design a patented automatic relief mechanism, while providing all the gripping pressure needed for the most difficult work, still limits the ultimate pressure obtainable and thus eliminates upsetting of the die faces and their premature deterioration from this cause.

The size of all bearings and working surfaces has been increased to enable the machine better to withstand hard service. All gripping toggles are located horizontally to insure proper lubrication, while a fully automatic system oils all bearings of the machine every ten minutes, supplying a predetermined amount of oil to each bearing in proportion to its service requirements. It is claimed that after a three-year test no machines of this type have required any repairs or realignment and that no working parts have showed signs of wear.

Previous trouble in die setting, which resulted from lack of horizontal adjustment for the heading tool, has been overcome by mounting the heading tool in a patented bolster plate on the front of the heading slide. This slide is screw-controlled in all directions to permit a quick and accurate adjustment of the heading tool with the gripping dies. Where hours were previously required in aligning the dies with the header, it is now only a matter of minutes. A diagrammatic illustration of the heading slide and bolster plate construction is shown in Fig. 1.

Three lengths of bolster plates are furnished, so that on all lengths of work, the tool may always be rigidly supported without overhang. The gripping or holding time may now be set to the exact requirements, by means of an adjustment in the gripping toggles. One result of thus limiting the length of contact with the heated stock is a reduction in the heating effect on the dies, and a consequent increase in the life of the dies. The breast-plate, shear, and gripping dies are water-jacketed to dissipate the heat.

Heretofore the automatic-feed header has been limited in regard to the variety of work that could be handled, and, in fact, is generally known by the term "rivet machine." With a view to increasing the adaptability of this type of header, consideration was given to features that would broaden its scope. One of the difficulties with the old type was that an inherent defect in the design of the shearing mechanism tended to distort badly the end of the sheared bar and make it difficult to center the next head. This condition has been corrected in the new design by building the feed mechanism at an angle to the machine proper. This gives an angle shear which, by compensating for the distortion, results in central heads, and makes it possible to upset and fill out an increased length of stock for large or special heads. The results obtained by this improvement will be understood by referring to the illustration Fig. 3, where a head produced on a machine of the old type is

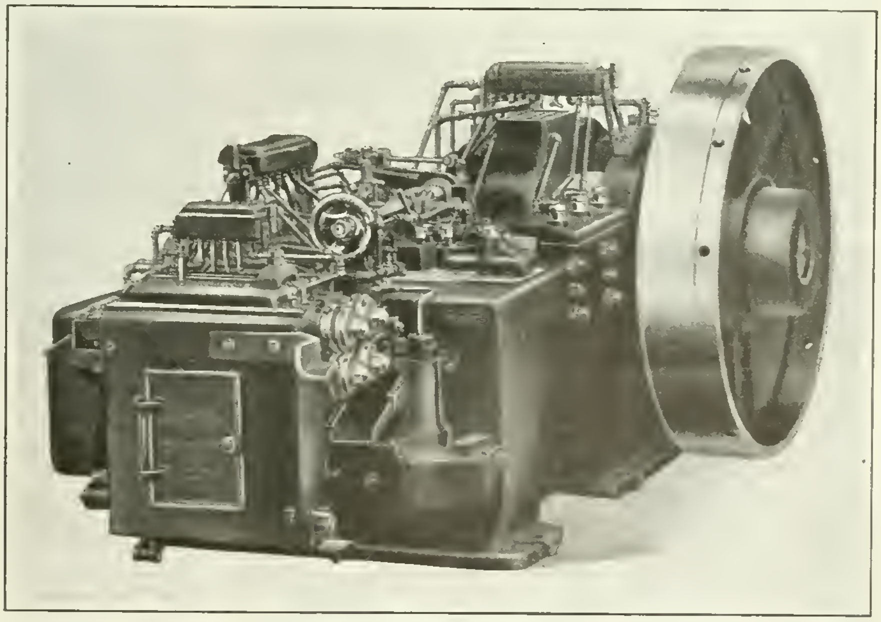


Fig. 2. Automatic Semi-hot Bolt and Rivet Header built by the National Machinery Co.

shown at the left, while a head made on the new machine is illustrated at the right. A bending or straightening device is regularly supplied for large head work. This device is adjustable without stopping the machine, and gives complete control over the centering of stock or the flash.

In attempting to make bolts requiring a large amount of stock, any misalignment of the heading slide causes the stock to buckle and form a defective or unfilled head. It was to secure better alignment in the new design that suspended-type heading and gripping slides of unusual length were adopted. To obtain a long heading slide without the necessity of a long bed frame, the slide, which is 60 inches long, is extended up and over the crankshaft, as shown in Fig. 1. It has two separate bearings with the main shaft located between. Because of the long heading slide being provided with screw adjustments for side alignment and the heading tool being rigidly held in the bolster plate with only a small amount of overhang, large heads can be made with a minimum of buckling, and the range of the machine has been considerably increased. It is possible to make U. S. square heads, large-head carriage bolts, track bolts of various standards, valve tappets, rim bolts, and a variety of special work previously considered impossible on automatic-feed headers.

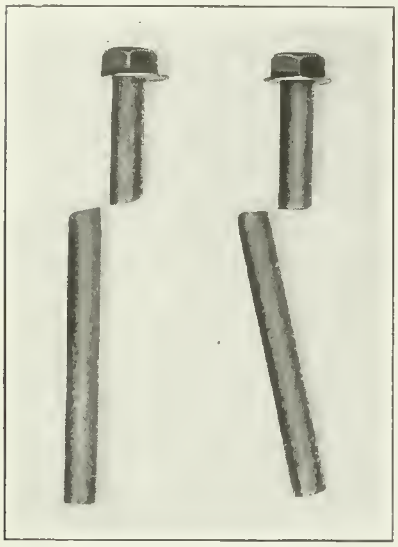


Fig. 3. Examples of Work produced with the Old and New Types of Shear

The machine is designed with a powerful shearing and gripping mechanism which enables work to be produced at low temperatures. This results in an improvement in the finish of the product, a material fuel saving, and a marked increase in die life. The claim is made that the life of the heading tools has been doubled, and that of the gripping dies, tripled. The machine has been designated as a "semi-hot" header, because rivets are made at a temperature of from 1000 to 1100 degrees F., and bolts at temperatures of from 1200 to 1500 degrees F. The work is made in one blow.

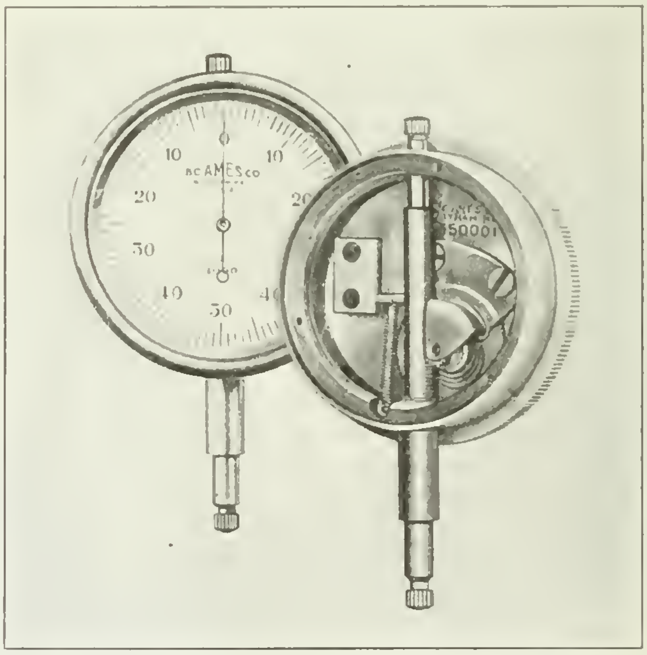
The stock gage is arranged with a screw of such pitch that a full turn of the handwheel gives a ⅛-inch adjustment of the stock. A wedge in back of the heading tool can be relieved to get the machine off center easily, and save delay when work is accidentally caught ahead of the dies. In the event of a "sticker" in the gripping dies, an automatic tripping device on the feeding rod automatically raises the rolls and stops the feed. The shear and faceplate construction and the horizontal adjustment of the heading tool bolster permits of adjusting the shearing travel. Water is supplied from the jacket in the faceplate to the back of the shear, but not to the cutting edge, there being provision to keep the water off the bar until it reaches the shear. A new type of attachment pushes rather than knocks the work from the dies, the work clearing itself from the dies by gravity. In the older machines, when the work was knocked from the dies, the blow would frequently drive it forward against the heading tool. The work would then be caught by the next advancing stroke of the heading tool which would take place before the blank dropped by gravity. The frame of the machine is only one-half the length of previous designs, and it is a steel casting. The distance from the center of the main shaft to the faceplate is 51¾ inches. The weight of the machine is approximately 31,500 pounds.

AMES DIAL GAGE

A dial gage designed to withstand gross abuse without losing its accuracy has been recently added to the line of products manufactured by the B. C. Ames Co., Waltham, Mass. This No. 55 gage may be dropped from a height of about five feet in such a way that the blow is applied to the plunger, it may be thrown about the room or hit with a hammer directly on the end of the plunger or spindle, or the case may become battered out of shape, and the gage will still function as it did before this harsh treatment. This is possible because the wheel staff is large and the spindle has a shoulder that comes in contact with the top of the case on the inside. The guide for the spindle is also of sturdy design, and has a stop to check the spindle.

Another feature of this new dial gage is that it has only thirty-nine parts against the fifty-five parts which make up the No. 5 gage. This simplicity has been obtained by putting both the rack and take-up wheels and the take-up spring on one staff, and using only one bridge to support these parts and the center pinion. A new bezel design eliminates other parts, such as lugs and lug screws, the bezel being held on the case by means of a brass wire spring. All parts are made in jigs and to standards, so that they may be easily replaced by similar members. All working parts are exposed to the eye by removing three screws and lifting off the back.

The guide block is a piece of solid brass of improved design with a slot at one side to allow for the passage of a stud on the spindle. A pin at the top of the block acts as a stop for the spindle after a travel of 0.3 inch. The bridge or support for the wheels is a piece of pressed brass, and is held to the gage plate by means of two dowel-pins and two screws. The case is of the same construction as that furnished with the No. 5 gage, being made of seamless brass tubing and machined all over. It is recessed at the back and front to receive the back and gage plates, respectively. The case stem is fitted to the bottom side of the case, and acts as a guide for the spindle; a hole drilled and reamed in the top side of the case also acts as a guide and bearing for the spindle. The bezel is made of brass, and knurled on the outside. Both the case and the inside of the bezel are grooved to receive the small wire spring previously mentioned. This wire expands against both the case and the bezel, and yet travels smoothly around the groove in the case. The tension on the bezel can be changed by merely bending the wire to increase or decrease its pressure.



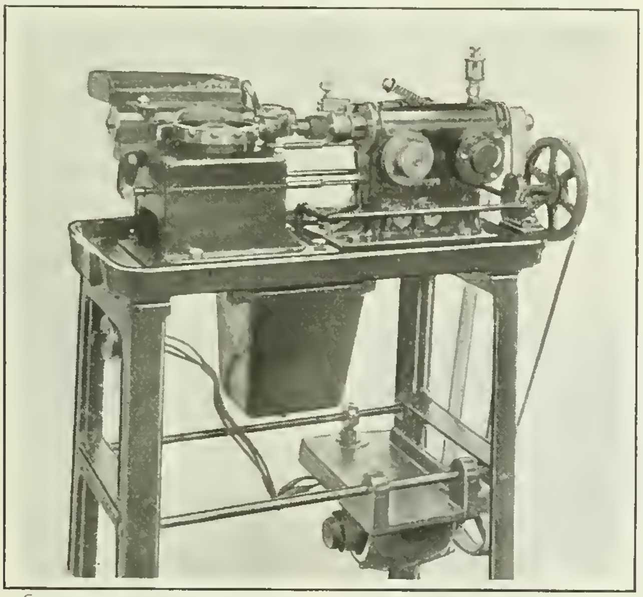
Ames Dial Gage in which the Number of Parts has been greatly reduced as compared with Previous Types

The wheel assembly is the special feature of the new gage, and patents covering its design have been applied for. The rack wheel consists of a large staff, a steel wheel, and a large brass wheel. The take-up wheel it fitted to a brass collar with a take-up spring, the collar being loosely mounted on the rack staff. Both the brass rack wheel and the take-up wheel engage the center pinion, but the rack wheel pushes the pinion while the take-up wheel drags against it, and thus eliminates backlash. Since two teeth are always in mesh with the pinion, the dial hand cannot be made to jump. The spindle is made of steel and is provided with rack teeth 1/8 inch wide and flat. The dial may be graduated to read from 0 to 50 each way, or from 0 to 25 each way; in other words, there may be either one hundred or fifty graduations.

KINGSBURY AUTOMATIC DRILLING MACHINE

An automatically operated machine intended for cross-drilling small work, such as binding posts and rivets, and also irregularly shaped objects, has been recently added to the line of automatic machinery built by the Kingsbury Mfg. Co., Keene, N. H. From the accompanying illustration, it will be seen that the equipment consists of the automatic sensitive drill head that was described in November, 1922, MACHINERY, and an automatic indexing fixture known as the No. 59. The work is simply laid in a dial provided with stations shaped to suit it, and is automatically clamped in the drilling position by means of spring pressure applied from the back.

The clamping jaw is mounted on a plunger, and is held in alignment by a hardened bushing which slides on a hardened and ground pin. The dial contains twelve stations and is indexed by means of a cam cut on the friction cam wheel which controls the feed of the drill. The machine stops at the completion of each cycle before indexing, unless the trip-lever is locked in its disengaged position to make the machine run continuously. The control is similar to that of a power press equipped with a dial feed. This feeding arrangement reduces the work-changing time to a fraction of a second.

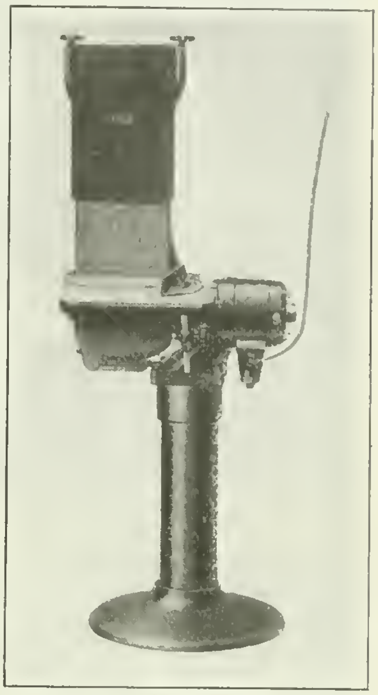


Kingsbury Drilling Equipment with Dial Feed

Where the nature of the work will permit it, the pieces can be ejected readily from the dial at a point beyond the drilling position. Then it is an easy matter for the operator to keep the dial fed with sufficient rapidity to produce at the rate of thirty-five pieces per minute, using a spindle speed of 4000 revolutions per minute. However, only work requiring small holes can be drilled at this speed, brass parts being especially suitable. The drilling time is automatically adjusted to conditions, and so the operator does not need to bother with feed adjustments. The machine is equipped with a pump and a 1/4-horsepower motor.

SYRACUSE BELT-SANDER AND GRINDER

In the motor-driven belt-sander and grinder made by the Porter-Cable Machine Co., 1708-12 N. Salina St., Syracuse, N. Y., the grinding bed may be placed in any position from the horizontal to the vertical. This is a feature which makes the equipment convenient for handling different classes of work. The illustration shows this portable ball-bearing Type B-1 sander and grinder in the vertical position. It is intended for grinding and finishing parts made from metal, wood, and composite materials. A direct motor drive is furnished, the motor being fully enclosed. All moving parts of the equipment are mounted in ball bearings.



Portable Belt-sander and Grinder built by the Porter-Cable Machine Co.

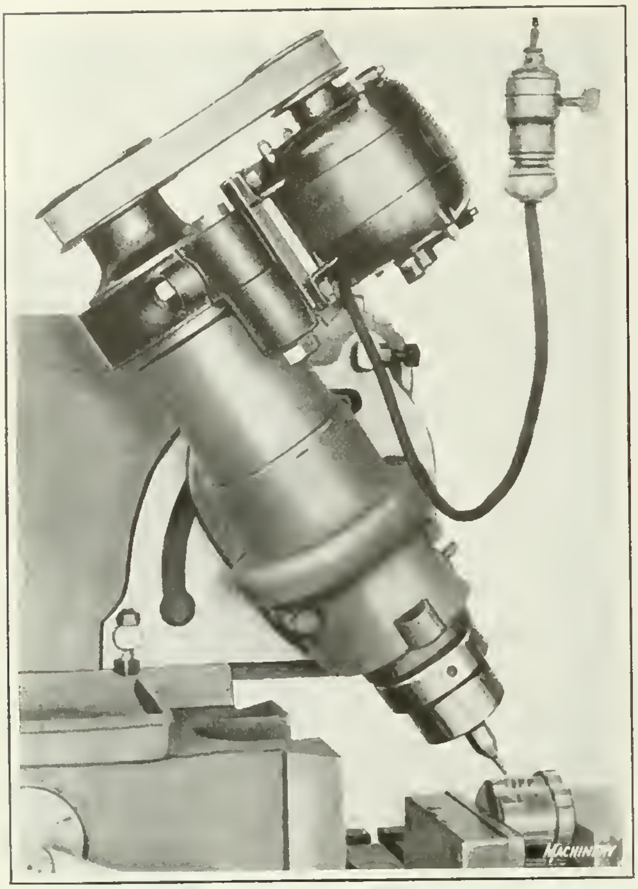
The table can be tilted by turning a hand-wheel, 45 degrees downward and 15 degrees upward. It is easily removable when it is desired to use the grinding bed in the horizontal position, and replaced by a rod which acts as a stop when grinding or sanding small pieces. Angle and core-print gages are used in a slot in the table, it being possible to set these gages at any angle, right or left, up to 45 degrees. The table measures 9 by 16 inches, and the top is located 36 inches above the floor. Adjusting screws insure parallel running of the belt, and they are used in securing the required tension and in changing belts. A leather belt can be used for buffing and polishing. All moving parts are amply protected by guards.

VAN NORMAN HIGH-SPEED MILLING ATTACHMENT

In milling such work as metal patterns, die-castings, and glass molding dies, it is often desirable to run end milling cutters of widely varying diameters at approximately equal peripheral speeds. For example, it may be desirable to run a 4-inch cutter at about 125 revolutions per minute, and a 1/4-inch cutter at about 2100 revolutions per minute. There are also many instances where it is preferable to combine heavy cuts with light and delicate ones during one set-up of the work.

It is for operations of the nature outlined that the Van Norman Machine Tool Co., 180 Wilbraham Ave., Springfield, Mass., has brought out a high-speed attachment to its duplex milling machine. This attachment has a separate ball-bearing spindle within the main cutter-spindle, which is driven by a high-speed ball-bearing motor that is adjustably mounted on the main cutter-head and moves with it. The motor is intended to be connected to an ordinary electric light socket.

The spindle is rigidly supported at the cutter end of the attachment in double ball bearings, there being provision for



Van Norman High-speed Milling Attachment

close end thrust adjustment. The rear or driving end of the spindle is supported in a floating ball bearing to compensate for endwise expansion or contraction. The front ball-bearing assembly is detachably mounted on the threaded nose of the main cutter-spindle, and the rear ball-bearing assembly is similarly mounted on the rear end of the main cutter-head. The motor assembly is attached on the rear ball-bearing housing, and is movable about the axis of the cutter-spindle. The motor is also pivotally mounted on an axis parallel to the spindle axis, a convenient means thus being provided for belt take-up. About five minutes is required to set up or take down this attachment. The high-speed spindle regularly furnished receives No. 5 B & S taper-shank end milling cutters.

The advantages claimed for this attachment are as follows: The cutter-spindle is radially movable on an axis, and can be set to cut at any angle from the vertical to the horizontal; the cutter-head is horizontally movable toward and away from the face of the column; and by the use of the attachment, it is possible to cut any irregular curves between a flat surface and a true circle by using a right-angle end-mill.

TURNER BLOW-TORCH

A blow-torch equipped with a safety valve is being placed on the market by the Turner Brass Works, Sycamore, Ill. The safety valve is located at the end of the horizontal pump cylinder, and is fitted with a diaphragm proportioned to give way automatically at an air pressure of 40 pounds per square inch. Thus the valve does not come into action until about double the normal pressure is present. A thumb-nut on the valve is turned by the operator to release the air pressure after his work is done, or to decrease the pressure during the operation of the torch. The pump is equipped with a leather which spreads out on the working stroke and closes on the return stroke.

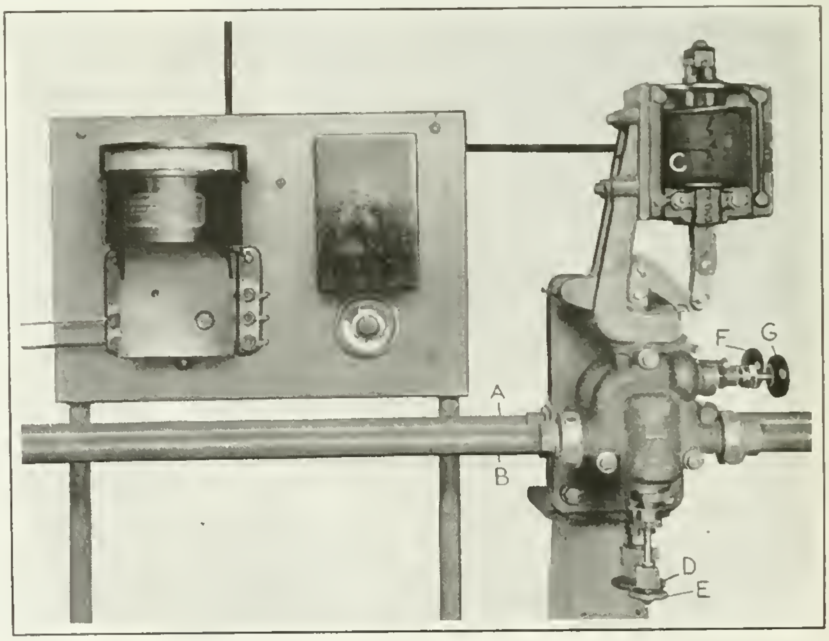
In its journey from the tank to the combustion chamber, the fuel passes through the interior of a bronze baffle. This baffle is located near the outlet of the burner tube in the path of the flame and quickly becomes white hot. Its intense heat vaporizes the fuel into a hot, dry, highly inflammable gas, and because of this feature the torch can burn either kerosene or the leanest grade of gasoline for fuel.

TEMPERATURE AND PRESSURE REGULATOR

A new type of temperature and pressure control intended for use in connection with heat-treating furnaces and steam boilers is being placed on the market by the Combustion Control Co., Otis Bldg., Philadelphia, Pa. For temperature regulation, the equipment is supplied with a pyrometric controller, as illustrated, but for pressure regulation a different controller and a signal light are furnished. The control, as shown in the illustration, is arranged for burning fuel oil and using air or steam for atomization. The oil line is indicated at *A*, and the air or steam line at *B*. The control consists of two separate but duplicate bodies which are mounted on a common housing. Each body has independent by-pass and auxiliary regulating valves. The housing forms a base on which is mounted a frame for solenoid *C* and its connections.

The solenoid levers are connected to the top of a shaft extending through the housing, while the lower end of the shaft is connected to an adjustable cross-bar, which carries and operates in unison the auxiliary valves for regulating the fuel oil and the air or steam. This cross-bar is provided with handwheel *D* for adjustment, the handwheel having indicators and a vernier to insure accurate setting. The air or steam line is provided with an independent adjustment *E*. The by-pass valves *F* and *G* are also mounted on cross-bars and have a handwheel, indicator, and vernier adjustment. The steam-regulating valve is of the balanced type, and the oil-regulating valve is provided with special angular porting, that gives close regulation. The solenoid is wound for continuous service, and can be furnished for either alternating or direct current of any voltage or cycle. The pyrometer controller has high and low contacts.

As an example of the operation, assume that in a furnace in which the temperature is regulated by pyrometric control the desired temperature is 1500 degrees F., then the by-pass



Temperature Regulator made by the Combustion Control Co.

valves are regulated to bring the temperature to about 1495 degrees F. and to maintain this temperature, and the indicator of the pyrometer is set to 1500 degrees F. After establishing radiation and vent losses, the current switch is closed, and as a temperature of 1500 degrees F. has been set by the indicator of the pyrometer, there will be a low contact and the circuit will be made through two coil relays and the energized solenoid. This will cause the core to rise with its lever and raise the shaft with the cross-bar and auxiliary valves, opening the valves and thus admitting more fuel oil and steam or air. As the cross-bar moves upward, an adjustment for fuel oil is made by means of the handwheel, and the amount of air or steam is regulated by the independent adjustment. This added fuel causes the temperature to rise until the pyrometer controller makes contact at 1500 degrees F. and opens the circuit. The solenoid is then de-energized and the auxiliary valves closed. Safety features provide against excessive temperature.

STARRETT STAINLESS STEEL RULE AND MILL GAGES

A rule which is made of stainless steel so that it will not rust or stain, and which is hardened and tempered is now being added to the line of tempered rules manufactured by the L. S. Starrett Co., Athol, Mass. This No. 1000 rule is made in 6- and 12-inch sizes, the former being 3/4 inch wide, and the latter 1 inch wide. Both sizes are graduated in eighths and sixteenths of an inch on one side, and in thirty-seconds and sixty-fourths of an inch on the opposite side.

The same concern has also brought out three new rolling mill gages designed for quick and accurate use on sheet and plate iron and steel. Two of these gages are for English or Birmingham standards, being for gage Nos. 000 to 25, and 1 to 32, respectively. The third gage is for U. S. standards Nos. 000 to 25. The decimal equivalent of each gage number is stamped on the back in extra large figures. The gages are hardened, tempered, and carefully tested. They are approximately 5 7/8 inches long, 1 7/16 inches wide, and 3/16 inch thick, and have a black finish.

SIMONDS WELDED HIGH-SPEED STEEL KNIVES

Woodworking machine knives which have a high-speed steel cutting edge welded, rather than brazed, to a backing of softer metal, are now being made by the Simonds Saw & Steel Co., Fitchburg, Mass., for use on planers, lathes, jointers, and other equipment. They are especially recommended for use on hard wood or where the knife must undergo exceptionally severe service. The line of the joint between the high-speed steel cutting edge and the backing piece is practically invisible. It is said that the edge does not separate from the backing when it is heated to a high temperature for the purpose of tempering. These knives are made in lengths up to 30 inches, widths up to 6 inches, and thicknesses up to 5/8 inch.

BROWN & SHARPE STAINLESS STEEL RULE

A 6-inch pocket rule made of stainless steel, which is known as the No. 350, is a recent addition to the line of mechanics' tools manufactured by the Brown & Sharpe Mfg. Co., Providence, R. I. This rule is rustproof, and will not stain or discolor. Every user appreciates the advantage of a rule that retains its bright finish so that it can be easily read, without the difficulty experienced in reading rules that have become rusty or blackened from use. The rule is graduated in eighths, sixteenths, thirty-seconds, and sixty-fourths of an inch.

NEW BOOK ON AUTOMOBILE SHOP PRACTICE

Automobile Shop Practice. By Edward K. Hammond and Franklin D. Jones. 306 pages, 6 by 9 inches; 221 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $3.

The automotive industry undoubtedly leads all other machine-building industries in the development and use of tools and methods for reducing production costs. This treatise deals with the standard and special tools, machines, and processes employed in many of the most efficient automobile plants in the United States. The particular operations featured in the various chapters have been selected on account of their importance and because they represent approved practice.

Methods of manufacturing such essential parts as cylinders, pistons, connecting-rods, crankshafts, camshafts, crankcases, transmission gears, axles, steering knuckles, etc., are described and fully illustrated. Specific information is also given on the successive order of machining operations, rates of production, and other subjects of value to shop executives and students of efficient manufacturing practice. The purpose of this book is to cover the production of those parts that require unusual tools and processes for accuracy and high production rates.

In preparing this book, the operations and equipment in many different plants were studied carefully to obtain the best examples of practice. Methods of machining similar parts in different plants have been described whenever this was warranted by interesting variations either in the designs of tools and fixtures used, or in the general methods of procedure. While this treatise is confined to the manufacture of automobile parts, it should be valuable to every one interested in efficient machine-building practice, since most of the tools and methods are adaptable, in principle, to similar classes of work in other lines of manufacture. In fact, this book is an exceptionally valuable treatise on modern machine shop practice, as it features the manufacturing methods used in plants where machine parts are produced by the most efficient means available at the present time. It should also prove of value to those engaged in repair work on automobiles.

A comprehensive idea of the contents of the book can best be obtained by a list of the chapter headings: Boring and Reaming Automobile Cylinders; Finishing Cylinder Bores by Grinding; Machining Pistons and Piston-rings; Manufacture of Connecting-rods; Turning, Grinding, and Drilling Crankshafts; Machining Camshafts and Testing their Accuracy; Machining Transmission Gear Blanks; Operations on Gear-cases and Engine Bases; Axle Manufacture; Manufacture of Hanger Bolts, Steering Knuckles, and Yokes; Special Machines and Fixtures in Automobile Plants; and Conveyor Systems for Automobile Plants.

* * *

TENTH NATIONAL FOREIGN TRADE CONVENTION

At the tenth national foreign trade convention, which will be held in New Orleans, May 2 to 4, a program covering a number of different phases of the foreign trade situation will be offered. The general convention theme will be "European Conditions as Relating to World Trade." Papers and discussions will deal with such subjects as "European Progress During the Last Year"; "Trade Barriers"; "Trading in the Face of Depressed Exchange"; "Education for Foreign Trade"; "Banking Facilities for Foreign Trade"; "Problems of the Export Manager"; "Foreign Trade Facilities of the Federal Reserve System"; "Trade with Latin-America"; "Inland Water Transportation, as Affecting Farms and Railways"; "Railway Service for Foreign Trade"; "The Shipping Situation of the World"; "Foreign Credits"; and "Export Advertising."

THE MACHINE TOOL SITUATION IN FRANCE

From MACHINERY'S Special Correspondent

The Wiesbaden agreement, about which much has been written, never became of great importance. Most of the German machine tool builders did not favor it, because when they delivered machines under this agreement they were paid in marks by the German Government. They preferred to sell directly to French buyers and to receive payment in francs or dollars. The prices of German builders at this time are practically all in dollars or francs for foreign trade. Furthermore, since January 13, the Wiesbaden agreement has not been in force, and Germàny is no longer able to export machine tools to France at a reduced tariff. The total value of German machine tools imported under the Wiesbaden agreement was about 10,000,000 francs.

Since 1919 German machine tools have not entered France to a value of over 20,000,000 francs, of which one-half was for the devastated area, under the Wiesbaden agreement, as mentioned. This is a volume which is quite negligible, when compared with second-hand machine tools valued at 200,000,000 francs available for sale in France. The following prices of German machine tools made by a first-class concern may be of interest. These prices are for stocks on hand in Paris with custom duties and freight paid.

	Francs
Boring mill, 34-inch table, weighing 7200 pounds..	22,300
Slotter, with ram travel of 14 inches weighing 15,000 pounds.	25,840
Tool-grinding machine, weighing 1900 pounds....	7,350
Horizontal milling and boring machine, diameter of spindle 6 inches, weighing 57,000 pounds........	67,900

In order to cope with the danger of German imports, the French builders of machine tools have joined in an association known as Union Metallurgique, the object of which is to sell to the manufacturers in the devastated areas on credit terms similar to those offered by German builders. Generally speaking, therefore, it is not German competition that prevents American firms from selling machine tools in France.

With the present state of the market, and as long as the exchange does not return to about seven francs to a dollar, it will be impossible to sell ordinary American machine tools in France, but it is quite practicable to sell such American machines as are not built in France, and there are several types of such machines now being sold; but French builders are constantly developing facilities for building the usual types of machine tools, such as engine lathes, drilling machines, and hacksaws. The industrial crisis through which France has passed is gradually passing. In the machine tool trade, particularly, old stocks are diminishing and new machines are being sold.

* * *

MEETING OF ELECTRIC STEEL FOUNDERS' RESEARCH GROUP

The Electric Steel Founders' Research Group met in Detroit, Mich., February 5 and 6. Important reports relating to electric furnace practice, core practice, and facing practice were discussed. It was decided to expand the scope of the work of the Research Group, by providing for greater activity on the part of the committee on new uses for steel castings. For this purpose, W. J. Corbett was engaged as industrial engineer, to be associated with R. A. Bull, research director. Mr. Corbett has had several years of experience in various steel foundries. His headquarters will be at the central office of the Electric Steel Founders' Research Group, 639 Diversey Parkway, Chicago, Ill. The Research Group is composed of the following firms: The Electric Steel Co., Fort Pitt Steel Casting Co., Lebanon Steel Foundry, Michigan Steel Casting Co., and Sivyer Steel Casting Co.

TONNAGE REQUIRED TO STRAIGHTEN COLD-ROLLED STEEL

By GEORGE N. DORR

The accompanying table gives the pressures required to bend cold-rolled steel of various diameters and lengths on different length centers. The values given were obtained by tests made in actual shop practice. It will be found that the calculation of the pressures necessary to bend cold-rolled steel of the sizes specified will give values that are somewhat lower than those given in the table. This is due to the fact that the width of the bearings on which the shaft rests and the width of the ram face are not taken into consideration in the calculations. In other words, the bending ram is considered as a knife edge, whereas in actual practice a ram having a flat face of some width must be used. If the table is used for material of a different tensile strength from that of cold-rolled steel, it is necessary to multiply the values given by a fraction obtained by dividing the tensile strength of the material to be bent by the tensile strength of the cold-rolled steel, which is taken as 60,000 pounds per square inch.

PRESSURES FOR STRAIGHTENING COLD-ROLLED STEEL

Diameter of Shaft, Inches	Distance between Shaft Supports, Ins.	Pressure Required, Tons	Diameter of Shaft, Inches	Distance between Shaft Supports, Ins.	Pressure Required, Tons	Diameter of Shaft, Inches	Distance between Shaft Supports, Ins.	Pressure Required, Tons
1½	6	10	2½	19	15	3½	25½	30
1½	5	15	2½	14	20	3½	22	35
1½	4	20	2½	9½	30	4	32	35
1½	3	30	2½	8½	35	4	22	50
1½	2	35	3	48	10	4	18	65
2	18	10	3	32	15	4	10	125
2	12	15	3	24	20	4½	31	75
2	9	20	3	16	30	5	45	50
2	6	30	3	14	35	5	35	65
2	5	35	3	10	50	5	20	125
2	4½	50	3	8	65	6	36	125
2	4	65	3	5	125	....	.....	.....
2½	29	10	3½	48	20	....	.....	.....

Machinery

* * *

AN AUTOMOBILE ENGINE IS NOT A MOTOR

The Society of Automobile Engineers takes exception to the use of the word "motor" to designate the power plant of an automobile, truck, airplane, tractor, or other automotive appliance. Motor is the correct name for an electrical machine used for changing electrical into mechanical energy. An electric motor is commonly used on gasoline automobiles in connection with the starting apparatus, but the use of the word "motor," as applied to internal combustion engines, can be correctly understood only by the context. The continued misuse of the word should be discouraged. We say "electric motor" and not "electric engine," and we say "steam engine" and not "steam motor," and so, the logical name for an internal combustion unit is "engine" and not "motor."

* * *

A. S. M. E. SAFETY CONFERENCE

A conference was held Saturday, February 17, at the American Society of Mechanical Engineers, 29 W. 39th St., New York City, with a view to discussing whether a national safety code for the forging industry ought to be adopted, and also whether a similar code should be adopted for the plate and sheet-metal working industries. The conference was called at the request of the Safety Code Correlating Committee which has had this subject under consideration for some time. A thoroughly representative group of men from all the interested industrial bodies were invited to attend.

PERSONALS

L. K. Berry, for sixteen years with the Warner & Swasey Co., Cleveland, Ohio, has resigned his position of domestic sales manager to become manager of sales for the Detroit Twist Drill Co., Detroit, Mich.

A. W. Berresford has resigned as vice-president and director of the Cutler-Hammer Mfg. Co., Milwaukee, Wis. Arrangements have been made whereby his services will be available in specific matters.

E. S. Lammers has recently returned to the employ of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., with whom he was associated from 1913 to 1919, and will be in charge of the controller sales in the industrial department.

Howard W. Dunbar has been made assistant to William La Coste Neilson, general sales manager and vice-president of the Norton Co., Worcester, Mass. Mr. Dunbar has in the past been sales manager of the Norton Co.'s grinding machine division.

Edwin L. Andrew has been appointed assistant to the manager of the department of publicity of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Mr. Andrew has had both engineering and advertising training and experience.

A. W. Copeland, president of the Detroit Gear & Machine Co., Detroit, Mich., at a recent meeting of the executive committee of the American Gear Manufacturers' Association was elected to fill the vacancy on the committee caused by the death of John B. Foote.

Alfred J. Doughty, formerly factory manager of the Burroughs Adding Machine Co., was elected director and vice-president of the company at the annual stockholders' meeting recently held in Detroit. He will have charge of all factory and mechanical operations of the company.

W. E. Sykes, of the Power Plant Co., West Drayton, England, has disposed of his Canadian and United States patents relating to gear-cutting machinery, to the Farrel Foundry & Machine Co., Ansonia, Conn., and Buffalo, N. Y., and is at present located at the Buffalo plant, where he expects to remain for some time.

William Blake Patterson, president of the Patterson Tool & Supply Co. of Dayton, Ohio, recently returned from his European tour and is again actively engaged in the business of the company. Mr. Patterson reports business as gradually improving, although the absorption of war material interferes somewhat with the sale of new tools.

Cloyd M. Chapman has become affiliated with Dwight P. Robinson & Co., Inc., New York City, as consulting materials engineer. Mr. Chapman, who has been active in the work of the American Society of Testing Materials and the American Concrete Institute, will in the future represent Dwight P. Robinson & Co. in the committee work of these societies.

W. W. Reddie has been appointed assistant to the manager of the industrial department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. He will have charge of the railroad shop, metal-working, machinery manufacturers', and material-handling machinery sections of the department. Mr. Reddie has been associated with the Westinghouse company ever since he graduated from college, with the exception of the period during which he served in the war, and was previously manager of the metal-working and railroad shop sections.

Clyde M. Carr has retired as president of Joseph T. Ryerson & Son, Inc., Chicago, Ill. Mr. Carr has been unable to take an active part in the management of the firm for the last two years on account of poor health. He will continue, however, as a director, but will be succeeded by Joseph T. Ryerson, as president. Mr. Carr was born in Illinois in 1869, and first became associated with Joseph T. Ryerson & Son in 1890. He has taken a very active part in the management of the firm, and in 1911 was elected president. In addition to his connection with the Ryerson concern, he is a director of the Corn Exchange National Bank, trustee of the Art Institute of Chicago, a member of the Chicago Plan Commission, and a member of the American Iron and Steel Institute.

Joseph T. Ryerson was elected president of Joseph T. Ryerson & Son, Inc., Chicago, Ill., at the regular annual meeting of the board of directors. Mr. Ryerson was born in Chicago in 1880, and is the grandson of the Joseph T. Ryerson who founded the firm. Immediately after graduating from Yale in 1901, he went to work for the American Sheet Steel Co., now the American Sheet & Tin Plate Co., at the company's mill in Vandergrift, Pa. In October 1902, he started with Joseph T. Ryerson & Son in Chicago and in 1904 was elected treasurer, becoming vice-president in 1911. Mr. Ryerson is also actively interested in the work of the National Chamber of Commerce, a director of the People's Trust and Savings Bank of Chicago and of the Morris Plan Bank of Chicago. He is also a member of the American Iron and Steel Institute.

M. Kessler, formerly superintendent of the Athol Machine & Foundry Co., Athol, Mass., has been appointed general manager to succeed H. R. Linton, who has left the company. Mr. Kessler has had an extensive machine shop experience. Previous to 1914, he was general foreman of the machine shop of A. E. Meyers Co., Pittsburg, Pa., and when this company was purchased by the Standard Steel Car Co. in 1915, he remained with the new company as superintendent. In the latter part of 1915, he went to the Westinghouse Electric & Mfg. Co. as general foreman of the department producing 8-inch British shells; later, he was in charge of the production of parts for the Browning machine gun at Springfield, Mass. In 1919 he became general superintendent of the Athol Machine & Foundry Co., of which he has now become general manager.

M. F. Cunningham, formerly of the Superior Corundum Wheel Co., is now associated with the Waltham Grinding Wheel Co. of Waltham, Mass. Mr. Cunningham began work for the Waltham Grinding Wheel Co. about thirty-two years ago, and remained in the employ of that company for about fifteen years. He then left to found the Superior Corundum Wheel Co., which he started in a very small way with only a couple of men. It was undoubtedly through his personal efforts that this concern was built up to its present size. Three years ago he sold out his interests in the Superior Corundum Wheel Co. to the International Abrasive Co., and since that time he has been acting as manager, on behalf of the consolidated companies, for the Superior Corundum Wheel Co. Now he has entirely severed his connection with that company, and again associated himself with the Waltham Grinding Wheel Co.

Henry A. Klein, who designed and prepared for production the latest model for the Durant Motors Co., is now associated with the Eadie Trailer Corporation, 191 Ninth Ave., New York City, in charge of standardization of design and production of this company's patented devices for trailers and other four-wheeled reversible-tracking vehicles. The Eadie Trailer Corporation proposes to standardize this line, and as a parts manufacturer, supply its devices to manufacturers of reversible four-wheeled trailers, industrial trucks, etc., under license to use its models and devices. The Eadie Trailer Corporation was recently formed to take over the business of the Eadie Vehicle Gear Co., and among its officers and directors are Theodore D. Pratt, general manager of the Motor Truck Association of America, and A. L. Campbell, formerly chief engineer of Brewster & Co. John M. Eadie is president of the corporation.

* * *

TRADE NOTES

International Sales Co., 832 Hearst Bldg., San Francisco, Cal., has been organized to promote the export sales of American products. The company will open a central foreign sales office in Shanghai, China, from where its foreign sales activities will be directed.

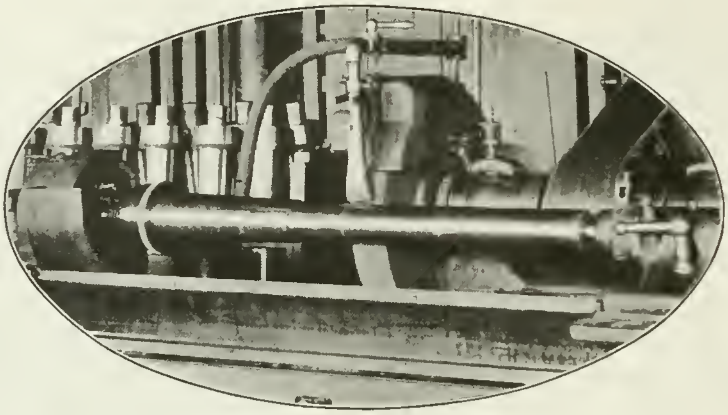
Solomon-Abbott Co., industrial engineers, 175 Fifth Ave., New York City, have changed their name to Abbott, Merkt & Co., Inc. There will be no change in the personnel of the present organization, except that G. R. Solomon will be active only as a director and stockholder.

Leiman Bros., manufacturers of air pumps for automatic feeders, folders, labelers, banders, and other automatic machines, have found it necessary, owing to the rapid increase in their business, to remove their New York office and show room to larger quarters at 60-62 Lispenard St.

Oilgear Co., 60 Twenty-seventh St., Milwaukee, Wis., manufacturer of variable-speed hydraulic power transmissions, has opened an office in Detroit, at 415 E. Jefferson Ave. Donald Clute, who formerly handled the sale of Oilgear products for the Cadillac Machinery Co., has been placed in charge of this office.

Doehler Die-Casting Co., Court, Ninth, and Huntington Sts., Brooklyn, N. Y., elected the following directors for the ensuing year at a recent meeting of the stockholders: H. H. Doehler, Charles Pack, John A. Schultz, Jr., H. B. Griffin, John Kralund, F. L. Duerk, John L. Pratt, A. P. Sloan, Jr., and E. J. Quintal.

American Electric Fusion Corporation has purchased a site for its new factory on Diversey Blvd., Chicago, Ill.



Two essentials for good work —High-grade Machines and

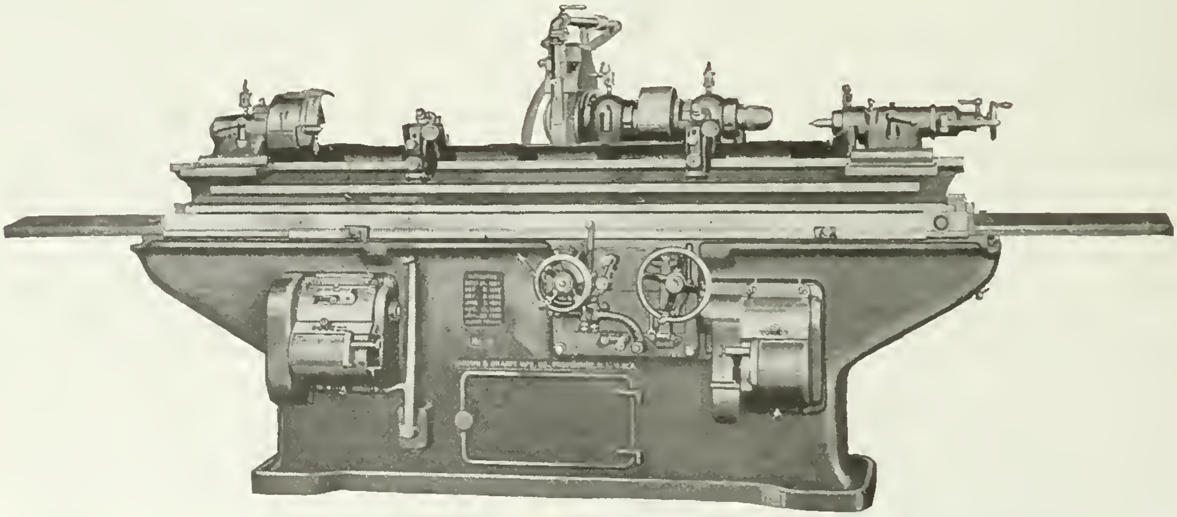
The quality of work a machine produces depends on the quality of the machine itself—particularly true of a grinding machine. To grind work to close limits with a smooth, even finish requires a machine correct in every detail of design and manufacture.

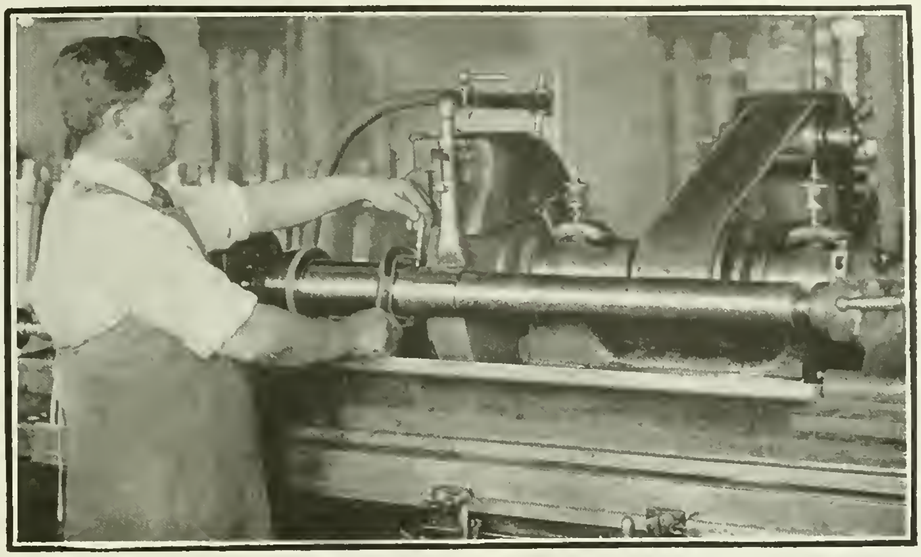
The combined skill of experienced engineers and expert workmen gives Brown & Sharpe Grinding Machines the qualities essential for producing good work. Manufacturers seeking a satisfactory solution of their grinding problems should consider the advantages of

BROWN & SHARPE

PLAIN GRINDING MACHINES

Send for Catalog No. 137





Reliable Machinists' Tools

Without reliable tools the mechanic working to close limits is at a serious disadvantage. The quality of his work and the speed of his production are largely influenced by the confidence he has in the tools he uses. Brown & Sharpe Tools are dependable and give men the confidence essential for good work. Every mechanic will be interested in

the new line of
REX MICROMETERS

Rex—a complete line of Brown & Sharpe Micrometers in 24 sizes covering a range from 0 to 24 in. Sturdy frame of I-section combines lightness with strength. The rectangular shape of the frame gives greater measuring capacity than a frame of the circular type. Every Rex Micrometer is regularly furnished with a Clamp Ring which locks the spindle and preserves the setting.

Write for Rex Circular

Look up Rex Set No. 135 shown in this circular. This set of six micrometer calipers measuring from 0 to 6″ will prove useful for the average work found in Grinding Rooms.

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U.S.A.

Rex Micrometers are Brown & Sharpe Tools

A program of expansion that will be carried through in 1923 includes plans for a total floor space of 80,000 to 100,000 square feet. The first unit, a two-story building of 20,000 square feet, is being erected now.

Harrisburg Mfg. & Boiler Co., Harrisburg, Pa., recently opened a sales office in the Park Row Building, New York City. The company manufactures boilers, tanks, steel stacks, breechings, and special steel plate and structural steel. It also makes a specialty of contracting to build entire lines of machinery for companies not having their own shops.

Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill., manufacturer and distributor of Hanna riveting machines, air hoists, sand sifters, Mumford molding machines, and the Milwaukee sprue cutter, is now represented in Detroit and surrounding territory by the Charron Engineering Sales Co., 1002 Real Estate Exchange Bldg., Detroit, Mich.

Superior Spring Co., Springfield, Ohio, manufacturer of Superior coiled wire springs, has found it necessary, owing to the increasing demand for its product, to double its previous capacity. The company reports that its 1922 business was more than double that of 1921, and the indications are that the demand in 1923 will require this increase in manufacturing facilities.

Harry E. Harris, Bridgeport, Conn., engineer specializing on manufacturing methods, has taken over the activities of Hubbard, Harris & Rowell, Inc., and will personally direct all the work of organization, installations, equipment designs, and economic investigations. The business will be carried on in the future under the name of Harry E. Harris, consulting engineer.

Blakely Mfg. Co., Fullerton Ave. and Monnier Road, Detroit, Mich., manufacturer of automobile shipping fastenings, has moved into a new modern factory, containing about 12,000 square feet of floor area. The company is equipping for increased production in its regular lines, and is also preparing to develop some new lines of shipping fastenings for the general manufacturing trades.

Reed-Prentice Co., announces that its New York office, Room 536, Singer Bldg., 149 Broadway, is acting as selling agent for the bench lathes and internal grinding machines manufactured by the Rivett Lathe & Grinder Co., Brighton District, Boston, Mass. The office is in charge of P. K. Dayton. The Rivett Lathe & Grinder Co. has had a similar arrangement with the Reed-Prentice Co. in the Detroit territory.

Edward Hollander Tool Co., 142 Miller St., Newark, N. J., has changed its name to Hollander-Westman Tool Co., and has moved to larger quarters at 566 Forest St., Arlington, N. J. E. Hollander is president, and J. Westman is secretary-treasurer. The concern will market the line of improved Hollander adjustable broaches and a department will be maintained for the manufacture of tools, jigs, dies, and special machinery.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., is erecting a $700,000 building in Chicago, located at West Pershing Road and Leavitt St. This building will be used for a combination district sales office, warehouse, and service shop, and is the first of three buildings to be erected by the company at this location in Chicago. It will be seven stories high, of reinforced concrete construction, and will have 218,000 square feet of floor space.

American Engineering Co., Philadelphia, Pa., manufacturer of Taylor stokers and marine auxiliaries, has taken over the Standard Crane & Hoist Co. and the patent and manufacturing rights to the mono-rail electric hoist formerly known as the "Standard." H. S. Valentine, chief engineer of the Standard Crane & Hoist Co., will remain with the American Engineering Co., directing the sales and supervising the manufacture of the hoists.

Miehle Printing Press & Mfg. Co. is erecting additions to its plant at 14th and Robey Sts., Chicago, Ill. Three new buildings will be erected and connected by a bridge with the present plant. One building will be used for machine shop, storage, packing, and shipping, assembling, erecting, and testing, and will also contain office, drafting-room and experimental department. A pattern shop and storage building and a blacksmith shop will also be erected.

Keller Mechanical Engineering Corporation, 74 Washington St., Brooklyn, N. Y., has succeeded the Keller Mechanical Engraving Co., the management remaining the same. The change in the name was made because the word "Engraving" did not accurately describe the business of the company, and the new name was adopted as better fitting the activities of the corporation, which builds die-sinking and mold-cutting machines, and also produces dies and molds.

Farrel Foundry & Machine Co. of Ansonia, Conn., and Buffalo, N. Y., has purchased the Sykes patents covering the United States and Canada, for the manufacture of double helical or herringbone gear cutting machines. This company will manufacture both gears and machines for the trade at its Buffalo plant where it now has a complete line of machines in operation ranging from the smallest to 15 feet in diameter. W. E. Sykes, of West Drayton, England, is at present with the Farrel Foundry & Machine Co. at the Buffalo plant.

Par-Con Co., Ltd., Bourse Bldg., Philadelphia, Pa., is a partnership formed by Earl Parent, formerly mechanical engineer for the Miller Lock Co.; William A. Parent, formerly general manager for the Dexter Metal Mfg. Co.; and Walter M. Conard, formerly secretary and purchasing agent for the Miller Lock Co. The new company will operate as material engineers for the mechanical development and sale of metal products, including finished and raw material of cast, sheet, bar, and wire products, as well as metal lockers, shelving, and office equipment.

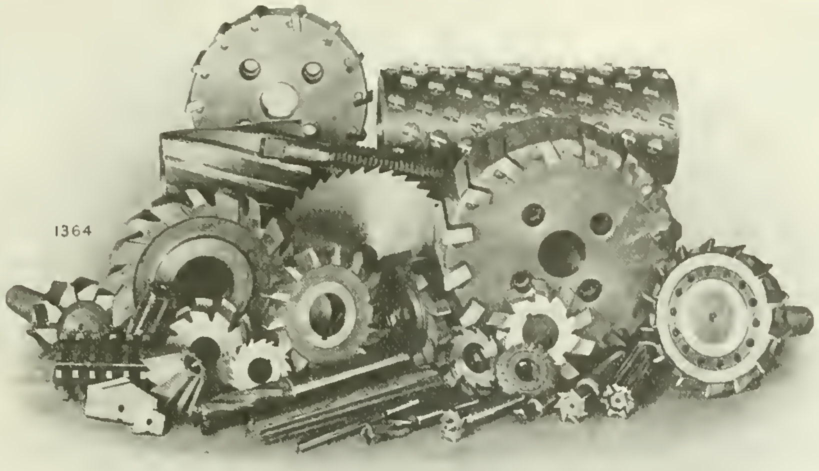
Associated Spring Corporation, New York City, has been incorporated under the laws of the state of New York. The incorporation embraces the following concerns: Wallace Barnes Co., Bristol, Conn.; William D. Gibson Co., Chicago, Ill.; Raymond Mfg. Co., Corry, Pa.; Barnes-Gibson-Raymond, Inc., Detroit, Mich., and the Wallace Barnes Co., Ltd., Hamilton, Ont., Canada. These concerns have all been in the business of spring manufacturing for many years. The new arrangement contemplates no change in either the management or the personnel of any of the organizations involved. Each business will operate as heretofore.

Standard Conveyor Co., North St. Paul, Minn., has acquired, by purchase, the rights and patents pertaining to the Brown line of portable and sectional piling, lifting, conveying, loading, and unloading machinery, for the handling of packed and loose material. This line of machinery has been manufactured by the Brown Portable Conveying Machinery Co. at North Chicago for ten years. The present plant will be continued in operation by the Standard Conveyor Co., and correspondence relating to this line should be addressed to the Standard Conveyor Co., Brown Portable Products Plant, North Chicago, Ill. The old organization will also be continued.

Hunter Crucible Steel Co., 6600 Grant Ave., Cleveland, Ohio, has acquired the plant and property formerly owned by the Electric Steel & Forge Co., Cleveland, Ohio. The new company will produce a full line of hot-rolled high-speed, carbon, and alloy tool steels, as well as automotive and special analysis steels. The annual tonnage capacity of the present facilities of the plant are 6000 tons of hot-rolled bars, and 12,000 tons of high-grade forgings. The officers of the company are Arthur H. Hunter, president; Frank B. Lounsberry, first vice-president; Donald W. Wells, second vice-president; A. B. Smythe, treasurer; L. H. Vinnedge, secretary; and F. J. Beebe, assistant secretary.

Rainey Tool Co., Cleveland, Ohio, have acquired the selling rights for the entire output of the factory of the Rainey Bros. Tool Co., Grove City, Pa. A. J. Bolger, formerly district manager for the Mid-West Mfg. Co., of Minneapolis, Minn., and D. C. Paul, formerly Cleveland branch manager for the Black & Decker Mfg. Co., are officers of the Rainey Tool Co., with headquarters in the Plymouth Bldg., Cleveland, Ohio. This company is manufacturing a complete line of tools for steam and pneumatic hammers, and miscellaneous hand tools for machinists, plumbers, and contractors. The factory will remain in Grove City, Pa., where additional ground has been obtained and a large building is being erected.

Gallmeyer & Livingston Co., 14 Campau Ave., N. W., Grand Rapids, Mich., has been incorporated with a capitalization of $450,000. In this company are consolidated the Valley City Machine Works, the Grand Rapids Grinding Machine Co., and the Union Machine Co. A new factory will be constructed immediately to house the consolidated organization. Practically all the products of the three original companies will be continued, which include twist drill grinders, tap grinders, universal cutter grinders, plain grinding machines, disk grinders, wet tool grinders, milling machines, single-, double- and multiple-spindle boring woodworking machines, universal saw benches, band saws, jointers, plain saw benches, and wood shapers. Christian Gallmeyer will be president of the new corporation; S. Owen Livingston, vice-president; William H. Gallmeyer, second vice-president; B. C. Saunders, secretary; and Charles H. Gallmeyer, treasurer. J. DeKoning will be executive superintendent. These officers, with Robert D. Graham, will constitute the board of directors.



Any cutter in the pile

can be quickly and correctly sharpened on the Cincinnati Cutter Grinder. The Patented Clearance Setting Dial has a lot to do with it.

No. 1½ Cincinnati Universal Cutter and Tool Grinder

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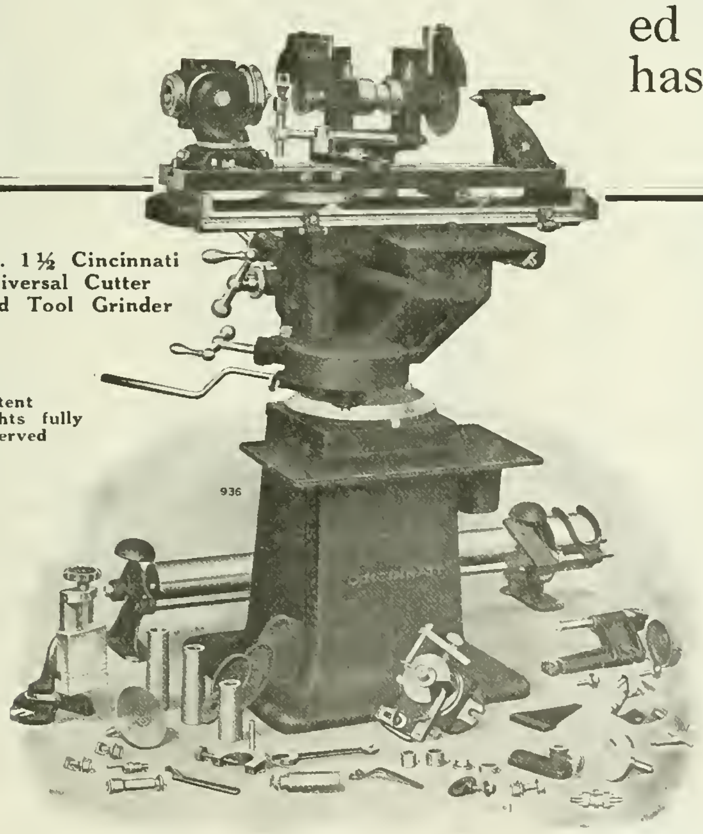

This machine takes work 10-in. diameter, 17 in. long. Has 11-in. table travel—9½ in. cross and 7-in. vertical. Will grind High Power Face Mills up to 12 in. in diameter and Standard Face Mills up to 16 in. diameter; formed cutters up to 5½ in. diameter, using a 4-in. diameter grinding wheel.

It is no trouble at all to grind correct clearances with the Cincinnati Patented Cutter Clearance Setting Dial. No clearance tables or diagrams are needed.

This is a big feature in the Cincinnati Cutter Grinder—no other grinder has it.

There are many other exclusive features, helping to increase production in hundreds of shops. *Let us give the full details.*

The Cincinnati Milling Machine Company

CINCINNATI, OHIO, U. S. A.

OBITUARIES

JAMES M. CARPENTER

James M. Carpenter, one of the pioneers in the tap and die industry, and founder of the Carpenter Tap & Die Co., Pawtucket, R. I., died January 24, at his winter home, in St. Petersburg, Fla., from pneumonia. Mr. Carpenter was in his eighty-fifth year at the time of his death. He was born in Cumberland, R. I. His early life, like that of many other leaders of industry, was a story of struggle and reverses in business, with ultimate success achieved by hard work and perseverance. He combined the qualities of a practical mechanic, an inventor, and a good business man. During the Civil War period he was a mechanic in the Burnside Rifle Works of Providence, R. I. Later he went to San Francisco, making the trip in a sailing vessel. There he worked at his trade for about a year and then returned East. In 1870 he went to Pawtucket and started the tap and die business which has ever since been identified by his name. This was begun on a small scale with a working force of only a few mechanics. Soon after, however, part of the present factory was obtained, and the business was expanded until finally the whole building was acquired and additions made.

Mr. Carpenter was president and treasurer of the company at the time of his death, and was widely known throughout the machine industry. Much of the machinery used in his plant was invented by him. During the last five years he had practically retired from active business. He is survived by his wife and one son.

JOHN ARMSTRONG

John Armstrong, president of the Armstrong Bros. Tool Co. of Chicago, died suddenly on January 28 at Chattanooga, Tenn., while enroute to his winter home at Seabreeze, Fla. Mr. Armstrong was born on December 16, 1866, in Chicago. He was the son of John Armstrong and Helen Lennox Armstrong, both natives of Scotland, who, with their four older children, came to Chicago in June, 1866, emigrants from their native land, looking for a home and a brighter future and broader opportunities for their growing family.

John Armstrong received a good training and common school education in the Annunciation Catholic Parochial School in Chicago, and started work at the age of thirteen in the manufacturing department of Charles Gossage & Co., dry goods merchants, where he remained until at the age of sixteen he was apprenticed to learn the patternmaker's trade with the Excelsior Iron Works, Chicago, where his father was employed as a blacksmith. About this time he entered night school and completed a course in mechanical drawing. While learning his trade he, in company with two older brothers, George and James, who were machinists, did considerable experimental work on automobiles, or rather steam-propelled vehicles, about 1884-1888. One of these "steam buggies," a three-wheeler front-wheel drive, was completed and successfully run on Chicago's streets in the neighborhood of West North Ave. and North Ashland Ave. in 1887.

With his brothers, John Armstrong began the manufacture of tool-holders for use on machine tools in 1890, in a one-story frame shop, 16 by 16 feet, built with their own hands on the rear of a lot owned by John Armstrong, Sr., at 78 Edgewood Ave., in the outskirts of Chicago. From this modest beginning grew the big plant of the Armstrong Bros. Tool Co., which was incorporated in 1895, and from which the Armstrong products are distributed to all parts of the world where machine tools are operated.

John Armstrong possessed many qualities which endeared him to his friends and business associates, but his deepest friendships were always with the "old boys," those who worked with him in the shop where he devoted so much thought and study to the development of Armstrong products. To his perseverance, knowledge and mechanical ability, the growth and success of the business was largely due.

Mr. Armstrong is survived by his wife and eight children, two sons and six daughters, his son, John O. Armstrong, being actively identified with his father's company.

A. H. BAUMAN, vice-president of the Cleveland Duplex Machinery Co., Inc., Cleveland, Ohio, died from influenza on February 4 at the East 105th St. Hospital in Cleveland after a very short illness. Mr. Bauman was thirty-two years old. He was born in Fremont, Ohio, and after graduating from the high school in that city, served an apprenticeship in the shops of the Lake Shore Electric Co., later going to Cleveland, where he became a toolmaker at the White Motor Co.'s plant. With the coming of the war, his services were requisitioned and he was made general foreman of the gun shop of the American Brake Shoe Co. at Erie, Pa. At the close of the war, Mr. Bauman became affiliated with the Cleveland Duplex Machinery Co., and was elected to the vice-presidency in October, 1921.

HOWARD M. WILSON, president of the Taylor-Wilson Mfg. Co., McKees Rocks, Pa., died suddenly at his office, February 16, aged sixty-one years. Mr. Wilson was born in Pittsburg and resided there all his life. He was graduated from the Rensselaer Polytechnic Institute at Troy, N. Y., in 1884. He had been a member of the Engineers' Society of Western Pennsylvania since 1886, and was also a member of the Pittsburg Chamber of Commerce.

CLARENCE S. BEMENT, formerly president of the Bement-Miles Co., Philadelphia, Pa., and a director of the Niles-Bement-Pond Co., New York City, died January 27 in New York, at the age of eighty, following an illness of several years.

OSCAR E. PERRIGO, for the last six years mechanical engineer with the Pratt & Whitney Co., Hartford, Conn., died January 25 at his home in Hartford. Mr. Perrigo was well known in the mechanical field as the author of several books, and in past years he wrote many articles for MACHINERY.

COMING EVENTS

March 13—Meeting of the American Society of Mechanical Engineers in the Engineering Societies' Bldg., 29 W. 39th St., New York City.

March 18-24—Second general meeting of the International Chamber of Commerce in Rome, Italy. Lacey C. Zapf, secretary American Section, Mills Bldg., Washington, D. C.

March 21—Joint meeting of the American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, and the American Institute of Electrical Engineers in the Engineering Societies' Bldg., 29 W. 39th St., New York City.

April 9-14—Paper Industries Exposition to be held at the Grand Central Palace, New York City. Charles F. Roth and Fred W. Payne, managers, Grand Central Palace.

April 16-19—Twenty-fifth annual convention of the National Metal Trades Association at the Hotel Astor, New York City. Secretary, L. W. Fischer, Peoples Gas Bldg., Chicago, Ill.

April 18-20—Spring convention of the Society of Industrial Engineers, at Hotel Gibson, Cincinnati, Ohio. Further information can be obtained from the business manager of the society, 327 S. La Salle St., Chicago, Ill.

April 19-21—Seventh annual meeting of the American Gear Manufacturers' Association, at the Hotel Cleveland, Cleveland, Ohio. T. W. Owen, 2443 Prospect Ave., Cleveland, Ohio, secretary.

April 28-May 3—Twenty-seventh annual convention and seventeenth annual foundry machine and equipment exhibit of the American Foundrymen's Association at Cleveland, Ohio. C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill., secretary.

May 2-4 (Note change of date from **April 25-27**)—Tenth National Foreign Trade Convention in New Orleans, La. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 3-5—Semi-annual meeting of the American Electro-chemical Society at Hotel Commodore, New York City. Secretary, Colin G. Fink, 327 S. La Salle St., Chicago, Ill.

May 7-10—Eleventh annual meeting of the National Chamber of Commerce in New York City at the Waldorf-Astoria Hotel. Secretary, D. A. Skinner, Mills Bldg., Washington, D. C.

May 15-18—Annual convention of the National Association of Purchasing Agents at Cleveland, Ohio. Secretary, O. H. R. Heydon, 19 Park Place, New York City.

May 17-19—Joint convention of the National Supply & Machinery Dealers' Association, Southern Supply & Machinery Dealers' Association, and American Supply & Machinery Dealers' Association in Cincinnati, Ohio. Secretary, F. D. Mitchell, 1819 Broadway, New York City.

June 11-14—Annual meeting of the Electric Power Club in Hot Springs, Va.; headquarters, Hotel Homestead. Executive secretary, S. N. Clarkson, Kirby Bldg., Cleveland, Ohio.

June 25-29—Annual convention of the American Institute of Electrical Engineers at Swampscott, Mass. For further information, address the secretary's office, 29 W. 39th St., New York City.

June 25-30—Twenty-sixth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa., secretary.

NEW BOOKS AND PAMPHLETS

Ideas for the Radio Experimenter's Laboratory. By M. B. Sleeper. 134 pages, 5¼ by 8 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, 75 cents.

This book contains information on the construction and use of radio laboratory instruments for amateurs and experimenters.

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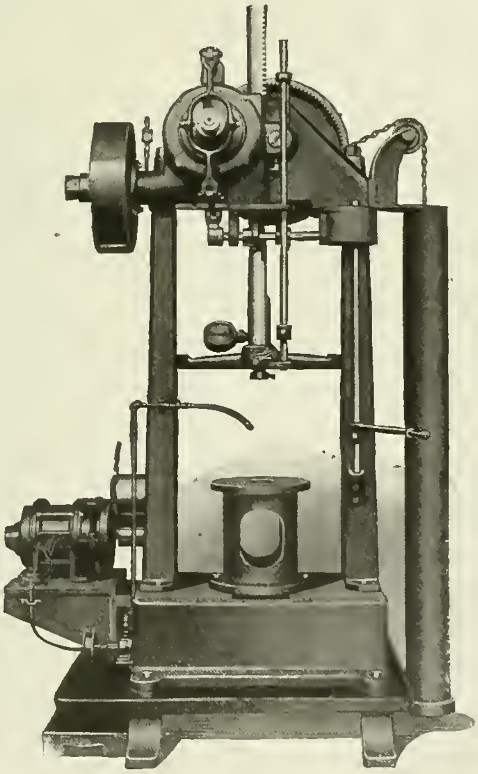

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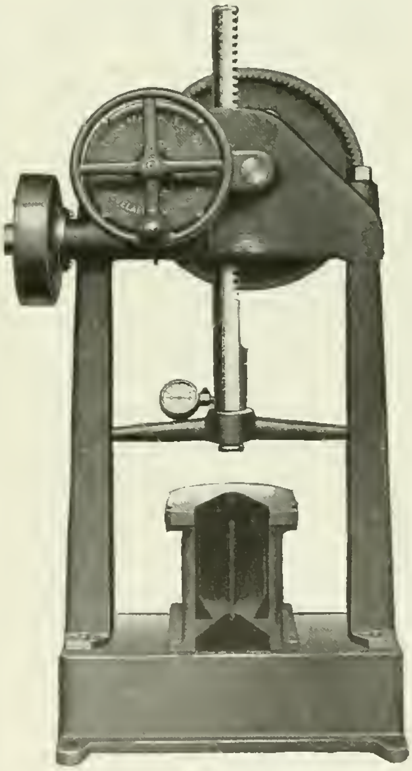


LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokio, Japan.

500 Plain Answers to Direct Questions on Steam, Hot Water, Vapor and Vacuum Heating. By Alfred G. King. 253 pages, 6 by 9 inches; 157 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $2.50.

This is the second revised and enlarged edition of a text-book treating of the science and general practice of heating. The work is arranged in question and answer form, and is intended as a guide for apprentice and journeyman fitters, as well as a reference book for master fitters, architects, and heating contractors. The important features of modern heating practice are covered, and many new heating systems and methods are illustrated and described.

Mechanical World Electrical Pocket Book for 1923. 326 pages, 4 by 6¼ inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 1s 6d. net.

The new edition of this well-known little handbook for electrical engineers contains a rewritten section on electrical measuring instruments, which describes the principal devices used, and contains a number of new illustrations. Another section is that dealing with plant, load, and diversity factors. The material on mercury rectifiers has been rewritten, and a new section has been added on power in alternating-current circuits. Other additions include material on the lead hydrate cell; cyc-arc welding; and transverters. A table of the properties of electrical insulating materials is also one of the new features.

Briquetting. By Albert L. Stillman. 466 pages, 6 by 9 inches; 160 illustrations. Published by the Chemical Publishing Co., Easton, Pa. Price, $6.

Although thousands of tons of briquettes are manufactured annually from all classes of raw materials, the only book published on this subject up to this time is a comprehensive work entitled "Handbook of Briquetting," by Professor G. Franke, translated from the German by Professor F. Lantsberry. The present book, therefore, is of particular interest, as it presents the subject for the first time from the American standpoint, and gives the result of the author's many years of experience with briquetting methods and machinery. The chapters that will be of particular interest in the machine-building field are those dealing with the briquetting of turnings, cast-iron borings, and non-ferrous metals.

Oxy-acetylene Welding and Cutting. By P. F. Willis. 254 pages, 4 by 6 inches; 99 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.50.

This is the sixth revised edition of a book treating of the use and maintenance of welding and cutting apparatus, and the welding of various metals including special castings and parts. It covers acetylene, oxygen and electric welding. The book is of an elementary nature which will appeal to the beginner, but it is also intended to meet the needs of the finished welder. The material is presented in eleven chapters headed as follows: Acetylene; Oxygen; Welding and Cutting Torch; Apparatus and Installation; Preparing for Welding; Welding of Different Metals; Welding of Sheet Metal and Pipe; Boiler Welding; Welding of Various Pieces; Welding Symbols; and Electric Welding.

Machinery Foundations and Erection. Edited by Terrell Croft. 691 pages, 5½ by 8 inches; 773 illustrations. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $5.

This book is one of a series on power plants, and is made up from material supplied by a number of different contributors. It presents in a simple way, without resort to intricate mathematics, the principles and methods of machinery and engine foundation, design and construction, and of machinery and engine erection, for the use of power plant engineers, works superintendents and millwrights. It discusses the proper proportions for foundations of various types; the selection of the proper type for a specific purpose; foundation installation and reconstruction; design and construction of foundations for machines and engines of all types; methods of erecting machinery and engines after the foundations have been built; and repair, enlargement, and removal of existing foundations.

Thomas' Register of American Manufacturers. 4200 pages, 9 by 12 inches. Published by the Thomas Publishing Co., 461 Eighth Ave., New York City. Price, $15.

This is the thirteenth edition of this well-known purchasing guide and directory, which covers all the manufacturing industries in the United States. The book embraces more than 70,000 articles and kinds of articles and contains over 300,000 names of manufacturers. It also gives a capital or size rating for each concern. The arrangement is the same as in previous editions, the book being divided into three principal sections, which are distinguished, for ready reference, by being printed on different colored paper. The first section, which is by far the largest section of the book, contains a classified list of the different products and the names and addresses of the manufacturers of each, arranged alphabetically, first by states, second by cities or towns, and third, by the firm names. This list is thoroughly sub-divided so that reference can easily be made to a specific class of manufacturers. The second section comprises an alphabetical list of manufacturers, giving the names, addresses, branches, successors, etc., and product. The third section contains an alphabetical list of the trade names of all the products included in the classified section, together with the name and address of the manufacturers. The book is thoroughly indexed and cross-indexed so that any product or class of manufacturers can easily be found. The appendix gives a list of the representative banks in the United States, the names and addresses and the name of the secretaries of commercial organizations, and a list of the leading trade journals in the country, including the name, address, and subscription price. Buyers and sellers will find this book a great aid in doing their work economically and efficiently.

NEW CATALOGUES AND CIRCULARS

Henry Disston & Sons, Inc., Philadelphia, Pa., manufacturers of saws, tools, files and steel is distributing a calendar for 1923 to the trade.

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, Ohio. Condensed catalogue of hand-, air-, and electric-molding machines, for steel, malleable, gray iron, brass and aluminum foundries.

General Bakelite Co., 8 W. 40th St., New York City. Booklet entitled "The Material of a Thousand Uses," illustrating the wide variety of electrical and mechanical uses of bakelite, condensite, and redmanol.

Hardinge Co., 120 Broadway, New York City. Catalogue 13, of Hardinge conical mills and their application to the field of grinding and pulverizing of abrasives and many other powdered or granular materials.

Long & Allstatter Co., Hamilton, Ohio. Calendar for 1923, illustrating the line of power punching, shearing, and forging machines manufactured by this company.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Circular pointing out the economies possible through the use of the "Liftabout"—a compact, powerful electric hoist recently brought out by this company.

U. S. Electric Welder Co., Cleveland, Ohio. Bulletin 23, outlining the distinctive features of United States Type S. A. F. resistance welding machines. The principal dimensions are given for the different styles and sizes.

Modern Machine Tool Co., 601 Water St., Jackson, Mich. Leaflet descriptive of a combination drill table and vise for use on drill presses. This equipment is made in two sizes having tables of 16 and 19 inches diameter, respectively.

Porter-Cable Machine Co., 1708 N. Salina St., Syracuse, N. Y. Loose-leaf catalogue containing illustrations and descriptive matter (including complete specifications) of Syracuse portable, motor-driven wood and metal sanders, grinders, and band saws.

Flather & Co., Inc., Nashua, N. H. Catalogue illustrating and describing Flather 13-inch standard engine lathes, 14- and 16-inch quick-change-gear lathes, 14-, 16-, 18-, 20-, 24-, and 26-inch double back-geared lathes, 11- and 16-inch tool-room lathes, and motor-driven lathes.

Perfection Tool Works, 209 Liberty St., Jackson, Mich. Leaflet describing the "Perfection" connecting-rod testing and straightening fixture for checking connecting-rods within one-half thousandth of an inch. This fixture is applicable to connecting-rods of any car or truck.

Edwin Harrington, Son & Co., Inc., 17th and Callowhill Sts., Philadelphia, Pa. Circular descriptive of Harrington chain hoists and travelers. Capacities and price lists are given for the "Peerless" hoist, the screw hoist, and the differential hoist made by this company.

Cincinnati Electrical Tool Co., 1507 Freeman Ave., Cincinnati, Ohio. Catalogue 18, illustrating and describing this company's complete line of portable electric drills, grinders and buffers Illustrations and tables of dimensions, capacities, speeds, etc., are given for the different tools.

Krieger Tool & Mfg. Co., Wisconsin Rapids, Wis. Leaflet containing instructions for using this company's crankpin tool for truing up automobile, truck, and tractor crankpins and main bearing journals; crankpin rounder; and universal reboring machine for boring the cylinders of automobiles and stationary engines in place.

Modern Machine Tool Co., 601 Water St., Jackson, Mich. Circular describing the Modern cutting-off machine, which is designed for cutting off gas-pipe, tubing, and solid bar stock, both round and hexagon. The machine is made in three sizes with capacities of 0 to 1 inch, 0 to 2 inch and 0 to 3 inch outside diameter, respectively.

Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletin 1003-A, illustrating and describing Type Q brakes used for stopping and holding rotating machinery. Their most general application is to cranes and other types of hoisting apparatus, although they are also widely used in connection with many other classes of electrically driven machines.

Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin 140 on the lighting of paper and pulp mills; bulletin 141 on automobile, garage and display room lighting; bulletin 142 on the lighting of woodworking plants; and bulletin 110-A on the lighting of textile mills. Bulletin 108-A on office lighting, and 112-A on light and safety, are also available.

Frank O. Wells Co., Inc. Greenfield, Mass. Circular descriptive of the "Threadwell" adjustable hexagon die, for producing accurate threads in production quantities. This die is adapted for use in releasing or non-releasing hexagon die-holders on screw machines, lathes, drill presses, bolt cutters, etc. Tables of dimensions and prices for the different sizes are included.

Beyer Machine Co., Jackson, Mich. Circular illustrating and describing the Baker adjustable angle-plate lathe fixture which is designed to do away with the old method of bolting and adjusting an angle-plate to the faceplate of a lathe. The fixture can be quickly attached to the lathe spindle, and readily adjusted transversely by means of a screw and wrench.

Universal Drafting Machine Co., Cleveland, Ohio. Catalogue describing universal drafting machines and their application. All the various types of drafting machines built by the company are clearly illustrated and applied as indicated. Numerous halftone illustrations of modern drafting-rooms are also included, showing plants where these machines are used.

Ingersoll Milling Machine Co., Rockford, Ill. Folder illustrating and describing a 100-ton adjustable-rail Ingersoll milling machine, capable of milling a casting 10 feet wide and 6 feet high. This machine will be used for milling large steel castings in the manufacture of vaults and safes. The folder also illustrates and describes Ingersoll inserted-tooth cutters.

Herman A. Holz, 17 Madison Ave., New York City. Booklet describing the Holz thetascope, an apparatus particularly useful for the determination of the lubricating efficiency of oils and greases, based upon their adhesive forces to metal surfaces; also folder entitled "Determining the Lubricating Efficiency of Oils," calling attention to the use of the Holz thetascope for this purpose.

Danly Machine Specialties, Inc., 1613 N. Lincoln St., Chicago, Ill. Catalogue illustrating and listing the Danly standardized die sets, leader pins, bushings, and dowel-pins for punch and die work. Also folder entitled "What Is the Time Between 'Grinds' on Your Dies?" containing a description of the Danly standardized and machined die sets, and component parts with drawings, tabulated data, and illustrations.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Publication 3015, treating of C-H lifting magnets, with special reference to the "Red" magnets. The features of the "Red" magnets are fully illustrated and described. Special mention is made of the method of control and the C-H magnetic controller and master switch furnished with Cutler-Hammer magnets. The numerous illustrations give evidence of the many and various applications of lifting magnets.

Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. Pocket-size edition of the company's catalogue, containing ninety-three pages descriptive of H & G, self-opening die-heads, covering the design, workmanship, and adaptability of these tools. The book is illustrated by fifty-six halftones and line engravings, and also contains many tables of value to those engaged in thread cutting. The catalogue has been put out in pocket size in order to be of greater value to the man in the shop.

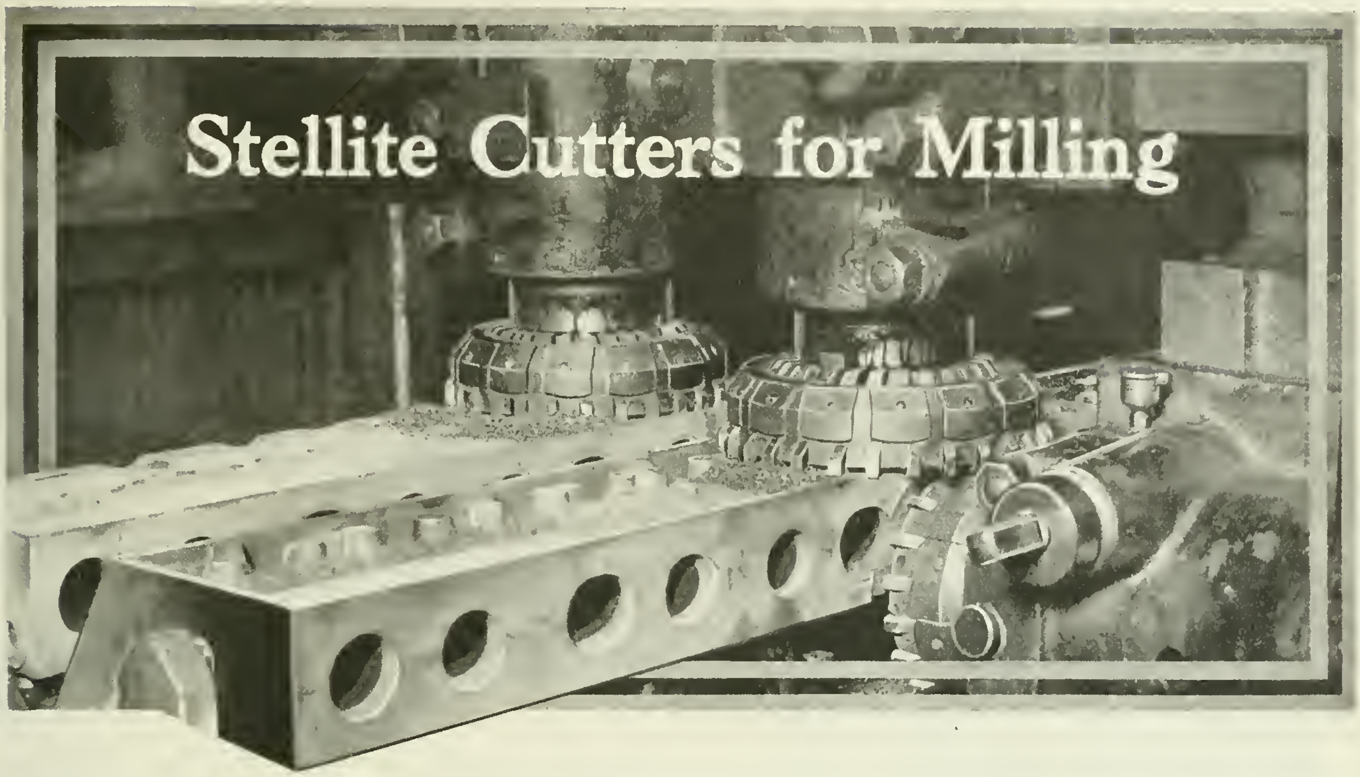
Cooke, Troughton & Simms, Ltd., Buckingham Works, York, England. Catalogue descriptive of the line of clinometers made by this concern for indicating or ascertaining vertical and angular values. One of the instruments described is an adjustable spirit level designed to meet the need of engineers who have to carry out leveling operations on shafts, machined surfaces, engine bed-plates, etc. This instrument not only establishes a true horizontal, but also measures the inclination of a shaft or surface to the horizontal.

L. S. Starrett Co., Athol, Mass. Revised supplement to catalogue 22, containing numerous new additions to the Starrett line of tools, including No. 224 micrometer caliper, No. 436 micrometer caliper, inspector's micrometer caliper gage, standard end measuring rods, micrometer depth gage, spring depth gage, sheet dial gage, vernier height gage, combination squares, drill point gage, screw thread gage, rolling mill gages, tap wrenches, thickness gages, center punches, nail sets, hand vises, hacksaw frames, and a new line of stainless steel, hardened and tempered rules.

Norton Co., Worcester, Mass. Catalogue of Norton grinding machines for railroad repair shops. The machines described have been selected from the entire Norton line as those that are especially adapted to the needs of this class of work. Among the machines included are the universal multi-purpose grinder, open-side surface grinding machines, car wheel grinding machines, and universal tool and cutter grinding machines. A general discussion of the use of grinding machinery in railroad repair shops precedes the description of the different types. Each type is described fully, and complete specifications are given.

APRIL MACHINERY 1923

Stellite Cutters for Milling



Design of Cutters for Milling Different Metals, and Directions for Grinding Clearance on Teeth

By C. W. METZGER, Haynes-Stellite Co., New York City

THE removal of metal in the shortest possible time by milling requires a sturdy machine in good condition and cutters correctly ground. Cutter grinding is an art in itself. The condition of the tool grinder is of just as great importance as the condition of the milling machine; and the location of the stops and the position of the tooth-rests are equally important. Stellite milling cutters are made in both the solid type and the inserted-tooth type. The inserted-tooth cutter has by far the wider application at present. The best results are obtained with either type when the teeth are fairly closely spaced, so that the cutting edges may be passed over the work rapidly, each taking a light cut.

Tooth Shape for Solid Stellite Milling Cutters

In the history of solid milling cutters, there have been many changes in tooth shape. Tables of clearance angles, profiles, number of teeth, etc. for milling cutters are given in engineering handbooks but these refer to carbon and high-speed steel practice only; and there is no standard for these values that is universally agreed upon. The usual type of top-rake or hook-tooth solid milling cutter, the profile of which is shown at the left in Fig. 1, has a great deal of chip space, obtained by using a coarse pitch. A top-rake tooth is not needed for solid stellite milling cutters except on very tough materials; the radial-tooth cutter shown at the right, having more teeth per surface covered, is preferred for taking light chips at high speed—the condition of greatest efficiency when using stellite cutters.

Let us consider the effect of top rake on the coarse-pitch tooth high-speed steel cutter, commonly termed "heavy-duty." This cutter permits of greater feeds, but in gaining some advantage in that respect, the extreme cutting edge projects so far from the body that it becomes necessary to draw the temper of the teeth considerably to obtain sufficient toughness. This means loss of durability when run at high speed. In the case of the coarse-pitch heavy-duty cutter, practically only one tooth is engaged at a time, as may be seen in Fig. 1. As the advanced tooth leaves the cut, it suddenly places an additional load on the second tooth, which has only just penetrated the work and started its chip.

On the other hand, with the fine-pitch radial tooth cutter, several teeth may be at work at a time, each taking a light chip; consequently, the strain on each tooth is less, so the cutter speed can easily be increased. The hook-tooth cutter is of no particular advantage in so far as stellite is concerned.

Inserted-tooth Milling Cutters

There is much more to take into consideration in the design of an inserted-tooth stellite milling cutter than in the case of solid cutters. As with solid cutters, the more blades there are, the less trouble is encountered in obtaining a good finish. The blades should not be set in the cutter body at too great an angle with the arbor hole (see Fig. 2), because this necessitates grinding the tooth to a rather thin edge that will not stand high speeds and the hammer-blow action to which each tooth is subjected. It is not reasonable to expect the same durability from a cutter having teeth set at an angle of 20 or 30 degrees, as from one with the teeth at an angle of, say, 6 degrees, as indicated in the lower part of Fig. 2.

The main idea in setting the blades into the body at an angle is to obtain cutting clearance, but this angle should not be so great that the cutting edge will not be supported properly. When the blades are set at an excessive angle, breakage is likely to result, an increased number of grindings is necessary, and the cutter will not operate efficiently except at low speeds where chatter is not so likely to occur. The body should be of steel and hardened; otherwise it may become marred on the back face from hard usage or in transportation, and this will prevent the cutter from being located true on the machine spindle. The back surface and the one against which the clamping nut bears must be parallel, so the cutter will be square with the spindle when clamped. These surfaces must also be square with the bore in the cutter body.

Arrangement and Angularity of Blades

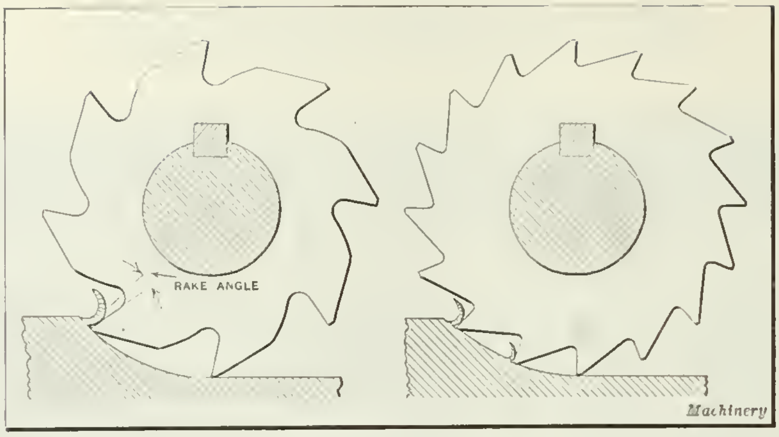


Fig. 1. Cutting Action of Milling Cutters of the Hook-tooth and Radial-tooth Types

The blades in a cutter intended for milling steel should not have more than 7 degrees top rake angle, while those intended for milling cast-iron and semi-steel should be arranged radially or with a very slight rake angle. Fig. 3 shows part of an inserted-tooth cutter used for cast iron or semi-steel, which has a large number of blades. When the blades are set comparatively close together, the slots for alternate blades are made less deep than the others. If the slots were all made the regular depth, they would weaken the body too much. The blades must be a snug fit in the cutter slots. If they are fitted loosely in the slots, they will shift under the cut, causing a rough finish and an early breakdown of the cutting edges.

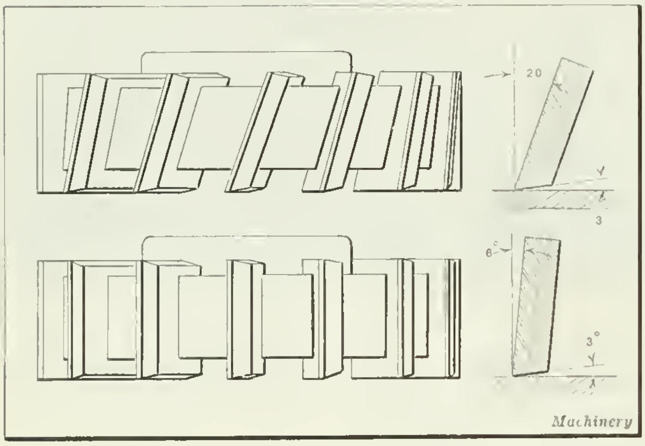


Fig. 2. Advantage of setting the Blades at a Comparatively Slight Angle in Inserted-tooth Milling Cutters

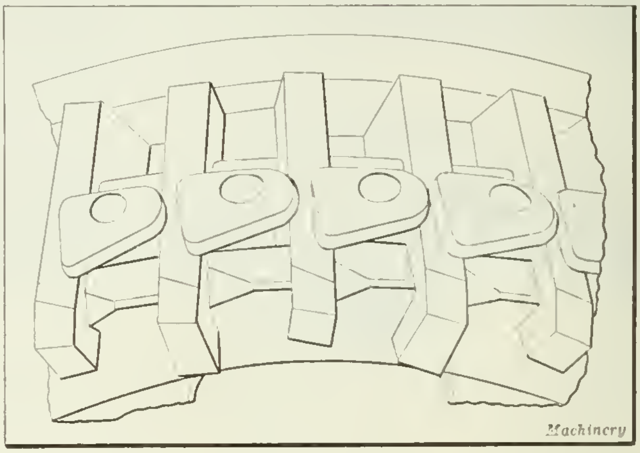


Fig. 3. Section of Inserted-tooth Stellite Milling Cutter for Cast Iron or Semi-steel

The blades may be held in place by clamps at the periphery, as shown in Fig. 3, and these may be arranged to hold the blades singly or in pairs. The blades may also be held by driving a taper pin into a slot between each pair of blades, or by slabbed taper pins driven against the side of each blade. The latter construction, while very common, is not recommended for stellite, because the blades will shift under the cut unless they are perfectly fitted in the slots and the

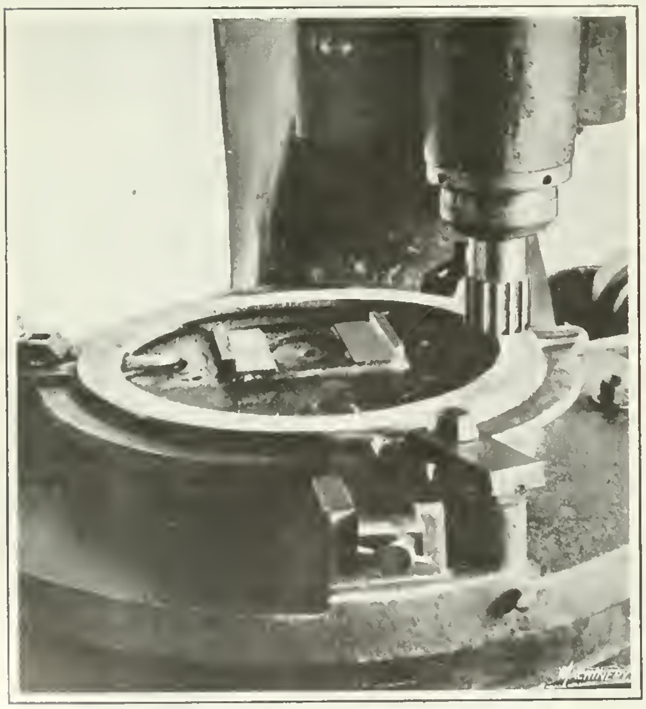


Fig. 4. Solid End-mill, 1¾ Inches in Diameter, 14 Teeth, milling Cast Iron; Cutter Speed, 210 Feet per Minute; Table Travel, 54 Inches per Minute; Depth of Cut, 3/32 Inch; Cutting Time, 42 Seconds; Pieces per Grind of Cutter, 380

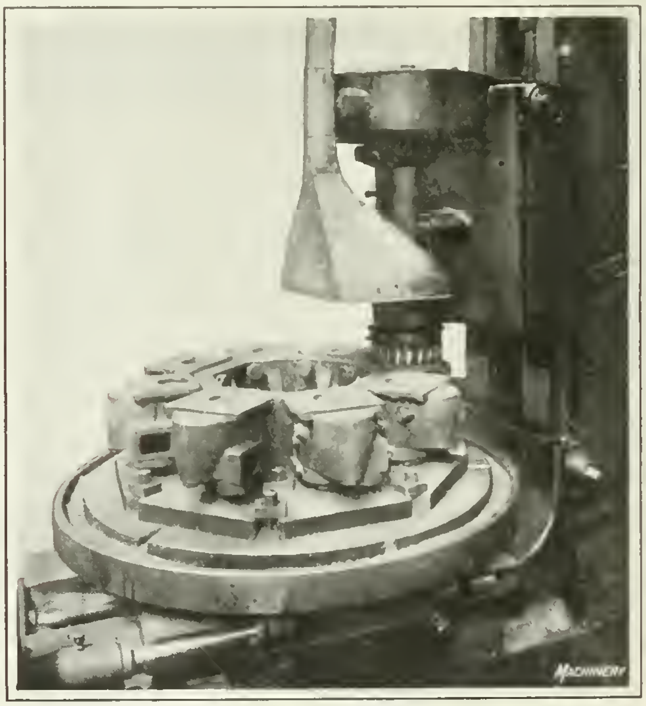


Fig. 5. Twelve-inch Diameter Cutter with 30 Blades milling Cast Iron; Cutter Speed, 147 Feet per Minute; Table Travel, 43 Inches per Minute; Depth of Cut, 3/16 Inch; Cutting Time, 30 Seconds; Castings per Grind of Cutter, 450

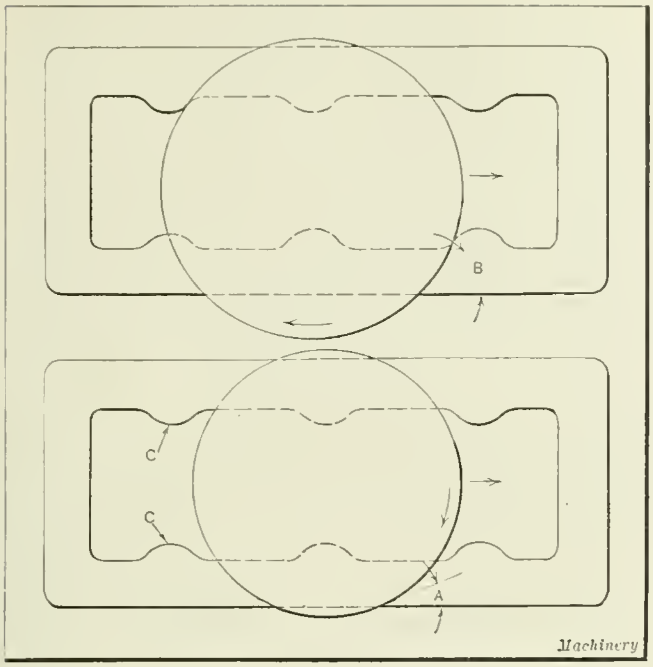


Fig. 6. Diagrams showing the Advantage of using a Face Milling Cutter somewhat Larger in Diameter than the Width of Surface to be milled

taper pins rest evenly against the blades. This is a condition that is difficult to maintain, especially in cutters with soft bodies, and the construction as a whole is expensive. With a fine-pitch cutter, where more blades are passing across the work per minute than in a coarse-pitch one, the hammer-blow action on each cutting edge is reduced, and there is no snapping out of one blade from the cut, upon the release of the cutting pressure, as is the case with a coarse-pitch cutter.

Large Cutters Recommended for Face-milling

For face-milling, the cutter should be larger in diameter than the width of the surface being machined. The diagrams in Fig. 6 illustrate this condition. When a casting is milled with a cutter that is just large enough to cover the width of the work, the angle of the blades as they emerge from the cut, designated by *A*, is too acute, and will cause the casting to chip off at the edge. If the casting is frail or is of the box type, there will also be a tendency for it to spring or to spread apart if the cutter strikes areas such as the two bosses *C* simultaneously. This may result in broken blades, fractured work, or low spots on the surface being milled.

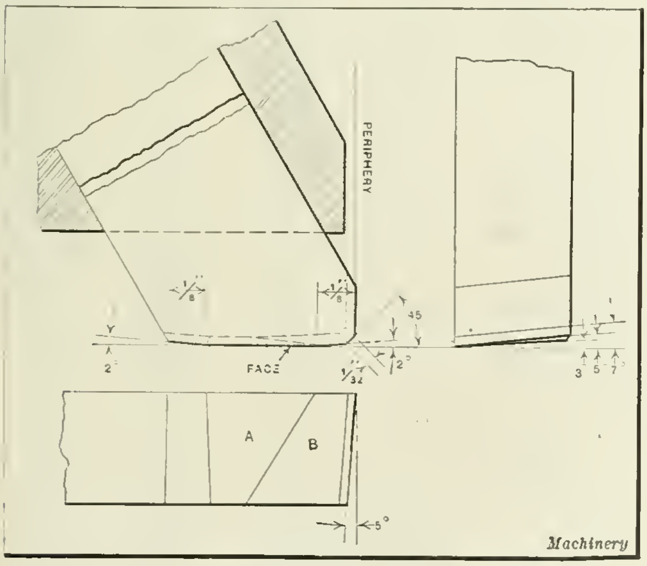


Fig. 8. Shape of Stellite Blade when the Machine Spindle is inclined 1 Degree

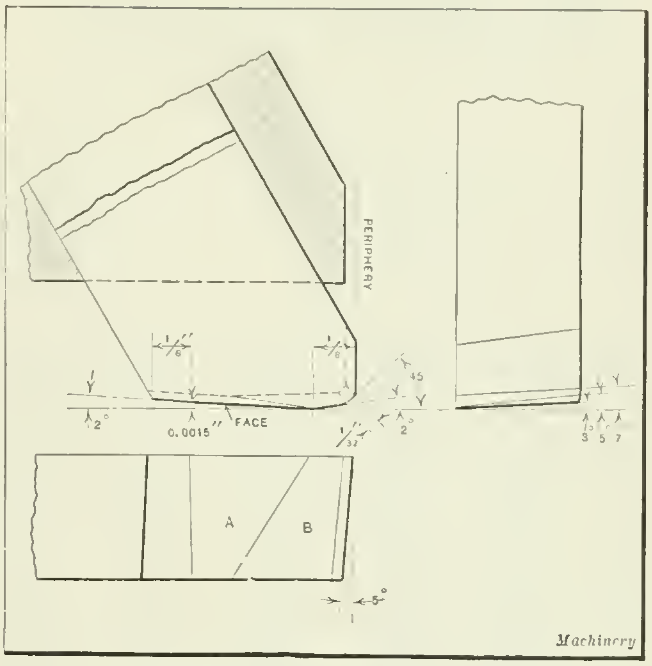


Fig. 7. Inserted-tooth Milling Cutter Blade as ground when the Cutter Axis is exactly at Right Angles to the Surface being milled

It is apparent, in the case of the large cutter shown in the upper part of the diagram, that when operated off center it strikes these bosses one at a time, so that the effects mentioned will not occur. Furthermore, the angle of the cutter as it emerges from the cut, designated by *B*, is not as acute as angle *A*; hence the work will not chip off at the edge. A large cutter will also give longer service per grinding.

Grinding the Cutters

The first operation in sharpening all stellite cutters—of the solid or inserted-blade type—is to grind the face at an 8-degree clearance angle. The second operation on the solid type consists of grinding a land on the cutting edge, 1/16 inch wide, with a 3-degree clearance angle. The object of grinding the larger clearance angle first is to leave a fine edge to facilitate the grinding of the 3-degree angle. This enables the desired results to be obtained more quickly and with greater accuracy.

Blades for inserted-tooth cutters are ground with the 3-degree land, to the forms shown in Figs. 7, 8, and 9. The clearance on the periphery of the blades is 5 degrees for a table travel of 8 inches per minute; 6 degrees for a

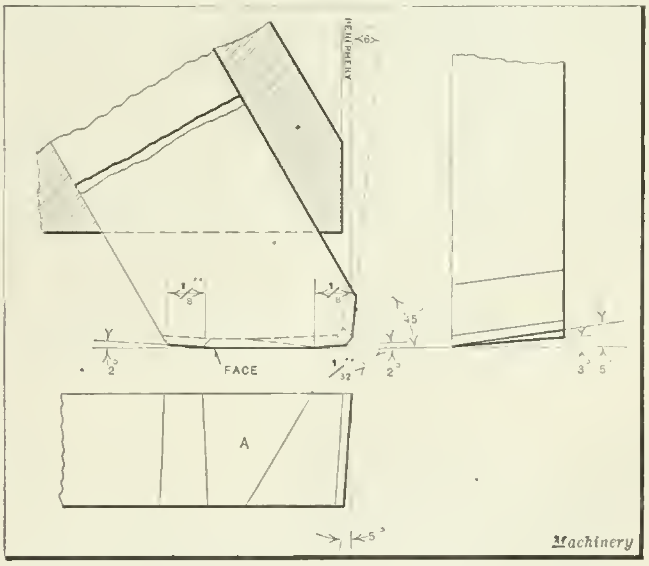
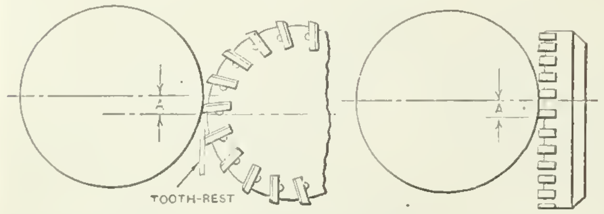


Fig. 9. Form of Stellite Blades used when Slow Speeds are employed and under Other Special Conditions

TABLE 1. DISTANCES FOR SETTING MILLING CUTTER BELOW GRINDING WHEEL FOR GRINDING FACE AND PERIPHERY CLEARANCES WITH DISK WHEEL



Diameter of Wheel	A for 3 Degrees Clearance	A for 4 Degrees Clearance	A for 5 Degrees Clearance	A for 6 Degrees Clearance	A for 7 Degrees Clearance
¾	0.020	0.026	0.033	0.039	0.046
⅞	0.023	0.031	0.038	0.046	0.053
1	0.026	0.035	0.044	0.052	0.061
1⅛	0.030	0.039	0.049	0.059	0.069
1¼	0.033	0.044	0.055	0.065	0.076
1½	0.039	0.052	0.065	0.079	0.092
1¾	0.046	0.061	0.076	0.092	0.107
2	0.052	0.070	0.087	0.105	0.122
2¼	0.059	0.079	0.098	0.118	0.137
2½	0.066	0.087	0.109	0.131	0.153
2¾	0.072	0.096	0.120	0.144	0.168
3	0.079	0.105	0.131	0.157	0.183
3¼	0.085	0.113	0.142	0.170	0.198
3½	0.092	0.122	0.153	0.183	0.214
3¾	0.098	0.131	0.164	0.196	0.229
4	0.105	0.140	0.174	0.209	0.244
4¼	0.111	0.148	0.185	0.222	0.259
4½	0.118	0.157	0.196	0.235	0.275
4¾	0.125	0.166	0.207	0.248	0.290
5	0.131	0.175	0.218	0.262	0.305
5¼	0.138	0.183	0.229	0.275	0.320
5½	0.144	0.192	0.240	0.288	0.336
5¾	0.151	0.201	0.251	0.301	0.351
6	0.157	0.209	0.262	0.314	0.366
6½	0.170	0.227	0.283	0.340	0.397
7	0.183	0.244	0.305	0.366	0.427
7½	0.197	0.262	0.327	0.392	0.458
8	0.210	0.279	0.349	0.418	0.488
8½	0.223	0.297	0.371	0.445	0.519
9	0.236	0.314	0.392	0.471	0.549
9½	0.249	0.332	0.414	0.497	0.580
10	0.262	0.349	0.436	0.523	0.610

Machinery

table travel of not more than 15 inches per minute; and 7 degrees for a table travel up to 20 inches per minute. An increase in the rate of table travel means an increase in the peripheral clearance to prevent the heel of the cutter blade from striking the work. The two accompanying tables give the distances for setting the grinding wheel relative to the cutter for grinding the various angles; the first refers to the use of a disk wheel, and the second to the use of a cup-wheel. They apply to both solid and inserted-blade cutters.

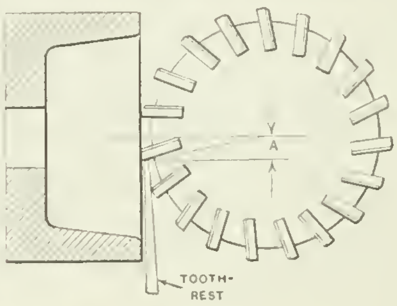
Table 1 gives the distances that the center of the cutter must be below the center of the grinding wheel when grinding the face clearance angles or the periphery clearance angles. These angles are from 3 to 7 degrees in magnitude, the largest grinding wheel size being 10 inches in diameter. Table 2 gives the distances for setting the tooth-rest below the center of the cutter when grinding peripheral clearance angles of from 3 to 7 degrees inclusive with a cup-wheel, for cutters up to and including 14 inches in diameter.

When the axis of the cutter is exactly at right angles to the surface being milled, the blades of an inserted-tooth face milling cutter are ground as shown in Fig. 7, with a 5-degree clearance on the periphery, a clearance on the face *B* of 5 degrees, and a clearance of 3 degrees on the face *A*. There is a 1/32-inch flat on the 45-degree bevel at the corner, with 7 degrees clearance. Both faces *A* and *B* are ground at an angle of 2 degrees to prevent tool marks.

On some planer type milling machines, the spindles are inclined at an angle of 1 degree to the vertical or the horizontal. In that case the cutters are ground as shown in Fig. 8. This form is used principally for finishing or for taking one cut only. The periphery clearance is 5 degrees. The blades are ground so that the edge of the blade at the face will be straight, with a clearance of 3 degrees. The face *B* has a 5-degree clearance, the same as in Fig. 7. Both the heel and toe are ground at an angle of 2 degrees.

When it is not possible to obtain the proper cutting conditions for stellite cutters, and slow speeds must be employed, the blades are ground as in Fig. 9. This method of grinding is also used frequently on intermittent milling operations, and where the blades of two cutters interlock or take alternate cuts. When milling a surface at 90 degrees with a face that has already been finished, especially if taking a heavy cut, the work will probably chip off where the two finished edges come together, unless this tooth form is adopted. It should also be used when milling a light casting or one having thin walls, ribs, or flanges. In case several cutters are working on one side of a casting and only one on the opposite side, it is best to have the cutting edge of the surface *A* parallel with the work on the single cutter side.

TABLE 2. DISTANCES FOR SETTING TOOTH-REST BELOW MILLING CUTTER CENTER FOR GRINDING PERIPHERY CLEARANCES WITH CUP-WHEEL



Diameter of Cutter	A for 3 Degrees Clearance	A for 4 Degrees Clearance	A for 5 Degrees Clearance	A for 6 Degrees Clearance	A for 7 Degrees Clearance
¾	0.020	0.026	0.033	0.039	0.046
⅞	0.023	0.031	0.038	0.046	0.053
1	0.026	0.035	0.044	0.052	0.061
1⅛	0.030	0.039	0.049	0.059	0.069
1¼	0.033	0.044	0.055	0.065	0.076
1½	0.039	0.052	0.065	0.079	0.092
1¾	0.046	0.061	0.076	0.092	0.107
2	0.052	0.070	0.087	0.105	0.122
2¼	0.059	0.079	0.098	0.118	0.137
2½	0.066	0.087	0.109	0.131	0.153
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4¼	0.111	0.148	0.185	0.222	0.259
4½	0.118	0.157	0.196	0.235	0.275
4¾	0.125	0.166	0.207	0.248	0.290
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5½	0.144	0.192	0.240	0.288	0.336
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6	0.157	0.209	0.262	0.314	0.366
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8½	0.223	0.297	0.371	0.445	0.519
9	0.236	0.314	0.392	0.471	0.549
9½	0.249	0.332	0.414	0.497	0.580
10	0.262	0.349	0.436	0.523	0.610
10½	0.275	0.367	0.458	0.549	0.641
11	0.288	0.384	0.480	0.575	0.671
11½	0.301	0.401	0.501	0.602	0.702
12	0.314	0.419	0.523	0.628	0.732
12½	0.328	0.436	0.545	0.654	0.763
13	0.341	0.454	0.567	0.680	0.793
13½	0.354	0.471	0.589	0.706	0.824
14	0.367	0.489	0.610	0.732	0.854

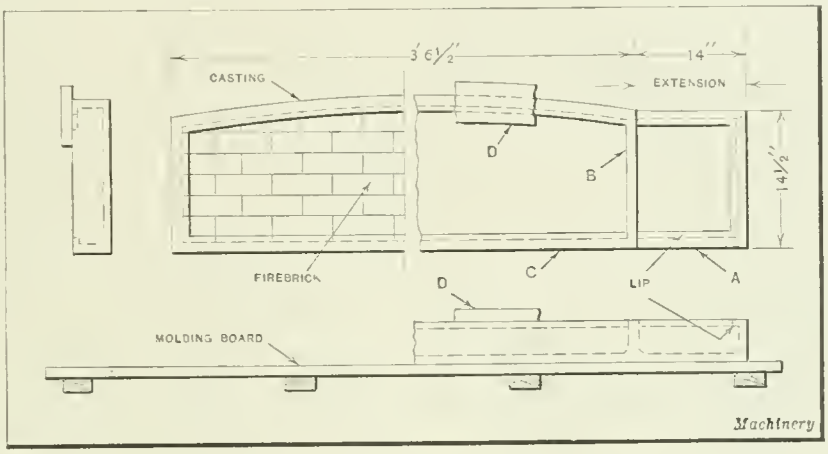
Machinery

Instead of this special shape, blades ground with a large 45-degree angle are often used with slower speeds. The shape in Fig. 9, however, is more efficient, because the toe of the blade, when ground as shown, can get under the hard scale, while the edge of a broad corner becomes dull rapidly.

The various methods of grinding shown apply to the milling of cast iron and semi-steel; for steel, the face is ground to a sharper angle. In milling aluminum with an inserted-tooth milling cutter, the blades are set at an angle in the body to give them a negative rake of about 6 degrees, although some manufacturers use the types of cutter blades recommended for cast iron. Negative rake allows the blades to strike the hard spots in cast aluminum called "nigger heads," which extend above the cutting edge and have a tendency to dull the tool.

Inspection of Cutters

It is almost needless to state that the cutters should never be returned to the milling machine after grinding without being inspected. For this purpose, special inspection methods are in common use, in which an indicator is employed to test the relative positions of the cutting edges. If some blades are allowed to project even slightly beyond the others, tool marks result. When a few high teeth do all the cutting, the cutter will work with equal efficiency and as economically if some of the blades are removed, because the metal is being continually ground away from several teeth that do no actual cutting. These high teeth also dull very quickly and leave a rough finish, because of the land worn on their cutting edge.



Half-section of Muffle Furnace Door lined with Firebrick; and Half-section of Pattern as arranged to produce a Longer Door Casting

Often an operator will stop his machine to inspect the cutter, because he sees that the surface of the work is not smooth. The dull teeth will have a certain amount of brake power, and may be under the cut when the machine comes to a stop, and the teeth that are seen will appear sharp. When cutting is resumed, the dull teeth are often broken out, with resultant damage to the cutter body and the surface of the work.

* * *

INCREASING THE SIZE OF A STANDARD PATTERN

By M. E. DUGGAN

The patternmaker is often called upon to make temporary changes in a pattern so that it can be used in the production of a special casting. In the present article, the use of extensions as a means of increasing the size of a pattern for a muffle furnace door is described. The extensions, one of which is shown at *A*, are 14 inches long. As only two of the special castings were needed, the patternmaker was instructed not to change the standard pattern. However, he decided that the ends *B* of the standard pattern must first be removed, and that the extension pieces at each end should be fastened to the body pattern *C* with stop-off strips temporarily fastened with screws to the sides of the pattern. The retaining lip pattern was made in the form of a frame, separate from the body pattern, and loosely held in place by wire nails, which served as dowel-pins.

The pattern was to be made in a two-part flask. In order to preserve the standard lip frame for future use, a new frame was made to correspond with the dimensions of the altered pattern. In making the new frame—which was intended to be used in the production of two castings only—the patternmaker did considerable work that was uncalled for and unnecessary. First, he made the lip frame, and on this frame built a core-print ¾ inch in thickness and 2 inches wider than the lip. The core-print, therefore, overlapped the lip on each side a distance of one inch. He also made two core-boxes, one for the curved top, and one for the straight section. These core-boxes were made approximately 24 inches long, so that two cores were required to reach the entire length of the pattern.

The removal of the end pieces from the standard pattern was unnecessary. As only two of the special castings were required, the two cavities left in the mold by the end pieces, after withdrawing the pattern, could be easily filled up and smoothed over by the molder. For the extension pieces, all that was required was two boxes, each consisting of a bottom and two sides, as shown in the illustration. The one-piece lip frame—although considered good patternmaking practice—was not required. This frame could have been made of short sections or pieces temporarily held in place with short wire nails. The wire nails, acting as dowel-pins, should be a tight fit in the frame and a loose fit in the body pattern.

The way in which the mold was actually made was as follows: The pattern was placed with its bottom down on a molding board, as shown in the lower view. On the molding board were placed the extension pieces *A* with their open ends against the ends *B* of the pattern. The lip frame or lip sections were next placed in position on the pattern. The wire nails in the frame, acting as dowel-pins, served to hold the loose ends in place against the ends *B*. The drag flask was next placed around the pattern on the bottom board. Sand was then shoveled in up to the top of the loose-lip frame, and the surplus sand struck off, after which the frame was lifted and the mold finished in the usual way. Cover or "ram-up" cores, as they are commonly called, were then placed over the space left by the lip frame. A section of one of these cores is shown at *D*. The cover cores could have been made from pieces of cores of various lengths. The pieces used for this purpose should, of course, be wide enough to provide a good bearing surface on the molding sand. When the cover cores were set in place, the filling in of the sand was continued to the top of the drag flask, which was finished in the usual way. The drag flask with the pattern in place was then rolled over ready for the cope flask. The cope flask was placed on the drag, after which it was filled in with sand and rammed up.

The cope was next lifted and the pattern withdrawn, the extensions being drawn first. After mending the mold, the cope was placed back on the drag and locked in place; the mold was then ready for pouring.

* * *

The cost of transporting materials by different means is compared in the Journal of the Society of Automotive Engineers. It is stated that $1 will haul a ton of freight 9 miles by horse and wagon; 24 miles, over good roads, by motor truck; 185 miles by railroad; 230 miles by canal; and 3000 miles by ship on the high seas.

Work-holding Surfaces of Machine Tools

Table Design for Different Types of Machines—First of Three Articles

By FRED HORNER

MACHINE tools are generally designed and built around the work-holding surface, the next consideration being the matter of holding and operating the tool. Without an efficient work-holding medium, a machine cannot be made to operate successfully. The early method of always fastening the work directly to a certain surface gave way to the use of special holding devices, jigs, and fixtures in connection with this surface. Of recent years, single-purpose machines have been built with special holding appliances that have nothing in common with ordinary tables or plates. These appliances are usually not adaptable for more than one part, nor is it intended that they should be. Sometimes an ordinary table surface is provided, on which is mounted a supplementary table having suitable supporting faces to receive the special shapes of pieces to be machined. Most machines, however, are built with ordinary holding surfaces adapted to securing any usual shape of casting or forging, together with special jigs, fixtures, centers, angle-plates, and other accessories.

Holding Conditions Vary with the Type of Machine

Certain variations regularly occur in holding surfaces, these variations being demanded by the shape of parts, direction of thrusts, or considerations of convenience in making adjustments. The conditions with a small table of a foot or so in width are not the same as those with a large baseplate. Neither are the cutting conditions similar, for instance, on a drilling machine and a planer. The thrusts and shocks are vastly different in the two. Furthermore, some classes of machines require greatly increased facilities for applying bolts and clamps, either because the work is varied and awkward to secure, or because the parts must be set up on the machine in quantities. There must also be possible the rapid transposition of bolts and stops about the clamping area to suit the best positions. Finally, reserve positions should be left for extra clamps, stops, struts or angle-plates, for effectually blocking the work against movements unexpectedly found to take place when machining the part.

Another factor in design that particularly affects some machine tools relates to abnormal capacity. Given a definite extent of holding surface of, perhaps, 3 by 5 feet, the problem may arise of how to make this surface accommodate abnormal sizes. Lately, this point has received much attention; for example, most milling machine tables now have a greater holding surface than was formerly the rule with a machine of the same size, the alteration having been brought about by raising the rim of the oil-pan surrounding the table to the table level, and machining it off uniformly. Thus, although the draining provision is still there, the table is in effect longer and wider, and equal, for many purposes, to the table on the next size of machine. The extension of the T-slots into the suitably thickened rim adds still further to the usefulness of the new construction.

Supplementary Supports

Another manner in which increased area may be obtained is by the bolting on of a supplementary plate, such a device being sometimes employed on shapers and boring and drilling machines. A cheaper and quicker scheme consists in placing a strip or bar, or a pair of these, so as to overhang the table and sustain a long object. Still another method that is handy with slides on long beds is to add a narrow table at a suitable place on the bed so that the piece overhanging the main table may rest on the supplementary one. This problem partly depends on whether the work moves or not, and is usually more difficult in the former event. Stationary work may be readily blocked up on the shop floor, or on a baseplate, whereas moving work must rest on a true surface, or be arranged upon a slide or a roller device which will maintain it in true alignment with the tools for the extent of the travel or adjustment.

Instead of altering the position of a cross-rail, drill head, or arm for a small number of pieces, it may be simpler to provide a supplementary support or table to raise the work. If the weight of the work is not too great, or its bulk prohibitive, a vertically adjustable table supplies a solution to the difficulty, and possesses the advantage of easy change of horizontal location, by swinging, sliding, or rotary movements. But should the work be too bulky or awkward to secure, the preference lies with a low base, on which the work remains stationary and the tool is adjusted to suit.

Thrust Factor in Table Design

The matter of thrust has an important bearing on table design. Sometimes the tool pressure is in a direct line

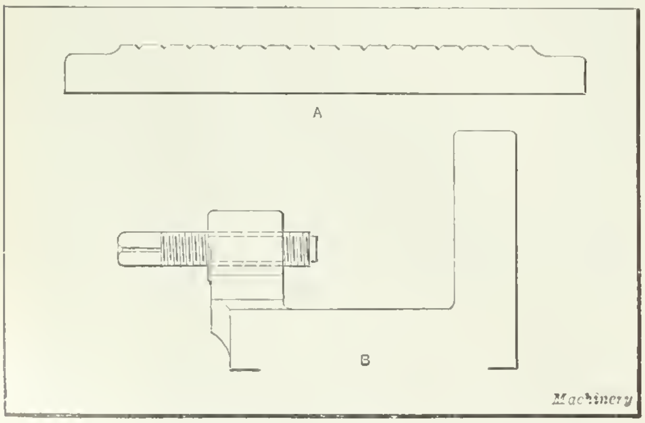


Fig. 1. (A) Grooves provided on Grinder Table to remove Dirt from Supporting Surface; (B) Arrangement employed for clamping Rails on Drilling Machine Table

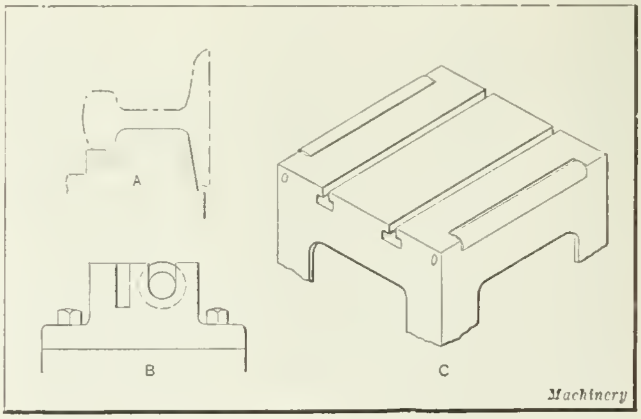


Fig. 2. (A) Holding Surface having a Contour Similar to the Profile of the Part it supports; (B) Roller Support for Drilling Machine; (C) Roll Table

against the holding face, at right angles to it, or in an oblique direction. Some machines have thrust always in one direction, others in two opposite directions, while still others may have thrust from all points of a circle. Special provisions are necessary to take thrust on planers and milling machines not only in a direct line with the cutting pressures, but radially also, because the tendency of the tool when at a corner is to swing the work around on the table. Side stops prevent this. On a boring mill table there are severe side and twisting pressures, and when the chuck jaws do not surround the work effectually, it is necessary to use screw stop-pins or stop-plates. In such examples as the foregoing, there must consequently be ample facilities in the table construction for the reception of stop-plate bolts, plain round stops, or angle-plates, without interfering with the use of plenty of holding-down bolts.

If castings are high, their overturning tendency must also be taken into account. This necessitates an ample space around the base of such castings for placing adequate blocking, angles, or struts. With repetition production, the difficulty is reduced, because jigs or fixtures can be employed to locate and secure awkward shapes on a smaller size of table than would otherwise be necessary. In special instances, stops alone are used, as with magnetic chucks where the side thrust is not resisted effectively by the magnetic pull. Here T-slots are only occasionally employed for holding-down bolts.

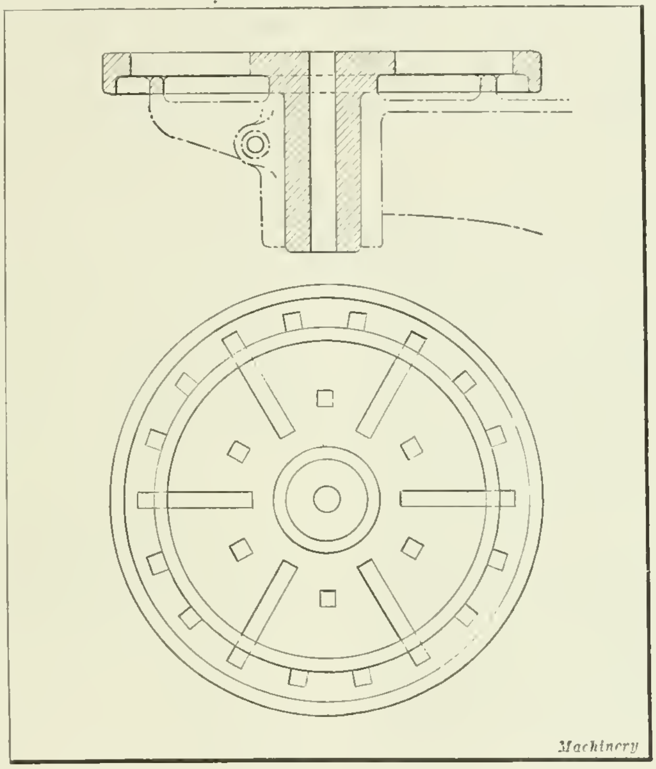


Fig. 3. Drilling Machine Table with Through Holes and Slots

Either horizontal, vertical, or inclined holding surfaces are met with in most types of machine tools. The fact that the holding surface lies in one or another of these planes may or may not make an essential difference in holding the work, lubrication, and other details. Modifications of T-slots are sometimes met with in vertical surfaces to prevent slippage of bolts, while modified designs of coolant pans or rims become essential when the plane is changed from the horizontal. Difficulties encountered with very heavy jobs may necessitate the addition of narrow adjustable tables or angle-brackets, to sustain the weight during the adjusting and bolting, but frequently the same service is supplied by wood blockings resting on the floor or at the bottom of a pit when the latter is provided for deep work.

Plain Work-holding Surfaces

A detailed examination of the principal features of holding surfaces provided on machine tools will now be made. The first class of surface to be considered will be the simplest—that where the job is laid on and held by the hand alone. The part is laid on a smooth rest or table, and the cut taken by pushing up to the wheel on a grinding machine or feeding the drill on a drilling machine. A factor that militates against accuracy in grinding is the presence of dust between the table and the under side of the part. This difficulty is lessened only by frequent wiping off. If the operation is comparatively accurate, the trouble can also be reduced by providing V-grooves on the resting surface, as shown at *A*, Fig. 1, or deeper U-shaped grooves to catch the dirt as the piece is slid along. The ridges also assist in securing a better frictional grip. Guide strips and protractors are applied to disk-grinder tables, to locate and support objects in definite positions relative to the disk wheels. The holding down still depends on the hand, but accuracy as to angles comes from the presence of the strips, which also take the lateral thrust.

On disk and other grinders, a strong clamp is often used to hold down the parts being ground, a quick-acting cam device being favored for the sake of rapid changing. On some drilling machines specially designed for such parts as long strips or rails, a plain table provided with a back-plate receives the rails, and these are gripped by means of a lateral screw as shown at *B*. A similar idea is followed in saw machines for cutting long strips, girders, and rails, either singly or in multiple, plain holding surfaces being utilized in conjunction with clamping screws, with or without special shaped pads on their ends. When a close and firm support happens to be desirable, a departure can be made from the plain flat surface and a profile surface provided, such as illustrated for a rail at *A*, Fig. 2. Supports like this may be interlocked, one above another, and the whole clamped down with a screw and pad.

Another case where there is no need for a slotted table, with bolts and clamps for securing the work, is in the drilling of long girders, plates, and other parts for constructional work on a multiple-spindle machine. Frequently sufficient support is provided by a series of narrow brackets, which hold the girders on their top edges. Bolt slots may or may not exist on these narrow tops, but if they do, their chief function is to fasten stop-plates for controlling the cross position of the long pieces as they are slid along under the drill spindles. The need of rapidly sliding heavy jobs with the minimum of effort sometimes renders the addition of rollers desirable, as illustrated at *B*. A wider table with slots for general work may likewise possess rollers at the ends, as shown at *C*.

Securing Bolts to Surfaces by Tapped Holes

The means for securing bolts to work-holding surfaces include tapped holes, plain through holes or slots, dovetail slots, and T-slots. The relative merits of each vary according to circumstances, such as the frequency with which the bolts must be changed or loosened, the respective changes in their position, the strain imposed, the positions of the surfaces clamped, and the facility with which the bolts can be put in place and removed. Generally speaking, tapped holes are only suitable in cases where the bolts do not require frequent changing. Tapped holes may lose their size, and the threads may lose their effectiveness of hold, with repeated use. This difficulty never occurs with plain holes or slots under the most severe duty. Heavy side pressures are also detrimental to the durability of the threads, causing them to lose their shape, especially in cast-iron tables.

A further objection to tapped holes is their liability to choke up with dirt, fine chips, and lubricant. While this may be obviated by the insertion of plugs during periods of non-use, the time occupied by the insertion and removal and the risk of neglecting to do so are a distinct drawback. The principal advantage of tapped holes lies in the fixedness of their position, so that the screws when manipulated cannot slide to the right or left, as in a slot. This feature is especially advantageous when clamps are required to remain in the same position for successive pieces.

A good many shaper and grinding machine tables are supplied with threaded holes, the latter being also furnished on the work-holding surfaces of continuous milling machines of both the vertical and the horizontal types. Upstanding ledges or tongues are largely used in these cases to receive the thrust of the cut, and thus relieve the cap-screws to a considerable degree. The work-holding surfaces on many special-purpose machines, however, serve also for the reception of fixtures that remain in position for long periods, and so the threads are practically immune from wear or rust. Some machines, both of ordinary and special design, have tapped holes on the work-carrying areas simply for the purpose of fastening down centers, rotary arbors, or other equipment, which always occupies the same position. Threaded holes are also occasionally located on the sides and ends of tables or bases for special functions in connection with the holding of work. If they do not interfere at other times, stud bolts may be screwed into the holes to offer a slightly quicker means of setting up the job.

Use of Through Holes and Slots

At an early period of machine tool construction T-slots were unknown and all tables and plates had simple through holes instead, in which the bolts generally had to be inserted from the back. Even the advantages of slots, by contrast with round or square holes, were not taken much note of, and bolts had to be withdrawn from one hole and put through the next for a small change of position. This practice, which now appears annoying and time-wasting, was partly unavoidable, because the tables were thin and poorly supplied with ribs. A box section construction was unknown. The principal designs in which through apertures are still retained are those where it is not difficult to quickly pass bolts through from the rear, or where there is no danger to the operator in so doing. It will be apparent that these do not include numerous kinds of box tables, long tables sliding on beds, baseplates close to the floor, and plates or tables carried on pivots or stems which bring them so close to other parts as to prevent the use of bolts.

The necessity of draining coolant from all over the holding area of a table may modify the slot arrangements. A table not provided with draining facilities can have through slots, whereas a similarly arranged table with proper draining devices will require T-slots in order to leave no openings. A great objection to through slots is that the bolts fall down as the clamps are slid off the work, or tumble through as the nuts are removed. This fact involves great inconvenience and waste of time. The expedient of using a nut to lock the bolt from above is sometimes resorted to. Types of machines now having through holes and slots, or a mixture of the two, include light drilling machines, small shapers, a few special machines embodying angle-plate holding surfaces, and certain multiple-spindle drilling machines having long tables suspended between supports so as to leave a considerable free space underneath the table.

On a simple drilling machine table the slots should be disposed so as to afford universal facilities for locating and sliding the bolts. The table shown at *A*, Fig. 4, meets these requirements fairly well, the four radial slots enabling in and out adjustments, and the interspaced ones movements which come in handy for working around the circle, not only outside the work, but within openings, etc. Stop-pegs to resist swinging of the work can furthermore be added at any distance from the center.

On a larger table the number of slots naturally increases, and four T-slots may be included in the set. A combination of through holes and slots is shown in Fig. 3. On small shaper tables the thin flanks may be perforated by slots, as shown at *B*, Fig. 4, or the slots may be arranged horizontally so that the bolts cannot slip down. Sometimes it is possible to cast gaps at suitable places to permit bolts to be dropped in from above instead of from the rear. This arrangement is occasionally adopted for massive planer tables of box section, and for rotary planer work bases. Two different lay-outs of such slots may be observed at *C* and *D*, the gaps being spread well apart so as not to weaken the plate materially.

T-slots on Machine Tool Tables

The old dovetail slot has practically disappeared from designs of work-holding surfaces in American and British practice, though many examples still are found on machines built on the continent of Europe. The obvious objection to this type of slot is the weakness of the bolt head and the metal near the top of the slot. This will be apparent by reference to *A*, Fig. 5. When lateral pressure on the bolt is severe or violent shocks arise, the wedging and wrenching-out tendency of the head is greatly intensified.

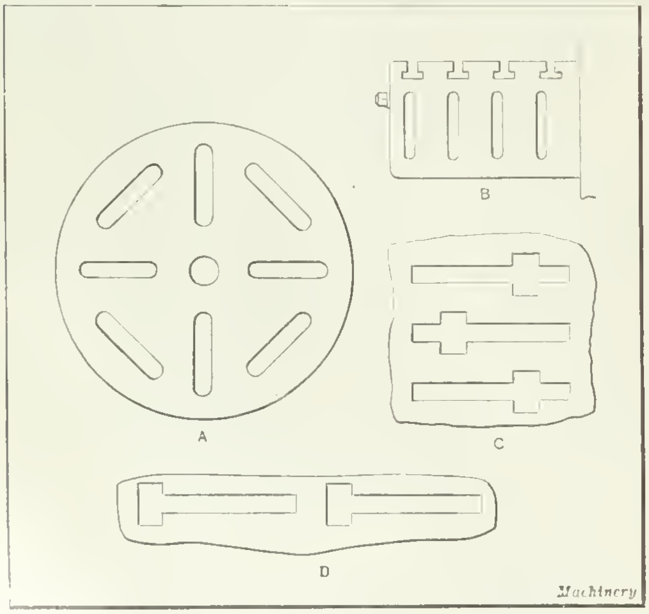


Fig. 4. (A) Convenient Arrangement of Slots for Drilling Machine Table; (B) Slot Arrangement on Shaper Table; (C and D) Slot Lay-outs for Massive Planer Tables

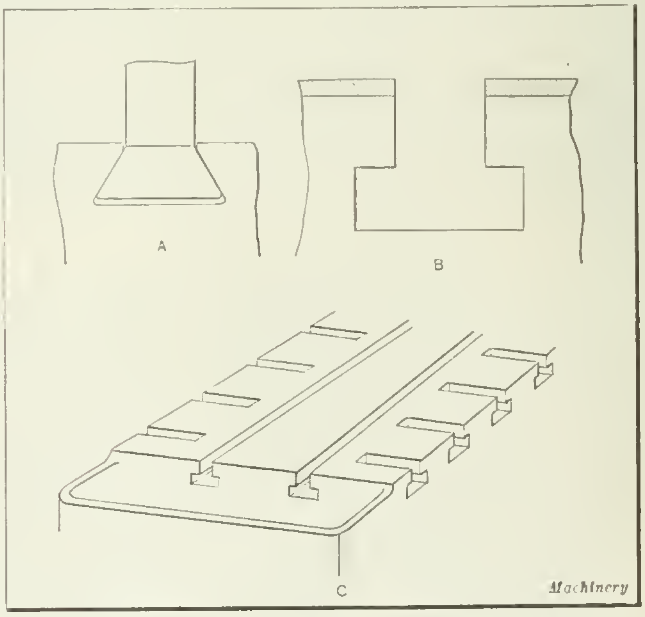


Fig. 5. (A) Detail of Dovetail Slot; (B) Suitable Proportions of T-slot; (C) Long Narrow Planer Table with Short Side T-slots and Long Longitudinal Ones

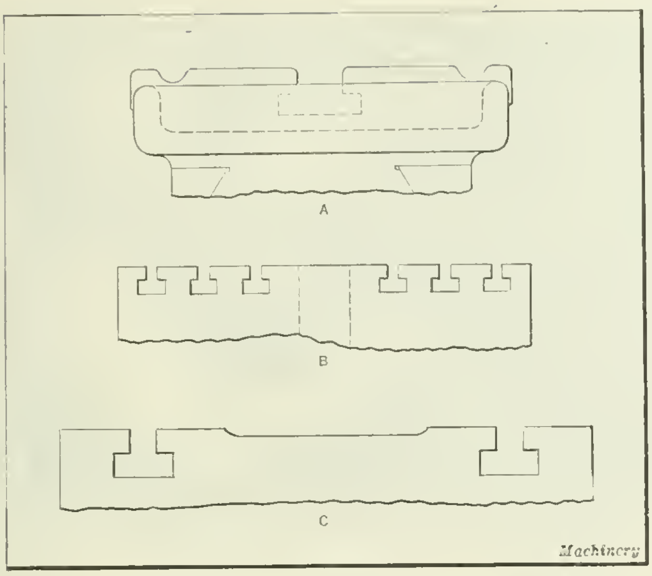


Fig. 6. Various Methods of arranging T-slots on Machine Tables

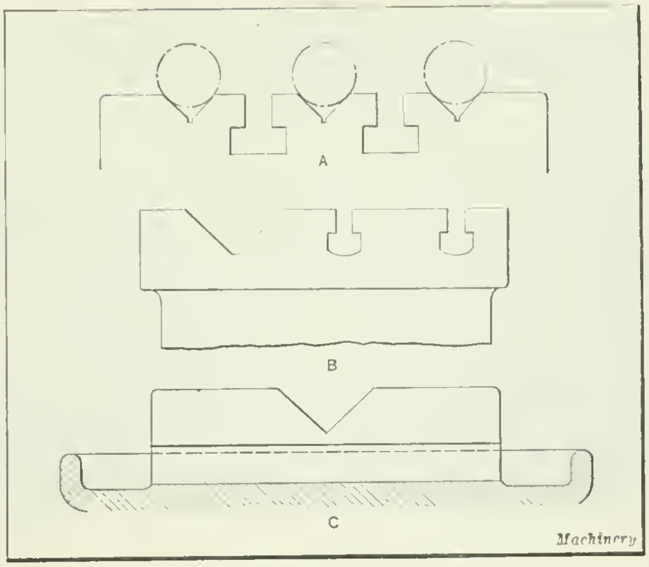


Fig. 7. Tables provided with V-grooves in addition to T-slots

The square-cornered T-slot holds the field now, and appears on practically all the principal types of machine tools. Some care in thinking out the proportions of the slot and bolt is essential. There must not only be ample metal to resist the distortion or bursting effort of the bolts, but the weakening effect of numerous slots on a table must also be borne in mind. The provision of ample metal around the slots, or deep ribbing, or the employment of a box section, all tend to increase the strength.

Another point not always given sufficient attention in designing a table relates to subsequent changes in the table thickness. Refacing or skimming up of the table surface frequently occurs in the course of its use, and unless the metal above the lip of the slots is ample, a dangerous weakening takes place in this subsequent truing. This is especially the case with magnetic chucks, which are generally reground several times during their life. The top of the T-slots should consequently be surrounded by plenty of metal, so that the gradual removal of the table surface will still leave the depth of metal ample. At *B*, the proportion of surface which may be safely removed is indicated by dot-and-dash section lines.

The practice of making denser castings, casting the T-slots with chills and mixing a proportion of steel with the iron are procedures that make for stiffness of tables and durability of slots. Another strengthening factor is the casting of tables integral with stiff trays, examples of which will be shown. The loads that tables must carry at present are much heavier than formerly, partly because heavy fixtures receive the parts to be machined, and partly because the cutting stresses are greatly enhanced, especially with multiple tooling methods.

Arrangement of T-slots

There ought never to be a large space without means for inserting or removing bolts without disturbing others; hence pockets should be cast for this purpose, or cross-connections be arranged to slide bolts in from the edges at numerous locations. Bolts with opposite corners of the head rounded off can be dropped into place readily, but are likely to loosen as the nut is slackened. Some surfaces are satisfactorily supplied with the slot or slots about the center, while others must have places for bolts close to the edges, as shown at *C*.

The direction of the slots varies in different machines and also in machines of the same kind but for special operations. A specific instance is the case of heavy plano-milling machines. Those for ordinary slabbing and facing cuts employ longitudinal slots like those on planer tables, but many of the heavy profiling machines have slots running across the table to provide easy lateral adjustments of the work and of the former device by which the profiling roller controls the cutter-slide. The relative dimensions of a table affect the direction and number of the slots, for a big area obviously gives room for the laying out of groups of slots in parallel groups, or possibly interspersed with radial or other slots.

The simplest design of table provided with a T-slot is represented at *A*, Fig. 6. This table is intended for a small hand miller, the slot being utilized to a considerable extent for fixture or vise holding, as well as for clamping work direct. The limitation of holding facilities on such a design is often reduced by providing a few tapped holes. Another design embodying slots well away from the center is shown at *B*. This is chiefly applicable to machines that have a central ram or bar passing down through the table; the one shown was built for a keyseater. Occasional instances of double-spindle machines that operate at the ends of long work, give rise to slots only at the ends of the table, as shown at *C*. The holding surface may run flush the entire length, or be recessed, as shown, and provided with a fixture resting on the machined surfaces to carry the work. The table represented is that of a duplex milling machine of modified Lincoln design.

Often the inclusion of grooves in a work-holding area influences the lay-out of the slots, which must be arranged with reference to the grooves. In a special planer for keyseating, the shafts rest in three V-grooves on the table, illustrated at *A*, Fig. 7, and two T-slots afford means of bolting. A different style of table is shown at *B*; this is used on a cold-saw cutting-off machine, where a single large bar, or several, are clamped down with a plate or bracket and screw. A series of transverse T-slots is cut in the keyway milling machine table illustrated at *C*. Ordinary clamping plates are used here from bolt to bolt.

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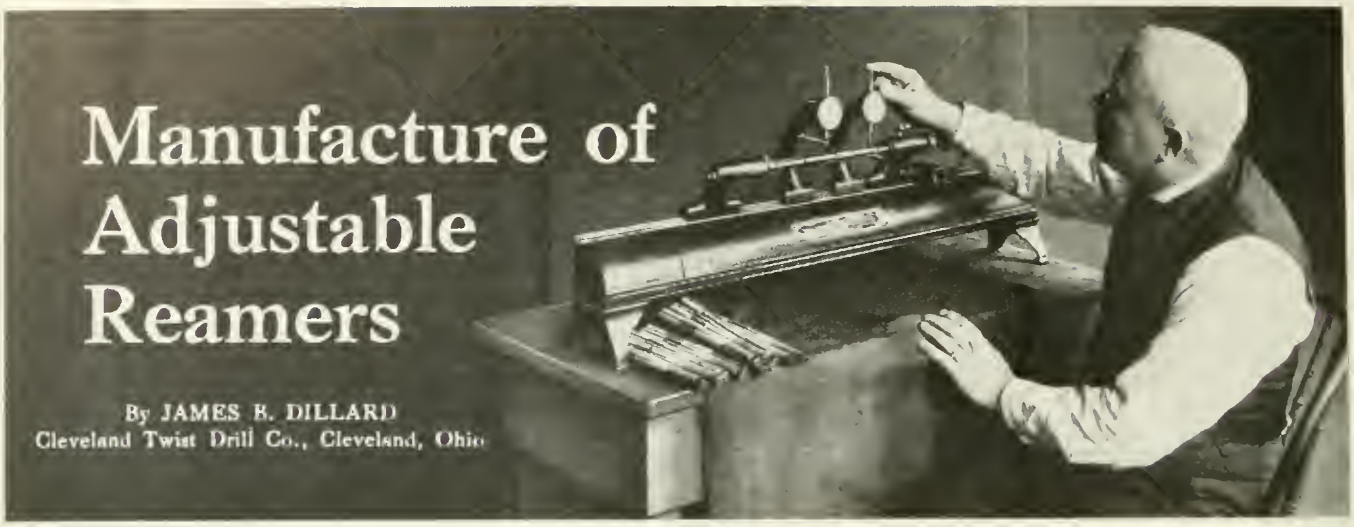
GRAPHITE CRUCIBLE INVESTIGATION

The final stage of the graphite crucible investigation, in which the Bureau of Mines, Washington, D. C., has been engaged for some years, has been completed. The object of this investigation was to determine the availability of domestic bond clays and domestic graphites for crucible making. During the war the obtaining of graphite and bond clays, which had been practically all imported, for making crucibles became a most serious problem. The bureau's investigations have shown that some American graphites and bond clays are, when properly prepared, equal or superior to foreign materials, for crucibles both in brass-making and in steel melting.



Manufacture of Adjustable Reamers

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Operations Performed on the Body, Nuts, and Blades of Adjustable Reamers

THE adjustable reamer called the "Quick-set," manufactured by the Cleveland Twist Drill Co., is of a type that has been known for many years. The production methods for this tool, however, have been worked out within the last two years, and represent modern methods applied to small tool manufacture. The reamer consists of a body with six longitudinal slots, in each of which is a blade. The blades are clamped in position by two nuts threaded on the body. The bottom of the slots are tapered longitudinally, as are also the bottom edges of the blades, so that, as the blades are moved in the slots, their outer surfaces expand cylindrically. The general construction of the tool is shown in Fig. 1.

As the market for this tool is large, its manufacture on a quantity basis is possible, and all the fixtures and methods used have been laid out with a view to large volume production only. A greater variety of operations are employed in making this reamer than is common in small tool work, and while most of them are not unusual in themselves, the degree of precision obtained is greater than ordinary. This article will explain in detail the processes employed.

The tool is made in eleven standard sizes designated by letters from A to K inclusive. Size "A" reamer has nominal expansion limits from 15/32 to 17/32 inch. Size "K" has corresponding limits from 1 11/32 to 1½ inches. The intermediate sizes are similar, and all sizes have actual working limits of a few thousandths inch above and below their nominal limits, so that one tool may enter a hole that has been reamed by the next smaller size.

The general production problem for these reamers is to obtain the accuracy required in such a tool, combined with interchangeability of parts, at production costs low enough to enable the tools to be sold in a highly competitive market. With minor modifications, the manufacturing processes are the same for all sizes. In order to make the subject matter clear, one size ("H") will be referred to in this article. The nominal expansion limit for this size is 15/16 to 1 1/16 inches. The reamer consists of three parts: (1) The body; (2) the nuts; and (3) the blades.

Operations on the Body

The body is made of low-carbon steel to the finished dimensions shown in Fig. 1. The operations are as follows:

1. Rough-turn one end and cut-off.
2. Inspect.
3. Center both ends.
4. Rough-turn other end.
5. Finish-turn one end.
6. Finish-turn the other end.
7. Inspect.
8. Mill square.
9. Recess.
10. Wash.
11. Burr square.
12. Inspect.
13. Harden square.
14. Grind.
15. Stamp.
16. Inspect.
17. Thread.
18. Inspect—wash.
19. Mill slots.
20. Mill chip grooves.
21. Inspect—wash.
22. Burr threads.
23. Buff ends.
24. Inspect.
25. Blue.
26. Oil.

The first operation is performed on an automatic screw machine. The original bar stock is 29/32 inch in diameter.

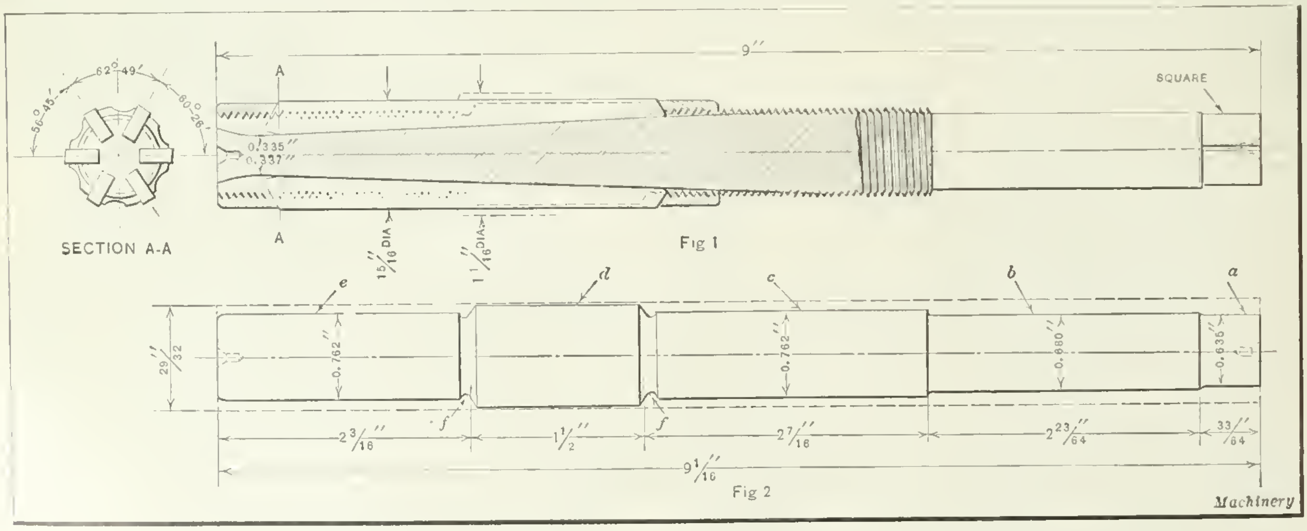


Fig. 1. Section of "Quick-set" Adjustable Reamer. Fig. 2. Appearance of Body of Reamer after Fourth Operation

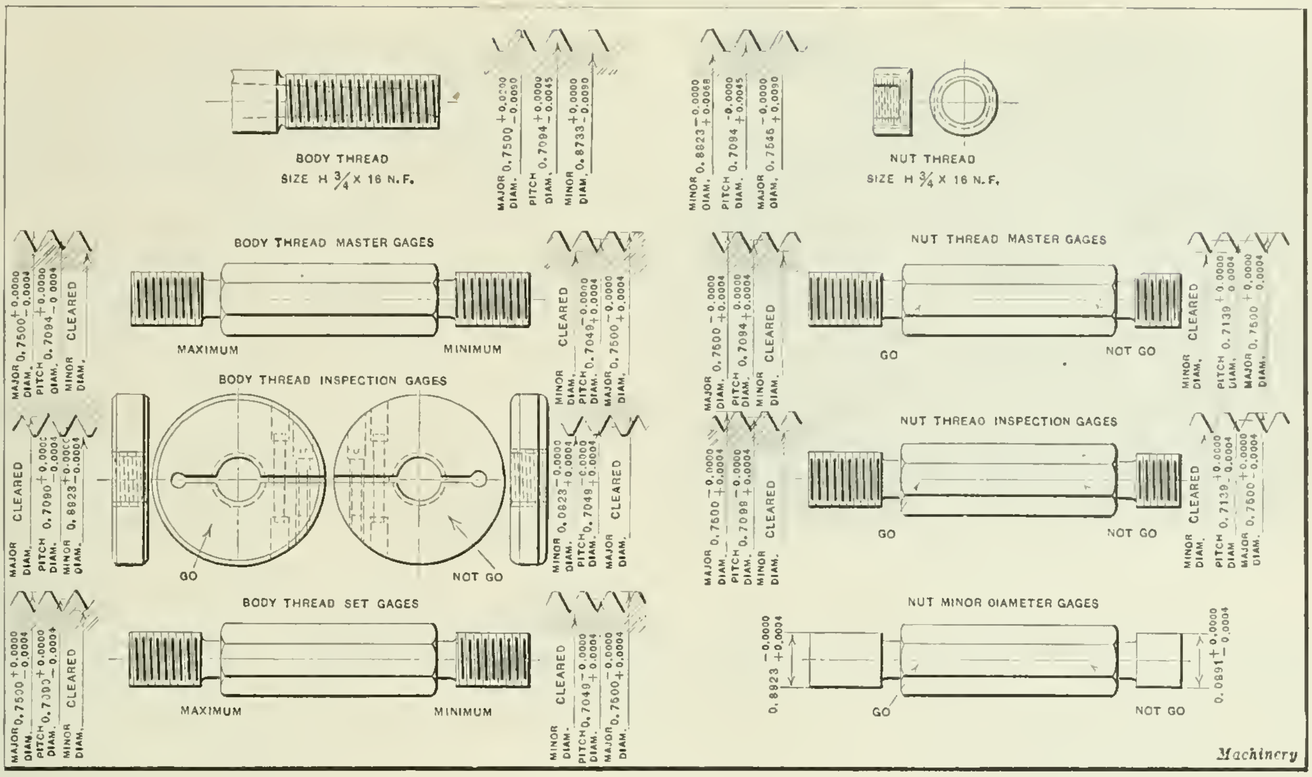

BODY THREAD
SIZE H 3/4 X 16 N.F.
MAJOR DIAM. 0.7500 +0.0000 −0.0090
PITCH DIAM. 0.7094 +0.0000 −0.0045
MINOR DIAM. 0.8733 +0.0000 −0.0090
MINOR DIAM. 0.8823 −0.0000 +0.0068
PITCH DIAM. 0.7094 −0.0000 +0.0045
MAJOR DIAM. 0.7546 −0.0000 +0.0090
NUT THREAD
SIZE H 3/4 X 16 N.F.
BODY THREAD MASTER GAGES
MAJOR DIAM. 0.7500 +0.0000 −0.0004
PITCH DIAM. 0.7094 +0.0000 −0.0004
MINOR DIAM. CLEARED
MAXIMUM
MINIMUM
MINOR DIAM. CLEARED
PITCH DIAM. 0.7049 −0.0000 +0.0004
MAJOR DIAM. 0.7500 −0.0000 +0.0004
BODY THREAD INSPECTION GAGES
MAJOR DIAM. CLEARED
PITCH DIAM. 0.7090 +0.0000 −0.0004
MINOR DIAM. 0.8823 +0.0000 −0.0004
GO
NOT GO
MINOR DIAM. 0.0823 −0.0000 +0.0004
PITCH DIAM. 0.7049 −0.0000 +0.0004
MAJOR DIAM. CLEARED
BODY THREAD SET GAGES
MAJOR DIAM. 0.7500 +0.0000 −0.0004
PITCH DIAM. 0.7090 +0.0000 −0.0004
MINOR DIAM. CLEARED
MAXIMUM
MINIMUM
MINOR DIAM. CLEARED
PITCH DIAM. 0.7049 −0.0000 +0.0004
MAJOR DIAM. 0.7500 −0.0000 +0.0004
NUT THREAD MASTER GAGES
MAJOR DIAM. 0.7500 −0.0000 +0.0004
PITCH DIAM. 0.7094 0.0000 +0.0004
MINOR DIAM. CLEARED
GO
NOT GO
MINOR DIAM. CLEARED
PITCH DIAM. 0.7139 +0.0000 0.0004
MAJOR DIAM. 0.7500 +0.0000 0.0004
NUT THREAD INSPECTION GAGES
MAJOR DIAM. 0.7500 −0.0000 +0.0004
PITCH DIAM. 0.7098 −0.0000 +0.0004
MINOR DIAM. CLEARED
GO
NOT GO
MINOR DIAM. CLEARED
PITCH DIAM 0.7139 +0.0000 −0.0004
MAJOR DIAM. 0.7500 +0.0000 −0.0004
NUT MINOR DIAMETER GAGES
0.8923 −0.0000 +0.0004
GO
NOT GO
0.0891 +0.0000 −0.0004
Machinery

Fig. 3. Detailed Dimensions of Gages used in producing the Threaded Part of the Body and the Nuts of the Reamers

Referring to Fig. 2, the surfaces *a*, *b*, and *c* are turned to the dimensions given, and the piece is cut off. After the fourth operation, which is performed in a lathe, the piece has the dimensions shown in Fig. 2. The fifth and sixth operations consist in finish-turning *a*, *b*, *c*, *d*, and *e*, respectively, to the following dimensions: 0.623, 0.668, 0.750, 0.887, and 0.750 inch. These operations are done in a plain lathe, using a multiple toolpost as shown in Fig. 4.

The seventh, eighth, ninth, and tenth operations are not of special interest. The squares are milled by straddle-mills in a special fixture that can be indexed through 90 degrees. The recesses shown at *f*, Fig. 2, are to allow clearance for the threading hob. The squares are hardened in the usual manner. The surfaces *b* and *d* are then ground to the finished sizes 21/32 and ⅞ inch, respectively. The stamping is done on a commercial machine. The bodies are now ready for the seventeenth operation, in which the threads for the nuts are milled.

This reamer is undoubtedly one of the first products to be put on the market in which the threads are made in accordance with the "Progress Report" of the National Screw Thread Commission (Bureau of Standards, Washington, D. C.). The National Fine Thread has been adopted, which is based on the standard S. A. E. thread for sizes ¼ inch and larger. The size "H" reamer has a ¾ by 16 N. F. (national fine) thread. The basic diameters of this particular thread are as follows: Major diameter, 0.7500 inch; pitch diameter, 0.7094 inch; and minor diameter, 0.6688 inch.

In quantity production it is impossible to produce screws and nuts exactly to the dimensions given in the foregoing. To attain interchangeable manufacture, the screws and nuts must be given tolerances such that economical production and satisfactory fits will be obtained. The National Screw Thread Commission has established various classes of fits (loose, medium, close, and wrench) with corresponding tolerances. In these reamers the medium fit is used (Class 2). Tolerances for this fit for the ¾ by 16 N. F. thread are as follows:

Screw Sizes

Major Diameter		Pitch Diameter		Minor Diameter	
Max.	Min.	Max.	Min.	Max.	Min.
0.7500	0.7410	0.7094	0.7049	0.6733	0.6643

Nut Sizes

Major Diameter		Pitch Diameter		Minor Diameter	
Min.	Max.	Min.	Max.	Min.	Max.
0.7545	0.7635	0.7094	0.7139	0.6823	0.6891

By the use of these tolerances, assurance will be had that any screw will enter any nut (provided there are no large errors in lead), and the smallest screw and largest nut will not give too loose a fit. The pitch diameter of the minimum nut is basic, with a plus tolerance, while the pitch diameter of the maximum screw has a minus tolerance.

To make sure that these tolerances on the body screw thread and the nut are maintained, the following gages are used:

Master Gages: Master threaded plug gages to represent the maximum and minimum thread on the body; "Go" and "Not Go" threaded plug gages for gaging the nuts.

Inspection Gages: "Go" and "Not Go" threaded ring gages for gaging the body threads; set or check threaded plug gages for each of the ring gages; "Go" and "Not Go" threaded plug gages for gaging the nuts; "Go" and

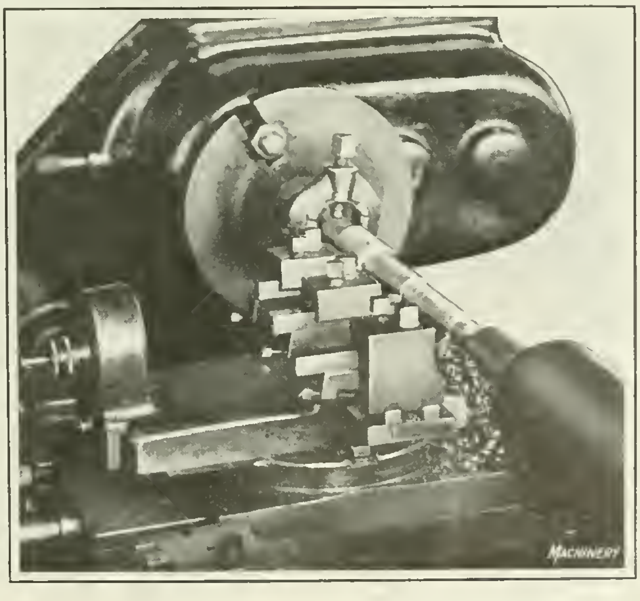


Fig. 4. Multiple Toolpost used in finish-turning Reamer Body

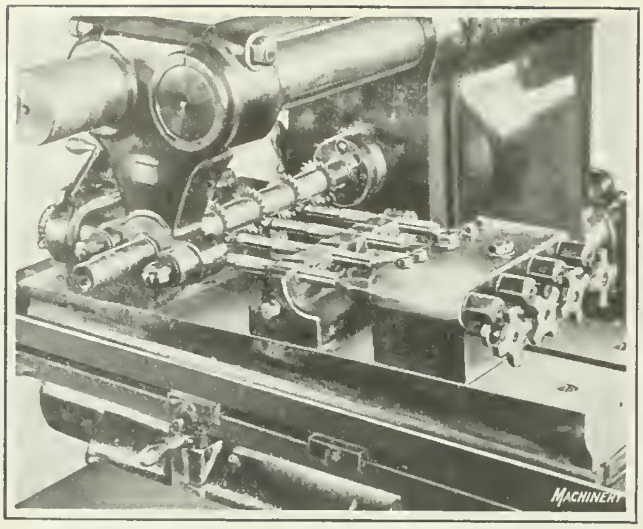


Fig. 5. Milling the Slots in the Reamer Bodies

"Not Go" plain plug gages for gaging maximum and minimum minor diameters of the nut.

Attention is called to the fact that gage tolerances and gage wear allowances are taken in directions that bring them within the limiting dimensions on the work. Fig. 3 shows the gages used, and gives the dimensions in detail.

The nineteenth operation—slot-milling—is the most important one performed on the bodies, as the accuracy of the tool is directly dependent upon the accuracy of the taper of the bottom of the slots, and upon the requirement that corresponding elements of the bottom of all slots must lie in a circle. The width of the slot must also be held within very close limits, as the blades must be a snug fit to avoid chatter. The operation is performed on plain milling machines and the set-up is shown in detail in Fig. 5. The fixtures rest on a taper platen permanently fastened to the table of the machine, and the reamers are held in gangs of four between centers. In addition to the centers, the reamers are supported by a rest on surface *d*, Fig. 2.

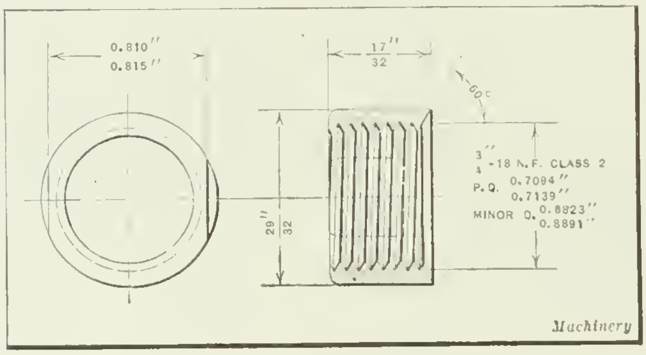


Fig. 6. Nut used for Adjustable Reamer

After the slot-milling operation is completed, each body is inspected for taper and concentricity of bottom of slots in the fixture shown in the heading illustration. A mandrel ground to the correct diameter and taper is used for setting the indicators. The mandrel is then taken out of the centers and each reamer body is tested in all slots. This fixture does not distinguish between errors in roundness and errors in taper, as in practice it has not been necessary to separate these, so far as routine inspection is concerned. If any slot shows a combined error in this fixture exceeding plus or minus 0.0005 inch, the body is rejected.

This high degree of accuracy is obtained only by the closest attention to detail in the manufacture of fixtures, and in the set-up and alignment of the machine. As four reamers are milled simultaneously, the cutters must be of exactly the same diameter and width. The cutters must be kept sharp and the arbors must run true. The separators between the cutters must also be true and accurate, as the cutters must line up with the centers of the fixtures. In addition, the fixtures must be kept thoroughly clean and free from chips. Any carelessness of the operator in regard to any of these details will invariably cause rejection of the finished parts.

In addition to being round and having the correct taper, the slots must be of the correct width. Each slot is gaged with a "Go" and "Not Go" gage. The slightest inaccuracy in the arbors, cutters, or separators is magnified in the slots and is sure to cause rejection, due to failure to pass the "Not Go" gage. The bodies are now complete, except for the finishing operation. As a rust deterrent, they are given a blue finish similar to rifle and small arms parts, followed by a final oiling.

Operations on the Nuts

The nuts for the size "H" reamer are shown in Fig. 6. The manufacturing operations on these parts are as follows:

1. Drill.
2. Tap.
3. Chamfer.
4. Cut off.
5. Inspect.
6. Finish-tap.
7. Face for length.
8. Form radius.
9. Inspect.
10. Mill flats.
11. Finish-chamfer and burr.
12. Wash.
13. Burr ends.
14. Inspect.
15. Caseharden.
16. Test for roundness.
17. Blue.
18. Oil.

Operations 1 to 4 inclusive are made on 15/16-inch bar stock in automatic screw machines. Operations 6, 7, and 8 are performed in one setting on a screw machine. Operation 10 is performed on a plain milling machine in the fixture shown in Fig. 8. Operation 11 is important, as the chamfered surface of the nut bears on the ends of the blades, and must be so aligned with the threads that the nut will have equal bearing pressure upon the six blades. It has been found by experience that the first rough-chamfering operation (No. 3) on the automatic machines is not sufficiently accurate. In order to secure this accuracy, the nuts are threaded for finish-chamfering on an arbor corresponding to the "Go" thread gage. Following the finish-chamfering, the ends are burred, after which they are inspected. The nuts are then casehardened and finished in the same manner as the body.

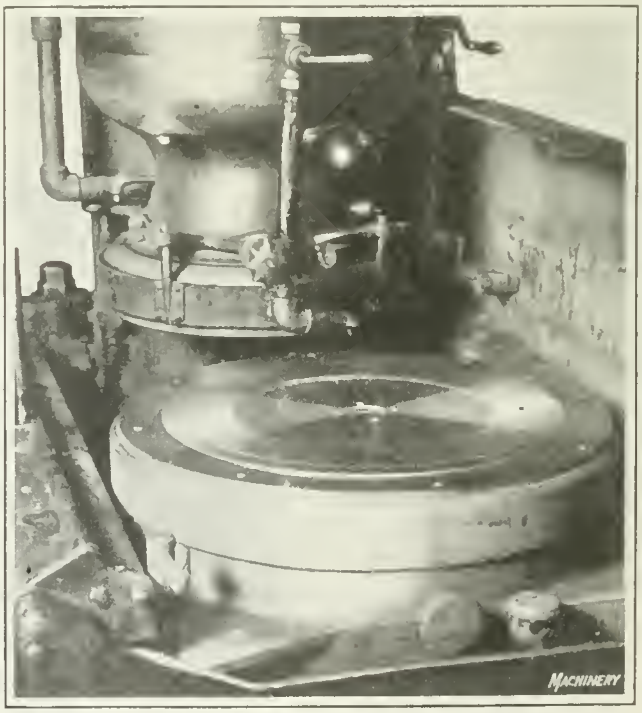


Fig. 7. Grinding the Sides of the Blades

Operations on the Blades

The finished blade for the size "H" reamer is shown in Fig. 9. In the case of the larger sizes, such as the "H" size, the blades are cut from bars having a cross-section approximating that of the longitudinal section of the blade. The smaller sizes are punched from sheet stock; otherwise the operations are the same. The stock from which the blades are cut is a high-grade carbon tool steel. The various operations on the reamer blades are performed in the following sequence:

1. Mill plates.
2. Cut blades.
3. Harden.
4. Inspect.
5. Straighten.
6. Grind sides.
7. Grind the top and the bottom.
8. Grind clearance angle.
9. Demagnetize.
10. Grind bottom edges.
11. Wash.
12. Inspect.
13. Grind to length.
14. Bevel bottom corners.
15. Wash.
16. Inspect.
17. Oil.
18. Finish-grind.
19. Inspect.
20. Stamp.
21. Oil.

The first operation consists of straddle-milling the edges of the rolled bars so that the width of the bar becomes approximately 0.018 inch more than the finished length of the blade. The second operation consists of sawing the bars into blades, leaving about 0.020 inch of stock for grinding. This work is done on a plain milling machine with a gang of forty-three saws, so that forty-two blades are cut at each pass. The third operation consists of hardening the blades, after which they are tested individually for hardness.

After straightening, both sides are ground in a vertical surface grinding machine to limits of + 0.000 and — 0.001 inch. In this operation, about 180 pieces are handled at one time. Fig. 7 shows the operation in detail. The blades are then clamped in a fixture (shown in Fig. 10), and are rough-ground on the top and finish-ground on the bottom (Operation 7). This operation is also performed on the vertical grinding machine used for the sixth operation. The blades, while still in the fixture, are then transferred to a grinding machine of the type shown in Fig. 10, for grinding the clearance angle.

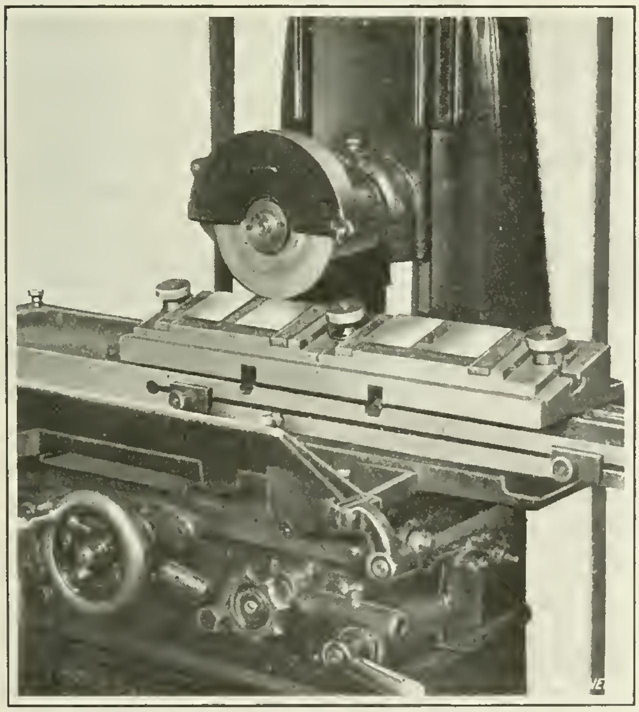


Fig. 10. Grinding the Clearance Angle of the Blades

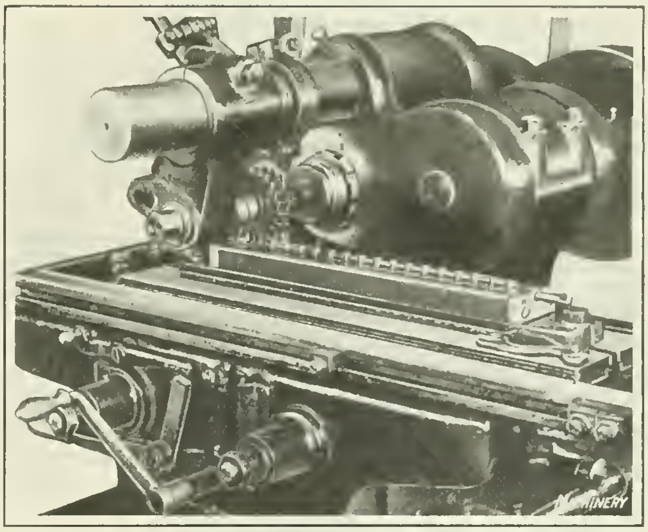


Fig. 8. Milling the Flats on the Nuts for the Reamer

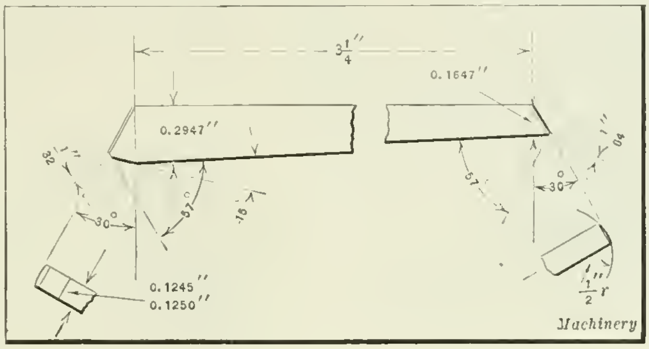


Fig. 9. Dimensions of Finished Reamer Blade

The ninth, tenth, eleventh, and twelfth operations are simple. The thirteenth operation—grinding to length—is one of the most important, as if the blades are not of the same length, they will not be clamped equally by the nuts, and one or more blades will be loose in the reamer. The tolerance on this operation is ±0.0005 inch. The remaining operations are self-explanatory, and will be understood by referring to the list given in the foregoing. After finish-grinding, the blades are divided into sets of six and stamped serially in sets so that any given set of blades can be identified at any future time.

The result of the operations, as explained, is that all nuts and bodies are completely interchangeable. Sets of blades are also completely interchangeable. In the final assembly, no selection of parts is necessary—that is, the blades are placed in the bodies at the time of final assembly, the nuts are screwed down and the reamers are ready to cut. The only requirement is that the utmost cleanliness be observed. Any blade fits any slot, but due to the division of the blades into sets after grinding for length, it is not claimed that any blade in one set is interchangeable with a blade in another set, but all blades in the same set are completely interchangeable. It is not claimed that this type of tool can be compared for precision with a solid hand reamer of standard construction. It is, however, a tool exceptionally well adapted to general garage work, and is most useful in the repair department in any plant.

Adjustment of Reamer

In adjusting a reamer from one size to another, the greatest care must be taken to see that the slots are free from dirt or chips, as any foreign substance lodged under a blade will cause it to project beyond the true circumference of the reamer, resulting in chattering, and preventing adjacent blades from cutting. The nuts should be set up to a snug fit, but should not be too tight. In the hands of a skillful mechanic, the tool is capable of great precision, but if dirt and chips were allowed to accumulate under the blades it would not be dependable.

TAPPING FIXTURES

The accompanying illustrations show two novel fixtures for multiple tapping. These fixtures are used in connection with a special multiple-spindle tapping machine capable of threading right- and left-hand threads simultaneously. The parts tapped form the upper and lower plates, respectively, of a small meter. The lower plate has eight holes to be tapped within a circle having a diameter of 1¾ inches, and the top plate has two holes about ½ inch apart, one having a right-hand and the other a left-hand thread. The multiple-spindle head for tapping the lower plate was arranged with two groups of spindles, spaced 1⅝ inches apart, since the distance between the centers of some of the spindles was only ⅛ inch, which precluded any possibility of arranging the spindles in one group. As the travel of the table carrying the fixtures up to the tapping spindles was very short, some provision for loading the fixtures at a position not directly under the tapping head was necessary.

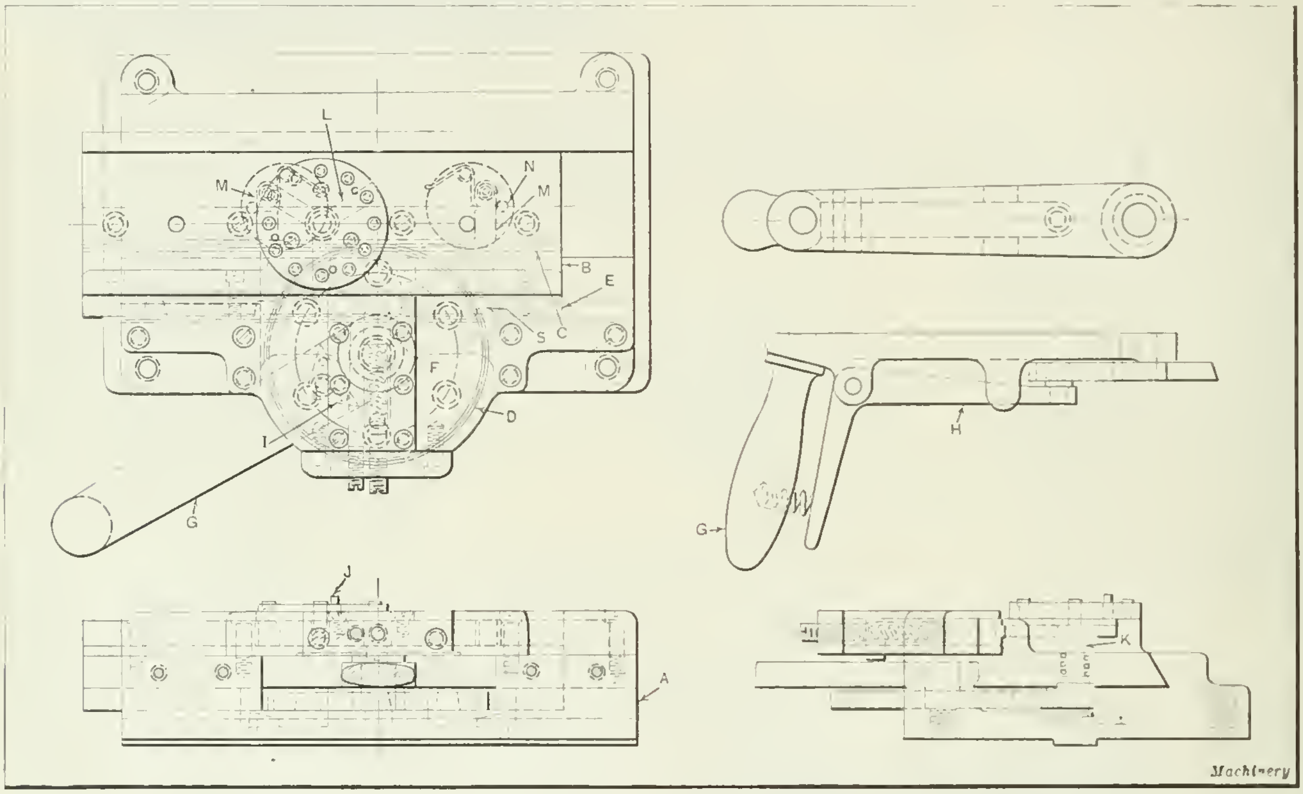


Fig. 1. Fixture used in performing Multiple Tapping Operations on the Lower Plate of a Meter

The fixture shown in Fig. 1 was evolved to solve the tapping problem for the lower plate. This consists of a base *A*, bolted to the tapping machine bed, and a dovetail slide *B*, carried by the base and provided with locating pins and an ejecting mechanism. Attached to slide *B* is a rack *C* which meshes with the index-gear *D*. An indexing strip *E* having four notches which are engaged by the locking bolt *F* in the base is also secured to slide *B*. The indexing gear is engaged by the handle *G* at the time of indexing.

As may be assumed from the illustration, there are four stations—two loading and two machining or tapping stations. Starting at the left-hand side, we have first the loading station, second the tapping station for one group of holes, third the tapping station for the remaining group of holes, and fourth the unloading station. The arrangement is such that the fixture does not have to be returned to the first station for reloading, this operation taking place at the fourth station. The slide carrying the plate is then indexed back from right to left in the operation of tapping the next plate.

The indexing is accomplished by the handle *G* through a trigger finger *H* which engages holes in the indexing gear *D*. When the indexing handle is at the central position, cam-plate *I* disengages locking bolt *F* from the notch in the strip *E* attached to slide *B*. Now by permitting the trigger finger *H* to engage the hole in the indexing gear, the slide can be indexed either to the left or to the right until locking bolt *F* drops into another notch in strip *E*. Thus if it is desired to index slide *B* to the extreme left position from the position shown in the illustration, trigger finger *H* would simply be depressed to disengage handle *G* from gear *D* and bring the handle to the central position in order to unlock or withdraw pin *F*. Now by releasing trigger finger *H*, so that handle *G* will engage gear *D*, the handle can be swung to the extreme right-hand position so that pin *F* will drop into the index notch at *S*. Starting with the handle *G* at the central line, three similar movements to the left will bring slide *B* to the extreme right-hand position.

The arrangement of the indexing mechanism is such that one hand only is required for indexing, so that the other hand is left free for loading and unloading. The feeding movement of the table is controlled by a foot-treadle. A cut-out arrangement on the machine stops the movement of the table at the end of the feeding stroke. The meter plates are provided with three working holes which are used for locating the work in all manufacturing operations. The fixtures are therefore provided with three locating pins *J*, which naturally would slow up the tapping operation in so far as loading and unloading is concerned, particularly if the holes in the plates are a tight fit on the locating pins. An ejecting device was incorporated, which consists of a simple plunger *K* carrying a three-armed spider *L*. The arms of the spider reach out to the ejector-pins placed adjacent to the locating pins.

Normally the three ejector-pins are held down or depressed due to the action of the spring on the central plunger. As the slide moves toward the right from the third to the fourth station, and to the left from the second to the first station, the central plunger pushes one of the pivoted cams *M* over until it backs against one of the pins *N*, at which position the cam causes the ejector-pins to rise and strip the work from the locating pins. By the time the slide has reached the first or the fourth station, as the case

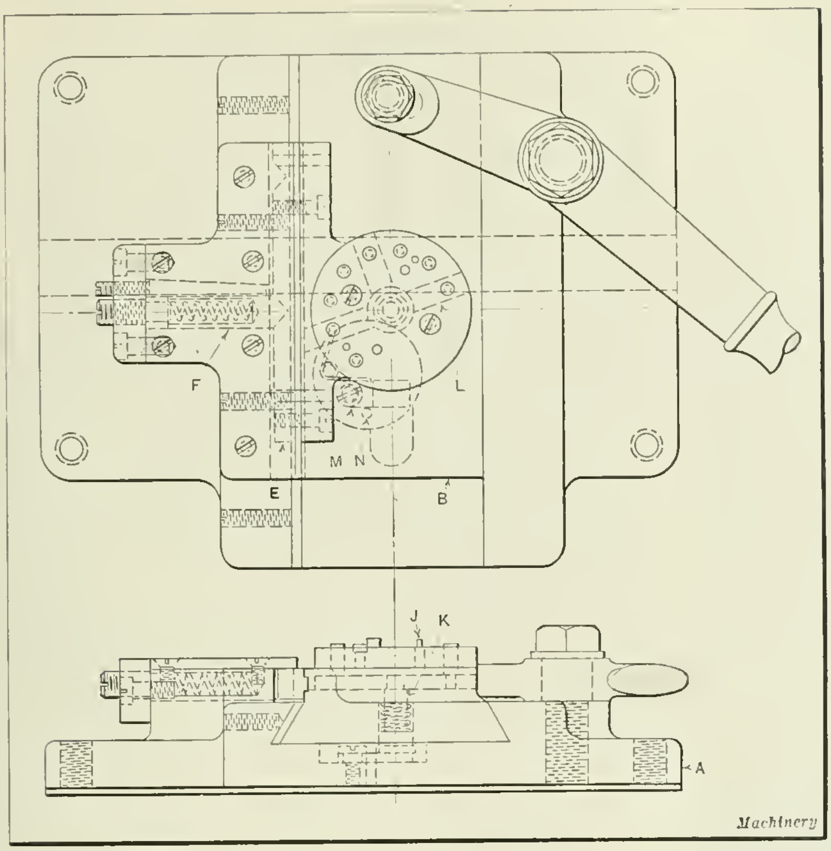


Fig. 2. Two-position Fixture used on Multiple Tapping Machine

may be, the plunger has dropped down in back of the pivoted cam. This movement causes the ejector-pins to assume their normal position so that they will not interfere with the loading operation. On the return motion the cam pivots or is turned back, allowing the central plunger to pass without raising the ejector-pins.

Considerable speed may be obtained by the use of fixtures such as the one shown in Figs. 1 and 2. The same type of fixture can be used for drilling operations as well as for tapping. If the spacing of the slide indexing strip is correct, a stationary overhanging plate can be fastened to the fixture to carry the guide bushings for the drills.

The fixture shown in Fig. 2 was designed for use in tapping the top plate, which has but two holes, one having a left-hand thread and the other a right-hand thread. Only two stations are used in this case, namely the loading and the tapping station. The indexing mechanism was simplified somewhat, in this case, a lever and link being used in place of the indexing gear. The locking bolt *F* was milled to an angle or point, and while it normally holds the slide securely in position, it is readily withdrawn by the pressure exerted on the indexing lever when moving the slide from one position to another. The ejecting device is the same as that shown in Fig. 1. B. G. C.

* * *

The railways of the country took approximately 22 per cent of all of the rolled steel manufactured in the United States in 1922; buildings and other construction work took 15 per cent; automobiles, 10 per cent; oil, gas, water, and mining, 10 per cent; agriculture, 4 per cent; food containers, 4 per cent; exports, 7 per cent; and all other uses a total of 28 per cent.

PIERCING, FLANGING AND BLANKING DIE

By P. BALDUS

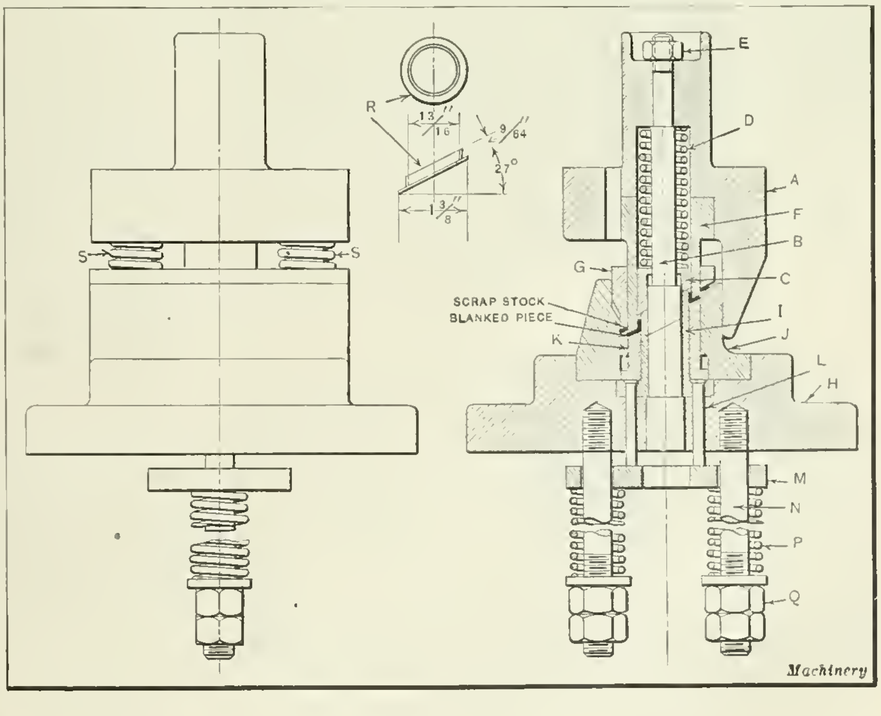
The combination die shown in the accompanying illustration is designed to pierce, flange, and blank the collar shown at *R*. This collar, which is of rather an unusual shape, forms part of the gasoline tank of a motorcycle. It is made from strip tin stock, 1 9/16 inches wide and 0.020 inches thick, which is fed through the die at an angle of 27 degrees, as indicated by the sectional view of the die.

The punch-holder *A* is made of machine steel and carries the piercing punch *B*, which is fitted with a stripper *C*. The stripper is operated by the compression spring *D*. Punch *B* is held in place by a hexagonal nut *E*. The drawing and trimming punch *F* is screwed into a counterbored hole in punch-holder *A*, and locked in place by a dowel-pin. The stripper *G* is operated by two compression springs *S* shown in the front elevation view. The piercing punch, stripper, and the drawing and trimming punch are made of tool steel, and are hardened and ground to exact size. Cast iron is used for the die-holder *H*.

The piercing and drawing die *I* is held in place in the die-holder by the trimming die *J*, which is secured by means of ½-inch fillister-head screws. A knock-out *K*, operated through pins *L*, ejects the finished piece from die *J*. The piercing and drawing die, the knock-out, and the trimming die are all made of tool steel, and are hardened and accurately ground to size. The knock-out pins *L* and studs *N* are made of cold-rolled steel. Pressure is transmitted to pins *L* through plate *M*. The tension of the two compression springs *P* can be adjusted by means of hexagonal lock-nuts *Q*.

* * *

Not less than eighty different types, or different makes of the same type, of electric furnaces have been used, tried, or suggested for melting copper, brass, or bronze, aluminum or nickel alloys. Descriptions of these different types of furnaces are contained in Bulletin 202, issued by the Bureau of Mines, Washington, D. C.



Combination Die for piercing, flanging and blanking Sheet-metal Collar

DESIGN OF MACHINE ADAPTERS

By H. P. LOSELY, Industrial Engineer, Detroit, Mich.

Adapters are used for so many different purposes in the shop that it is of advantage to have one man in the tool-designing department attend to the ordering and assigning of all adapters, as well as the drawing of new ones. This man need not be an expert tool man although he must be acquainted with the general run of work and machines, and must be rapid and systematic. He should maintain a card index of all adapters, making a separate card for each adapter which will show its main characteristics and where it is being used; this card should be filed by number. Besides this, a card should be kept for each machine, and on this card should be listed all adapters fitting that machine.

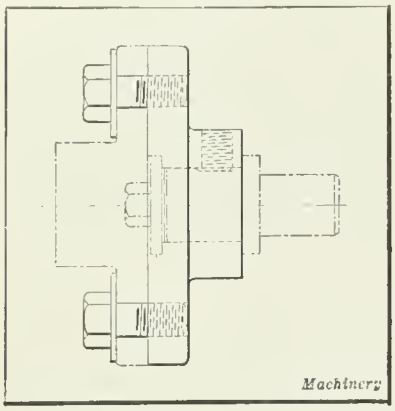


Fig. 1. Faceplate Adapter which has no Projections

Then when an adapter is wanted for any purpose, it will be easy to determine from the machine list whether a suitable adapter already exists; if so, the drawing should be looked up to make sure that it is exactly what is required. The adapter card might also be looked up to see if it is available. If it is, it can be listed as assigned to the required job. When new adapters are required they should be drawn to scale and listed in the card index. It is important that the index be kept strictly up to date, as it will then require little time for upkeep, and, by saving a great deal of adapter duplication, will help to keep down the amount invested in equipment. It will also prevent wasting time in waiting for new adapters when old ones are available.

Fig. 1 illustrates a common type of faceplate adapter in which the freedom from any projections will be noted. The screw heads are located behind the faceplate, and a safety type of set-screw is used to prevent the arbor from turning. The screws have sufficient clearance in the faceplate holes to permit truing the adapter with an indicator. The type of adapter commonly used with chucks is shown in Fig. 2 at *A*. Most chucks attached by fillister-head screws have the tapped holes in the chuck body. When cap-screws are provided, the adapter is, of course, made with plain holes instead of counterbored ones, and in cases where the screws are put in from the jaw side of the chuck, the adapter must be provided with tapped holes.

It is useful to have "dummies" made to match the spindles of those lathes that are frequently fitted with adapters, as this saves a great deal of trouble in the tool-room; the machinist can turn up and thread an adapter at one setting, testing the thread and the pilot hole with the dummy. Otherwise, he is obliged to try the adapter on the machine, and since the adapter must be left in the chuck until completed, this procedure necessitates dismounting the chuck of the tool-room lathe each time the adapter is tried on the spindle of the machine. Often the assistance of a helper is required. Not only is the whole procedure laborious, but there is also a chance for the adapter to be mounted slightly out of true when the chuck is put back on the tool-room lathe.

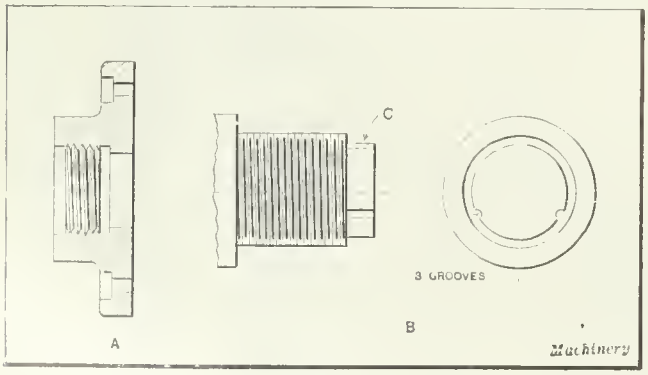


Fig. 2. (A) Type of Adapter used in Connection with Chucks: (B) Lathe Spindle Pilot provided with Dust Grooves

An examination of a large number of lathe spindles shows that the nose *C*, in the view *B*, Fig. 2, which serves as a pilot and should be smooth and true, in the great majority of cases is pitted and grooved after a comparatively short term of service. It is the opinion of the writer that lathe manufacturers should always provide dust grooves on these pilots, as indicated. It is inevitable that small chips will get into the adapter, and when the latter is put on the spindle, these chips are rolled into the metal of the pilot and gradually ruin its accuracy. The grooves suggested would pick up these chips and so preserve the spindle. When a new lathe is bought, it would be of advantage to have such grooves provided before putting the lathe into use.

An adapter for mounting an end-mill on a milling machine is illustrated in Fig. 3. The body of the adapter is attached to the machine spindle by means of four fillister-head screws, the drive being through two tongues *A*. The cutter is slotted on the face and is driven by the two keys *B*, which are rounded to fit the milled slots in the adapter. However, they might just as well be straight and so save the extra expense of rounding the ends. The cutter is piloted on the nose of the adapter and drawn down tight against the face by means of the special screw *C*. This screw is plugged by disk *D* to prevent chips and cutting compound from getting into the spindle. The same result could be secured in a cheaper way if a square-hole drill were available by drilling the hole only half way through.

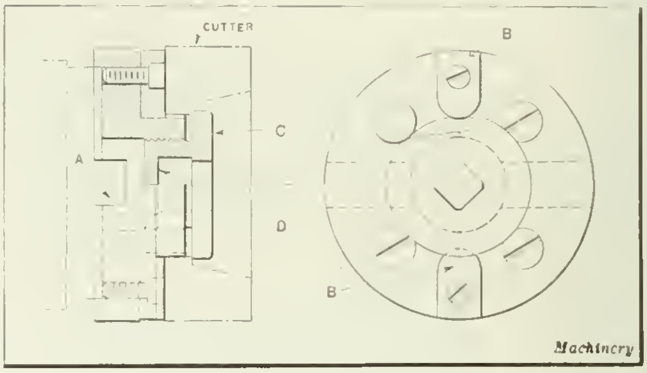


Fig. 3. Construction of an Adapter for attaching a Cutter to the End of a Milling Machine Spindle

* * *

IMPROVEMENT IN STEEL CASTING BUSINESS

The steel casting business improved very much in 1922, the sale of commercial castings in that year being almost three times as large as in 1921, and at almost the same level as in 1920. This estimate is based on reports from sixty-five companies comprising over two-thirds of the commercial steel-casting capacity of the United States, the reports having been made to the Bureau of Standards in cooperation with the Steel Founders' Society. The railways were heavy buyers of steel castings during the past year. The business done in 1922 was equivalent to nearly 70 per cent of the steel casting capacity, as compared with less than 25 per cent in 1921.

BUTTON METHOD OF CHECKING ANGULAR WORK

By W. G. HOLMES

In checking the angular surfaces of jigs and fixtures, it frequently happens that the large size of the work, or the impossibility of removing the angular part to be tested, makes it desirable to do the checking by some process other than by the usual sine-bar method. For cases of this kind the button method here described has proved satisfactory. By using two buttons having a difference in diameter of from 1 to 2 inches, quite accurate results may be obtained. Referring to Fig. 1, it is required to check the angular location of surface *NP* in relation to the surface *MP* of the surface plate, or in other words to check the accuracy of angle *e*. The line *MNS* is perpendicular to the surface plate, and may represent either the edge of a square or the side of a parallel which is clamped to the piece. In clamping the square or the parallel to the work, considerable care must be taken to see that the surface *MS* is in a truly vertical position or at exactly right angles with the surface *MP*. Careful shimming is often required in order to obtain this condition.

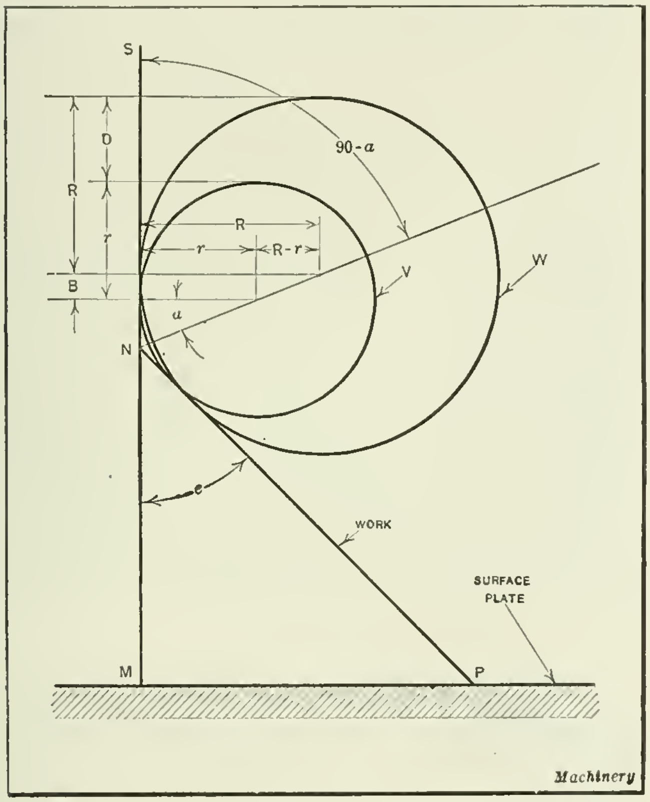


Fig. 1. Button Method of checking Angular Work when the Angle is Less than 90 Degrees

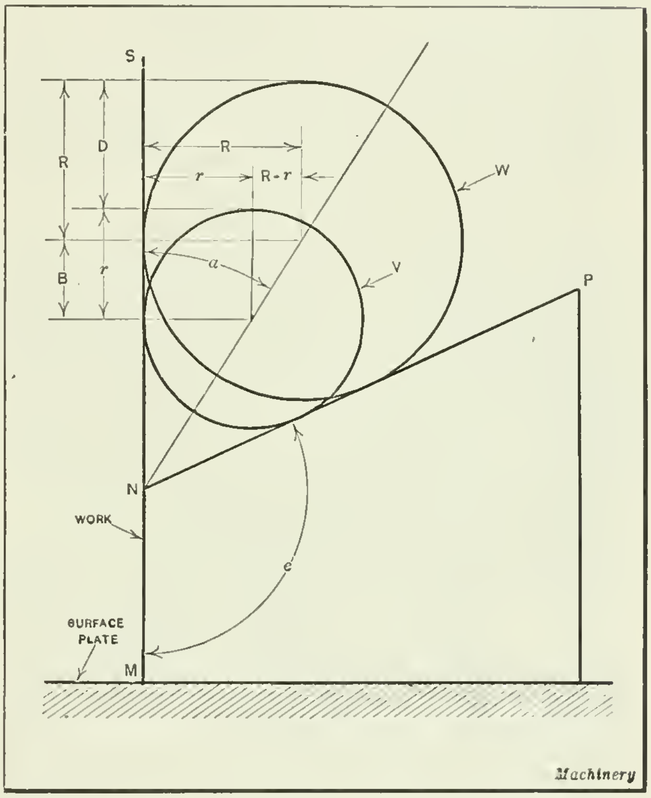


Fig. 2. Method of using Buttons to check Angular Work when the Angle is Greater than 90 Degrees

The button *V* is placed in contact with the side of the parallel and the side of the work in the angle *SNP* and a measurement taken over the top of the button with a height gage. The same procedure is also followed with respect to button *W*. By subtracting one reading from the other we obtain the difference *D*. We now have given:

r = radius of button *V*;
R = radius of button *W*; and
D = difference in the measurements taken over the two buttons.

From the values given it is required to find angle *e*, or the angle which the top face of the work forms with the vertical line *SM*. When angle *e* is less than 90 degrees, the solution is as follows:

In Fig. 1, we have:

$$a = 90 \text{ degrees} - \frac{180 - e}{2} = \tfrac{1}{2}\, e$$

$$B = (R - r) \tan a$$

$$D = R + B - r \quad \text{or} \quad D = R - r + (R - r) \tan a$$

Transposing

$$(R - r) \tan a = D + r - R$$

Hence

$$\text{Tan } a = \frac{D + r - R}{R - r} \quad \text{and} \quad e = 2a$$

When angle *e* is more than 90 degrees, as shown in Fig. 2, the solution would be as follows:

By geometry we have

$$a = \frac{180 \text{ degrees} - e}{2}$$

and by trigonometry,

$$B = (R - r) \cot a$$

Now

$$D + r = R + B \text{ or } D = R + B - r$$

By substitution we now have

$$D = R + (R - r) \cot a - r$$

Transposing

$$(R - r) \cot a = D - R + r$$

Hence

$$\text{Cot } a = \frac{D - R + r}{R - r} \quad \text{and} \quad e = 180 - 2a$$

* * *

NEW APPLICATION FOR STEEL CASTINGS

Bronze is generally thought to be the only material suitable for church bells, but experiments made in Bohemia indicate that bells cast from Siemens-Martin steel give practically the same tone as bronze bells of the same size, and are lighter in weight. This matter is of particular importance at the present time in Germany and the former Austrian territory, because most of the church bells were melted down during the war, and the question now arises how to replace them by metals less expensive than bronze. The steel castings for the bells are turned, and are then rustproofed.

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FRANKLIN D. JONES, ASSOCIATE EDITOR

THE AUTOMOBILE INDUSTRY'S FUTURE

There have been so many surprises in the automobile industry that it would be venturesome to prophesy its future course. But there are two different opinions voiced among men directly and indirectly connected with this industry that are worth recording for the guidance of manufacturers in the general machine-shop equipment field.

According to one opinion—an optimistic, and yet, in the light of past automobile history, a conservative view—the industry will continue to operate in the future at practically the present output, with possibly a slight increase. Those who hold this opinion claim that while the 1922 production was about 2,400,000 cars, fully half of this was replacement business, and in the future the replacement of worn cars by new ones will be even greater than now, in proportion to the total business. As the automobile becomes more of a necessity and a business adjunct, rather than a luxury, the market for it increases.

The other opinion, also expressed by men whose past judgment in automobile affairs has been frequently verified, is that if the production and sale of new cars proceeds at its present high rate, an increasing number of old cars must be taken by dealers in trade, and soon the second-hand market will be so glutted with cars that the sales of new automobiles will be seriously interfered with. Those holding this opinion expect this condition to make itself felt seriously enough to influence production schedules in automobile factories in about six months, and are advising the buying of materials and parts with that possibility in mind.

We do not undertake to say which view is correct, because there are various arguments to support both; but it is wise to proceed with caution, and not to load up with too heavy stocks of materials or finished products in anticipation of a continued high-pressure automobile production. On the other hand, a slump in the automobile industry is not within the probabilities; the general prosperity of the country insures a steady and moderate increase.

For the past fifteen years we have repeatedly heard that the automobile market has finally become saturated; but the builders of cars always have found ways of increasing their sales and the field to which they appeal has constantly broadened. Early in 1921, it was believed that if in the following two years the industry did a business of from 50 to 75 per cent of that for 1920, it would do well. In 1922, a year later, the sales exceeded 1920 by 20 per cent.

* * *

THE SCARCITY OF SKILLED LABOR

The machine-building field in general, and the machine tool industry in particular, all over the country, is facing a serious shortage of skilled labor. There has been such a great industrial expansion during the last ten or fifteen years that the supply of skilled workers in the industry no longer is sufficient for its needs; and unfortunately there has been no systematic effort to maintain—not to mention increase—the number of all-around machinists and toolmakers. The apprentice system has survived only in comparatively few shops. Manufacturers may have been justified in ceasing to train young men in view of the difficulties of holding apprentices until their terms were completed; but the need for skilled workers makes the adoption of some form of apprenticeship imperative.

Evidently the training proposition does not offer sufficient inducement to young men for them to be willing to complete their terms of apprenticeship. The ease with which the unskilled worker can find a job to operate a machine that calls for little or no skill, constitutes the principal difficulty in holding the student until his training is completed. Imagine the effect upon the apprentice earning a comparatively small amount a week, who does not realize that his biggest compensation is the practical knowledge he is acquiring, when he meets a former schoolmate who earns two or three times that amount running a semi-automatic machine in an automobile plant. The apprentice does not fully realize that he is merely going to school, that he is fitting himself for greater responsibility and a better position in the industry than the other boy can ever hope to attain. The machine operator, as such, will always remain an operator, but his own ability and perseverance will set the only limits to the advance of the trained mechanic. Many great mechanical engineers of this generation, as well as thousands of our superintendents and works managers, were just ordinary apprentices twenty or thirty years ago, and the boys must be brought to a full realization of this fact if the apprentice method of training skilled mechanics is to succeed.

That it should succeed is imperative, or the supply of skilled workers will become so limited that the standing and progress of the machine-building industries will be imperilled. The problem of working out the details of a thoroughly successful apprenticeship system that will apply to all shops has not yet been completed; but the efforts of the National Metal Trades Association are certainly in the right direction and are likely to go far toward solving the problem, if adequately supported by its members.

* * *

DON'T WASTE SALESMEN'S TIME

In a manufacturing plant in the Middle West, the following announcement is prominently displayed at the information desk: "Visiting salesmen will please insist upon receiving prompt attention. We, too, have salesmen whose time is valuable." If this method of dealing with salesmen were more general, what an amount of their time could be saved. A great deal of thought is given to saving time in the performance of machining operations, where much experimenting is required, followed by expenditure for special machinery; but why not also consider the wasted time of salesmen, who sometimes have to wait for hours to see the man whom they wish to interest?

A salesman must, of course, be willing to wait until the prospective customer finds it convenient to see him, but often he is kept waiting unnecessarily, particularly when after waiting a half hour or more, he is told there is nothing wanted in his line. If practicable, this information should be given without delay. It also will save the salesmen's time to make a practice of telling them about how long they probably will have to wait to see a certain person, so that they may have the choice of waiting or coming back. Often a salesman can put his time in profitably by calling on someone else in the interval.

Wonderful results have come from cooperative effort. Make this effort in your own plant, and like many unselfish movements, it may spread until it becomes a custom that will benefit you as well as others.

Standardization of Tap Thread Tolerances

What has been Accomplished Toward Standardization by Cooperation Among Manufacturers in the Tap Industry

About fifteen or twenty years ago several of the manufacturers of taps began to realize the desirability of a greater degree of standardization in the tap manufacturing industry. At that time there were no commonly accepted standards for the sizes of squares, diameters of shanks, lengths of threaded portion, or tolerances to be allowed on the tap threads. Gradually each tap manufacturer adopted a standard practice of his own, as far as the product of his shop was concerned, but taps made by different manufacturers at that time often varied considerably. This was recognized to be a disadvantage to both manufacturers and users of taps; but no means had been found up to that time to bring the practice of the many tap manufacturers of the country into uniformity.

It was not until after the formation of the Tap and Die Institute, comprising among its members the leading tap manufacturers of the country, that effective steps toward the adoption of standards that would apply to the practice of all the manufacturers could be taken. The first steps were to standardize such matters as the square, the shank, overall length, length of thread, etc., of the taps. The largest, most difficult, and at the same time most important item of standardization, however, was the tolerances for the pitch and outside diameters of the thread, and the lead of the thread. Various manufacturers, for inspection purposes in their own plants, had adopted tolerances and developed measuring instruments that made it possible to readily inspect the taps in order to ascertain that they were within these tolerances. But no two manufacturers employed the same tolerances for their entire product, and in some cases there were very wide variations.

Investigations Preceding the Standardization of Tap Thread Tolerances

About 1916 the first thorough investigation was undertaken by the Tap and Die Institute, as an organized body, with a view to determining what the tolerances employed by the different manufacturers were at that time on the commercial product regularly sold by them in the market. The object of this investigation was to record the commercial practice as it existed at that time, and to draw such conclusions as would make it possible to establish a commercial standard for tap thread tolerances that would be adhered to by all the tap manufacturers.

Having determined upon this investigation, it was decided to select some competent authority to carry out this work, which was probably the most extensive so far undertaken on any line of tools, aside from the investigation made by Frederick W. Taylor in his extensive experiments and research in regard to the art of cutting metal. Each of the tap manufacturers who were members of the institute sent to the authority selected to carry on the investigation fifty taps of each of twenty-one sizes, ranging by sixteenths from 1/4 to 1 inch, and by eighths from 1 1/8 to 2 inches. This meant that each manufacturer sent 1050 taps to be measured. For the several manufacturers this meant a total of 12,600 taps. The taps of each manufacturer were assigned a letter, so that as the measurements of these taps were made, they could be recorded on tracings and distributed without identifying the manufacturer by actual name.

One man was assigned to the work of measuring and recording the dimensions of the taps submitted, in order to insure complete uniformity in the measuring process. The work of measuring all of these taps required about four months, every outside and pitch diameter being recorded, as well as the error in lead per inch. The taps measured were all hand taps, and the record thus produced gave a most accurate idea, not only of the current practice at that time in this line of manufacture, but also of the commercial possibilities. Each manufacturer, when the investigation was completed, was furnished with a complete set of blueprints, showing the entire measurements. The identifying letter of his own company was furnished to him, but he was not able to identify the other companies. He could, however, compare his own product with that of all the others, and could determine whether, in some cases, his product was above or below the average. It is evident that even if the work had gone no further, this investigation would have stimulated every manufacturer to reach the highest standard indicated by any one tap maker, and would, in itself, have proved of great benefit both to tap manufacturers and tap users.

The Adoption of a Commercial Standard

Having undertaken the work of recording these measurements, the Tap and Die Institute concluded that this should be considered only the first step in the adoption of a commercial standard of tolerances that all the manufacturers would use. The results, as recorded by the measurements, were carefully studied, many meetings between the different manufacturers were held, and the principal users of taps consulted. It was found that many different conditions had to be met; for example, in certain taps the user wants a nut that will screw freely on the bolt, and he also wants a tap that will have a reasonably long life before it is worn down too small to produce acceptable nuts. This larger allowance permits a larger tolerance on the tap, which is also desirable from a commercial viewpoint.

The standards finally adopted as a result of this work have been published, as mentioned in December MACHINERY, in booklet form by the Tap and Die Institute, 116-120 W. 32nd St., New York City, and are available to all users of taps. They were adopted with a view to meeting the general average conditions in the trade, as indicated by past experience, and it is stated that 90 per cent or more of the requirements of the tap users are met by the standard tolerances that have been adopted.

There remains a small number of tap users who require tolerances smaller than those adopted as standard, but as no two of these users, as a rule, require the same tolerances, it has been found impracticable by the tap manufacturers to adopt any standards for these finer tolerances; but each case is considered special, and any taps required for purposes of this kind are made to order. There is also a growing demand for ground taps with exceptionally small tolerances, but compared with the total number of taps made, the output of ground taps is, as yet, quite small, and it was not considered necessary at this time to establish any standard tolerances for this small proportion of the product of the tap industry.

Tolerances for Different Kinds of Taps

In establishing the commercial tolerances, the requirements for different classes of taps were considered. For example, the tolerances established for hand taps are less liberal than those for tapper taps, in each case the practical requirements of the trade having been considered. The average requirements in the trade were taken as a measure of the most desirable standard for commercial purposes, especially as taps meeting these requirements can be produced by the tap manufacturers at a commercial price.

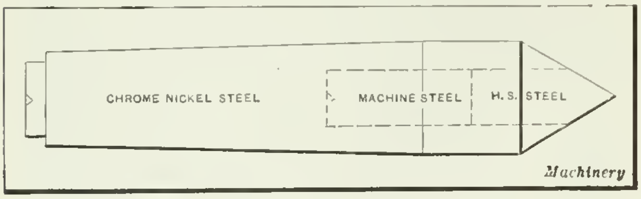
The result of this standardization is that the user knows what the manufacturer can produce and what he can expect to obtain in commercial taps. The manufacturer, in turn, has a definite standard to live up to, and as he knows that the user is cognizant of this standard, it becomes necessary for him scrupulously to meet its requirements. On the other hand, if the user's requirements demand finer tolerances than those obtainable in commercial taps, he will know that he must have these taps made to order as special, or must obtain ground taps. In other words, the object of this standardization, as of all other forms of standardization, is to obtain uniformity and simplicity. One general standard of taps to cover the very large percentage of requirements is most desirable for the tap manufacturers as well as the users, all other requirements to be taken care of as explained previously.

* * *

THE DEVELOPMENT OF HIGH-SPEED CENTERS

By THOMAS FISH, President, The Ready Tool Co., Bridgeport, Conn.

During the war, when all manufacturing concerns in the metal-working field were endeavoring in every way to assist the Government in regard to tool requirements, the Ready Tool Co. was requested to manufacture bridge reamers. In order to produce the quantities required, it became necessary to make use of some lathes without taper attachments, and to set over the tailstock center to turn the long taper. From the very beginning there was a great deal of trouble due to the wearing down of the carbon-steel centers, and it was found necessary to grind them at least once a day and sometimes twice. In order to overcome this difficulty, an experiment was made with the use of high-speed steel centers. These centers, being made from solid high-speed steel, were, of course, very expensive.



High-speed Center formed of Three Kinds of Steel

When high-speed steel centers were used on the same machines and for the same work as the carbon-steel centers, they showed no signs of either burning or wearing after five weeks of hard usage, and as a result we definitely decided on their use in our own plant and made plans to put them on the market.

Experiments have shown that on lathe work at both high and low speeds the life of high-speed centers is easily ten times that of carbon-steel centers. In cases where the work is long and of fairly small diameter, when carbon centers are likely to burn off due to the expansion of the work being machined, the danger of spoiled centers and spoiled work seems to be entirely overcome by the use of high-speed steel centers. In grinding machines, high-speed centers also seem to stand the wear of the abrasive which gets into the cutting compound and which deteriorates the carbon-steel centers very rapidly.

One of the problems in substituting high-speed steel centers for carbon centers is the increased cost due to the higher priced material. But by welding the front or wearing end of the high-speed steel center to a chrome-nickel steel shank, an equally satisfactory center can be made at a much lower cost. Recently we have developed a center (for which patents are pending) as shown in the accompanying illustration. The object in designing this center was to reduce the first cost, especially in large sizes, and still retain all the advantages of a high-speed steel center.

The center consists of a chrome-nickel steel shank having a high-speed steel point. This point is welded to a machine-steel extension piece to provide an unusually deep seat in the shank and insure holding the point securely. The hole in the shank is reamed slightly tapering, and the point or plug is ground, after hardening, to the same taper as this hole.

In assembling the plug and shank, the latter is first heated to about 1100 or 1200 degrees F., and then the plug is forced into the hole under a heavy pressure, after which the shank is cooled by plunging it into cold water. As a result of this combination shrinkage and force fit, the plug or center is gripped very tightly by the shank, and it would be impossible to even locate the joint between them were it not for the slight variation in color between the high-speed steel plug and the chrome-nickel steel shank.

This construction is particularly advantageous for large centers, not only because of the saving in high-speed steel, but also because better heat-treatment can be applied to the smaller section of high-speed steel than was possible with the large ends that were formerly welded to the shank.

* * *

CATALOGUE INDEXES SHOULD BE COMPLETE

By N. G. NEAR

Many manufacturers publish catalogues that are inadequately indexed or have no index at all. Money may be spent without stint to secure the best paper and illustrations obtainable in getting out a catalogue, and the result may be very attractive in appearance, but too often it is disappointing from the practical viewpoint, because the information contained therein is not indexed for ready reference. The writer has often been obliged to make a time-consuming search in catalogues published by prominent manufacturers in order to locate the information desired. because the indexes were too general in nature.

In many cases the indexes are set up in large type, and they look as though an attempt has been made to use as few words as possible. It is well to be terse in certain descriptive matter, and in much advertising. The description that fully describes a thing in the fewest words is usually the best. In the case of an index, however, the manufacturer should not be stingy with words, but should use plenty of them and provide as many pages for the index as may be needed to make it complete.

In making catalogues it is too often the practice, if there is a page left open, to use that page for the index in some haphazard manner. Sometimes even when there is a page available, it is not used at all, and the catalogue is published without an index. The writer believes that some kind of index, even a poor one, is better than none at all. Again when the manufacturer notes that there is a spare page that can be utilized, instead of using it for an index, he sometimes inserts an illustration of some machine or product. The writer has often admired the indexes to be found in the catalogues of some of the large well-known mail order houses. These catalogues are very well arranged, and manufacturers and advertising men might well study the make-up of the indexes in these catalogues. They are certainly hard to beat for simplicity and completeness.

* * *

With a view to gaining experience in the latest developments of steam turbine practice in Great Britain, the Commonwealth Edison Co. of Chicago, has ordered a 40,000-kilowatt turbo-alternator from C. A. Parsons & Co., of Newcastle-on-Tyne, England. In 1912, the Commonwealth Edison Co. ordered a 25,000-kilowatt turbo-alternator from the same concern.

NUMBERING AND INDEXING DRAWINGS

By EDWARD HELLER

Nearly every mechanical engineer or chief draftsman has at some time been confronted with the problem of devising or improving a system for indexing and numbering drawings. While this problem is comparatively simple, when the work covered by the drawings is of one kind, it becomes greatly complicated when the work is of a varied nature. For instance, the methods used for numbering and indexing drawings of automobile parts are not entirely suitable for drawings of tools designed to machine those parts. Neither will a system devised for numbering drawings of structural work prove satisfactory for either of the cases mentioned. In fact, there is no system that will suit all purposes, but there is usually one good system that will meet the requirements of each particular case. The characteristics of such a system must be flexibility, simplicity of application, and expansibility.

The system must be so flexible that it will readily include the different activities of the drafting-room or shop with a minimum of clerical work. When a new system is required to replace an old one, it must be so planned that it will be easy to change from the old to the new. If the cost of installing a new system is estimated to be more than will be saved in a reasonable length of time, by the new system, it is obvious that a change should not be made.

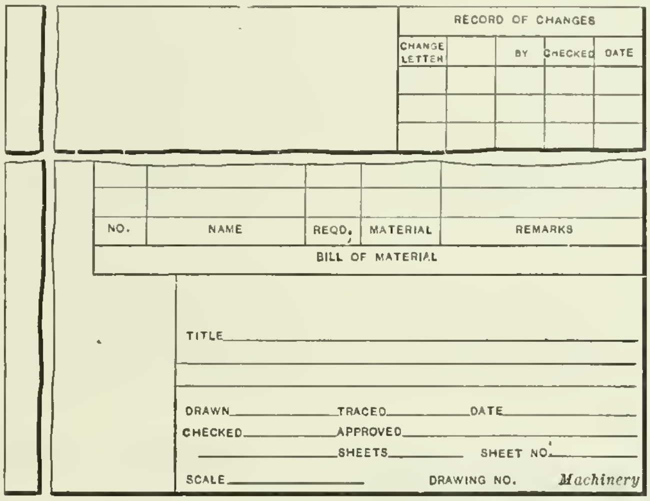


Fig. 1. Upper and Lower Right-hand Corners of Drawing Sheet

An important feature of a good system is the possibility of expanding it to include any new activities that may be under consideration. The writer was recently confronted with a problem of this nature, and as conditions were of a very general character, it was necessary that the system developed meet the requirements of many shops and drafting-rooms. The system was established in a large shop in northern Ohio devoted to the manufacture of an extensive line of aluminum and enameled steel utensils.

The drawings that required indexing included four general classes, namely, drawings of the product; drawings of tools; drawings of special machinery and equipment; and miscellaneous drawings, such as building and plant lay-outs. Of course, every drawing was numbered in some manner under the old system and the numbers recorded. A record was also kept of tools and patterns. The problem in this instance was made more difficult by the fact that a great many tools were made up in the tool-room without any drawings. Patterns for the replacement of broken parts were also made up in the pattern room without drawings of any kind. It was necessary, however, to keep a record of this work.

In the new system, standard sizes for drawings in multiples of 8½ by 11 inches are used. Each size is designated by a letter; thus, the 8½- by 11-inch size is given the letter A, the 11- by 17-inch size, letter B, etc. The title space in the lower right-hand corner of each drawing is made up as shown in Fig. 1. A space for recording changes is also provided in the upper right-hand corner as indicated.

Index Cards

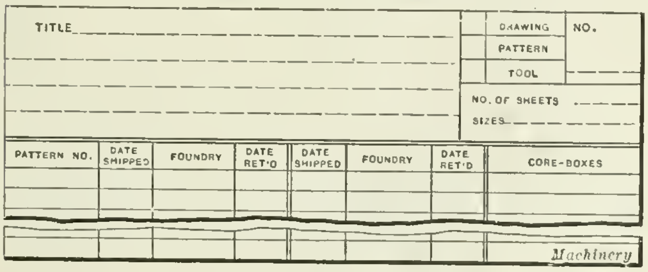
After adopting standards for the sizes of drawings, the next problem was to design a suitable index card. The front side of the card finally developed is shown in Fig. 2, while the back of the card is shown in Fig. 3. It will be noted that sufficient space is allowed at the top of the card for the title. A space for the drawing number and other information is provided at the right of the title space.

The drawings are assigned numbers in the order of their completion. A card is filled out and a check mark made in the square on the line marked "Drawing." If the drawing happens to be a tool or piece of machinery, a check mark is also placed on the line marked "Tool." The drawing number also serves as the reference number for the tool or piece of equipment. If patterns are required for the job, a check mark is made on the line marked "Pattern." The drawing number with a letter added is used as the pattern number, and this is placed in the column headed "Pattern No." Thus, if the drawing is numbered 4372, the patterns for that job are numbered 4372-A, 4372-B, 4372-C, etc.

Record of Tools Made without Drawings

If a tool is made up in the tool-room without a drawing, the drafting-room is notified and a number secured for the tool. Numbers issued for tools made up without drawings are given out in consecutive order, just as though a drawing had been made. All the information necessary for filling out an index card is obtained at this time. In filling out the index card, a check mark is placed on the line marked "Tool," and also on the line marked "Pattern," provided patterns are used. In cases of this kind, the square on a line with the word "Drawing" is not filled in. This shows that no drawing has been made for the piece.

The same system in indexing and issuing numbers is applied to patterns that are made in the pattern shop without drawings. In this case, a check mark is placed only on the line marked "Pattern." The chief draftsman keeps a memorandum of such tools and patterns and in slack times has the drawings made up. When a drawing is made for one of these parts, the fact is recorded on the index card by placing a check mark on the line marked "Drawing." The order in which the drawings are completed is indicated by the letters representing the sheet sizes. Thus, A, C, B, A, indicates that sheet No. 1 will be found in the "A" size file, sheet No. 2 in the "C" size file, and so on.



TITLE

DRAWING
PATTERN
TOOL

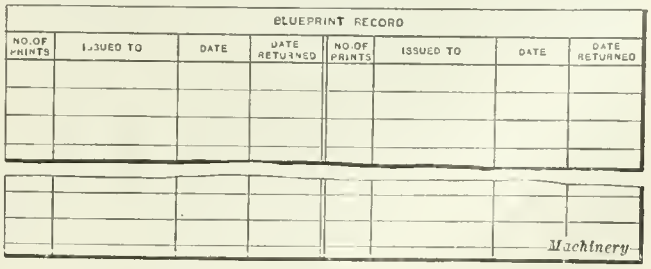
NO.

NO. OF SHEETS
SIZES

PATTERN NO.	DATE SHIPPED	FOUNDRY	DATE RET'D	DATE SHIPPED	FOUNDRY	DATE RET'D	CORE-BOXES

Machinery

Fig. 2. Front Side of Index Card



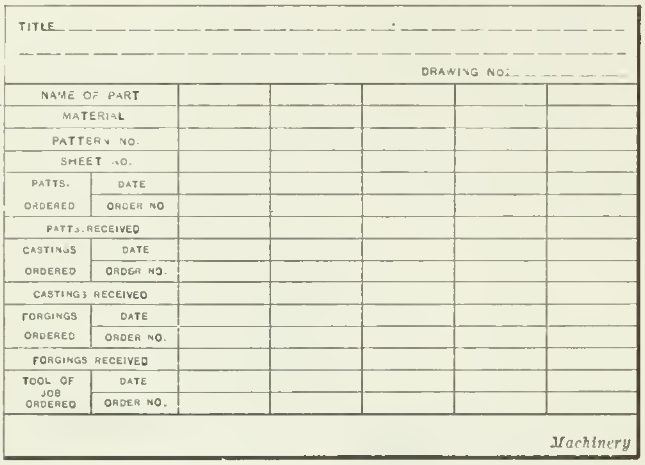
BLUEPRINT RECORD

NO. OF PRINTS	ISSUED TO	DATE	DATE RETURNED	NO. OF PRINTS	ISSUED TO	DATE	DATE RETURNED

Machinery

Fig. 3. Back Side of Index Card

The body of the card also has a space for the pattern record. In this particular plant the engineering department does all the ordering of castings and material or parts not kept in stock. When castings are ordered, a record is made on the card showing to which foundry the patterns have been sent, so that any pattern can be readily located by inspecting the index card file. When the patterns are returned, the receiving department notifies the engineering department so that the index card can be changed accordingly. When the space on one card becomes filled, another card bearing the reference number only is placed in front of the first card. Columns are ruled up on the back of the card, as indicated in Fig. 3, to provide for a record of blueprints.



TITLE

DRAWING NO.

NAME OF PART						
MATERIAL						
PATTERN NO.						
SHEET NO.						
PATTS. ORDERED	DATE					
	ORDER NO					
PATTS. RECEIVED						
CASTINGS ORDERED	DATE					
	ORDER NO.					
CASTINGS RECEIVED						
FORGINGS ORDERED	DATE					
	ORDER NO.					
FORGINGS RECEIVED						
TOOL OF JOB ORDERED	DATE					
	ORDER NO.					

Machinery

Fig. 4. Index Card of Alphabetical File

Index Cards Arranged in Alphabetical Order

The index cards described are filed numerically, but in order to facilitate the location of a drawing, it was found necessary to have another set of index cards filed alphabetically. Considerable care must be exercised in making up the alphabetical card index. Many indexing systems that would otherwise be satisfactory are made confusing by an incorrectly designed alphabetical index. Usually the same kind of card is used for both files, although sometimes a card of a different color is used, with the same arrangement of columns and printing. This method, however, results in considerable duplication of the data contained on the cards, and thus increases the possibility of error.

To eliminate this trouble, an entirely different type of card was used for the alphabetical cards. The most prominent part of the card, as shown in Fig. 4, is the title space. The body of the card is designed for recording the progress of a job so that the engineering department can issue information to those concerned regarding the standing of the work at any time. The card is printed the same on both sides, thus providing space for records of at least ten parts. If more parts are needed on one job, another card is used. If a job requires castings, forgings, or other material not kept in stock, the card should be divided into several columns.

An important feature of the alphabetically filed card is that it shows definitely where a tool or piece of work may be found. Thus a forming die might be filed under "forming," or under "die," or, again, it might be filed under the part that the die forms. Usually it would be filed under the last-named heading, but in either case, definite information must be recorded, so that anyone will be able to locate the required drawing or part when needed.

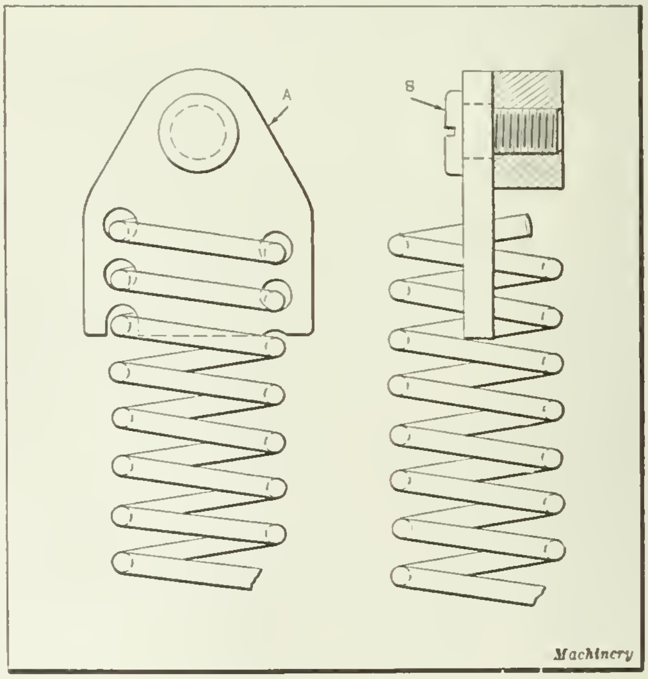
In a great many cases it is desirable to fill out cards and file them under various headings. The records are usually kept on the card that is most likely to be referred to, while the other cards bear only the title and drawing number with a reference to the fully filled out card written across their faces. One precaution must be taken, however, when filing more than one card for the same item, and that is to record that fact on the numerically filed card, so that in the event of a change being made in the title, all the cards can be readily looked up and changed. The few minutes spent in making out an extra card are often more than made up in time saved when a drawing or record is to be located.

A system of the kind described can be put into operation without interfering greatly with any system that is already in use. In placing the system in operation, the first number selected for the card index should be larger than any number used in the old system. If the drafting-room has a system employing numbers up to, say, 2500, the new system can start with 3001. Any drawing or tool bearing a number smaller than 3001 will at once be recognized as being recorded under the old system, while a drawing, tool, or pattern with a number above 3000 will be identified with the new system. Tools, patterns or other pieces that have stamped or cast numbers can be numbered under the new system when they become worn out, or undergo repairs, while drawings that do not involve such things can be changed at once. This method of changing from the old to the new system really amounts to the use of two systems instead of one for a time, but the change involves very little inconvenience or expense.

* * *

TENSION SPRING CONNECTION

Small and medium-sized tension springs usually have their end coils bent up parallel to the axis to form hooks, which are held by spring pins, eyes, or similar end connections. For heavy-duty springs, the stresses set up in the wire by bending the ends in this manner often make the method inapplicable. Under such conditions the device here illustrated has been found to give satisfactory service. It consists of a sheet-steel plate *A* having two rows of holes spaced to conform to the diameter of the spring and the pitch of its coils. The end of the spring is simply screwed into these holes, and the stud *B* which passes through the plate prevents the latter from unscrewing. With this connection no undue stress is exerted on the spring at the point at which failure usually occurs. An additional advantage of this construction lies in the fact that the plate and its stud form a substantial bearing, which permits the spring to swing freely if the motion of the part to which it is attached tends to pull it out of line. P. R. H.



Tension Spring Connection

Standardization in the Industries

Various Aspects of Standardizing Mechanical Products, with Particular Reference to Small Tools

By CARL J. OXFORD, Chief Engineer, National Twist Drill & Tool Co., Detroit, Mich.

THE constantly increasing demand for low production costs has given a decided impetus to the movement to standardize manufactured products of all kinds. Standardization, as applied to mechanical products, may rightly be said to have originated abroad; but with the growing interest in this matter here, the time may soon come when we will outstrip our foreign friends. The establishment of the American Engineering Standards Committee (A. E. S. C.) marks an epoch in our industrial development. Reports covering the work of the A. E. S. C. are encouraging in that they show that standardization is being extended to wider and more varied fields from year to year.

To anyone who seriously has considered the subject, there can be no question about the desirability of standardization. The degree of desirability will vary, however, according to the kind of products considered. In some instances, absolute necessity has forced the issue, and standardization is an accomplished fact; in other cases, the necessity is less apparent, and as a consequence nothing has been accomplished. A uniform gage for railroad tracks, for instance, was early recognized as of paramount importance. In consequence, the standard gage is in universal use today.

Standardization of small tools is one of the important questions confronting our manufacturers today. Judging by the results of standardization, where such work has been undertaken, there can be no doubt about the gain resulting from it. The small individual savings will in the aggregate mean the saving of millions of dollars. It is therefore a matter that is worthy of interest and serious attention on the part of engineers, manufacturers, and consumers alike.

The Economic Importance of Standardization

Generally speaking, standardization would be justified only as a matter of convenience, but the real argument in its favor is the elimination of great economic waste. A case somewhat in point is cited from the great Baltimore fire. When it became apparent that the Baltimore fire fighters could not cope with the situation single-handed, a call for help was sent out to nearby cities. A great quantity of equipment was dispatched in response to this call. Upon arrival much of this equipment was useless, because the firehose couplings of other cities did not fit the pipe connections in Baltimore. The outside firemen were therefore compelled to stand idly by and watch the city burn. Through the energetic work of the National Board of Fire Underwriters and other agencies, standardization of hose couplings and connections has been effected to such an extent that today a greater portion of this equipment is uniform throughout the country.

It is difficult to interest anyone in a new movement while it is yet in what might be termed its abstract stages, especially if changes proposed involve the expenditure of money. Only by pointing out individual and public economic benefits can any measurable results be obtained. Educational work to promote standardization must therefore be directed along these lines.

The continued use of divergent standards for many manufactured products not only constitutes a national economic waste of enormous proportions, but is also a great danger to our ability to compete with foreign manufacturers in the markets of the world. It must be brought home to our own manufacturers and business men that in the standardization of their product with the consequent possibility of simple quantity production they have available the greatest competitive weapon ever afforded. Standardization must be applied both to the product they themselves manufacture and to the raw material, machinery, and tools used in the various manufacturing processes. With these thoughts in mind we will consider some of the questions involved in the standardization of the most universally used aids to mechanical manufacturing, namely, cutting tools.

Cost of Cutting Tools—an Important Item in Manufacturing

There is hardly a manufacturing establishment of any kind or size in which cutting tools are not used to a greater or less extent. In the strictly mechanical industries they are as necessary as raw material or labor; in the production of many articles the cost of the cutting tools closely approaches the cost of one or both of these items. It is, therefore, easily realized that the annual cost of cutting tools for the entire country represents a great many millions of dollars.

In the automotive industry alone, it is conservatively estimated that, on an average, one per cent of the gross sales price of every automobile represents the cost of tools used up in its manufacture. This may not at first glance seem a large amount, but when it is remembered that the annual sale of automobiles amounts to nearly two billions of dollars, it is seen that the cost of tools for this one industry alone is very great.

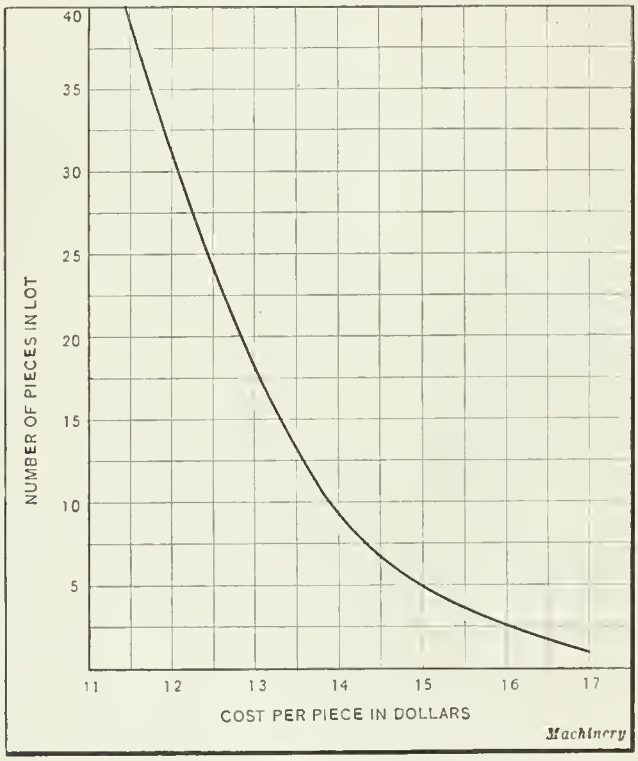
A manufacturer of a well-known type of mechanical equipment recently purchased a single milling cutter costing almost a thousand dollars. This cutter could perform only one of several machining operations on a stock part. While the tool cost for each of these parts is not definitely known by the writer, it is estimated that it might exceed one dollar for each piece produced. The above is cited as another illustration of the importance of cutting tools, and of their share in making up the net cost of finished articles.

It is idle to speculate on ways and means of eliminating cutting tool costs, for as long as we are facing the necessity of cutting or separating materials of any kind, tools must be used. It is not idle, however, to bend our efforts toward the reduction of tool costs. Successful efforts in this direction will eventually mean lower costs of nearly all manufactured products. Lower tool costs will, for instance, mean lower-priced machinery. Whether this be textile machinery, steam engines, locomotives, electric motors, or automobiles, the cost of tools must eventually be absorbed by the public who purchase clothing, electric light, power or transportation of any kind. For it is very clear that the manufacturers of these commodities are compelled to price their product in proportion to their costs.

Great savings are possible through the proper handling and use of small tools. Instances of gross abuses of tools are so common that they are hardly conspicuous. Credit is due to efficiency engineers and others who have endeavored to correct this evil through educational efforts and improved methods. It is to be regretted that this work can be extended only to a comparatively few of the larger manufacturing establishments. To accomplish results, a continuous effort is necessary on the part of those in charge. This is all too often lacking, because the advantages are seldom immediately apparent.

Savings due to Standardization of Small Tools

Still greater economies can be realized from the proper standardization of small tools. In some instances the tool manufacturer must take his cue for standardization from existing or proposed standards for other products. On the other hand, there are numerous cases where designers and manufacturers can profitably alter their designs and specifications to conform with such small tool standards as have been established. For example, if the gear manufacturers were to adopt as their standard only a few of the present pitches of gear teeth, then the obvious thing would be for the tool manufacturers to arrange their standards for gear cutters and gear hobs accordingly. Both gears and tools could then be made in larger quantities of each size with a corresponding decrease in cost. Or, take the matter of tap drills. The American Screw Thread Commission has established a system of maximum and minimum diameters for tapped holes. The twist drill manufacturers are now in a position to establish standards for drills used in drilling such holes.



Relation between Cost and Number of Pieces manufactured

Keyway Cutters as An Example of Need for Standardization

A group of mechanical engineers recently in convention discussed the desirability of definite standard tolerances for keyways in shafts and holes, and corresponding standards for keys. If such standards were established, the keyway cutter manufacturers would be in a position to reduce these to practice by making cutters of a thickness which automatically would produce keyways within the desired limits. As matters now stand, the cutter manufacturers must make keyway cutters to the thickness specified by each individual consumer; and the latter's ideas as to the tolerances vary to a great extent. The following variations in thickness of cutters made for 5/16 inch keyways are from the files of a cutter manufacturer:

Maximum..	0.3115	0.312	0.3125	0.313	0.3135
Minimum...	0.3110	0.311	0.3115	0.312	0.3115

Obviously, the cutter manufacturers are unable to anticipate such varied requirements by carrying all the different sizes in stock. The proposition is further complicated by the fact that these cutters are ordered in various diameters ranging from 1½ to 4 inches in diameter. If they could be standardized to comprise only two or three sizes for one nominal size of keyway, then they could be made up in large quantities and carried in stock. Consumers could then purchase these cutters at approximately half the price, and in addition have the advantage of several sources of supply. Thus the benefit of standardization is twofold, affecting both producer and consumer.

The Designer's Part in Standardization

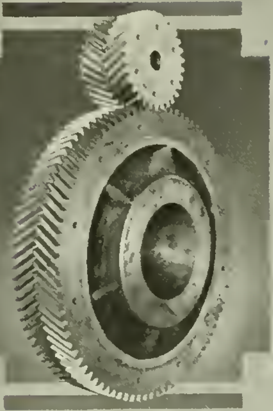
Designers could bring about the elimination of many existing sizes of tools if they would so arrange their designs as to use only a preferred list of sizes for holes and other finished dimensions. Shafts and other machine elements of any considerable size are usually designed with a sufficient factor of safety to permit appreciable intervals between successive sizes. Thus a shaft could be made either 2 or 2¼ inches in diameter, instead of using some of the sixty-fourth, thirty-second or sixteenth inch sizes between these figures. Six or seven sizes of drills and reamers now carried in stock by manufacturers could then be eliminated entirely, and the remaining sizes made in correspondingly larger quantities and at a much lower unit cost.

Not long ago the writer had occasion to point out an actual case where the cost of manufacturing a few special milling cutters proved to be 480 per cent higher than the cost of making standard cutters of approximately the same size. Needless to say the cost to the users of these cutters had to be based upon the expense of manufacturing. The difference in manufacturing cost will vary with the quantity manufactured in accordance with the curve shown in the illustration. The reason for this variation is fairly obvious; it is due to the fact that all overhead expenses must be absorbed by the number of pieces of each kind. Much of the overhead is the same, regardless of the quantity manufactured. If these charges are spread over several hundred pieces in one case, and over only half a dozen in another, the result is obvious.

Adapting the design of manufactured articles, and of jigs and fixtures, to the use of standard tools instead of special tools will often mean large savings to the consumer. Recently a large automotive manufacturer was prevailed upon to change a certain drilling operation so as to permit the use of standard drills. This change involved the virtual scrapping of about $3000 worth of tools, and the substitution of approximately $2500 worth of new equipment. Under the old method he bought special drills at seven dollars each, while he is now using standard drills at two dollars each. It is also found that a greater number of holes per drill is obtained with the standard drill than with the special one. The operation in question is one involving large quantities of parts to be machined and several dozen drills are used each week. It requires but simple arithmetic to find that the change was a profitable investment for him. Incidentally, he has also been able to reduce his inventory on this size of drill, because he can now purchase his requirements in the open market, as his production warrants. Similar instances could be recounted almost without end.

* * *

A census was taken on a much traveled New England highway in order to determine the average size of auto trucks and the speed at which they ordinarily traveled along the highways. Forty per cent of the trucks were of 1-ton capacity or under, and 33 per cent were between 1 and 2½ tons. Less than 2 per cent were of more than 5 tons capacity. Over 50 per cent of the trucks traveled on a level stretch of road at 20 miles an hour, and 37 per cent traveled at a higher speed.



Cutting Double Helical or Herringbone Gears

By FRANKLIN D. JONES

Duplex Type of Planer Used for Herringbone Gears of Large Pitch—Application of Gear Shapers and End-milling Process—Second of Two Articles

WHILE most herringbone or double-helical gears are cut by the hobbing process, this method is not as practicable for very large pitches as planing on a machine of the templet or form-copying type. Some of the gears used in rolling mills, etc., have circular pitches ranging from 3 or 4 up to 8 or 10 inches, but the cost of the hobs required for such large pitches would be excessive and, in addition, a very heavy and expensive machine would be required to withstand the strain of hobbing. On the other hand, a planer of the templet or form-copying type using relatively simple inexpensive planing tools provides a very satisfactory way of cutting these coarse pitches.

Double-helical Type of Planer for Gears of Large Pitch

When herringbone gears are larger than, say, 3 inches circular pitch, a double-helical gear planer is used by the Fawcus Machine Co., Pittsburg, Pa., instead of a hobbing machine. Fig. 11 shows the cutting of cast-steel herringbone gears on a planer which has a capacity for gears up to 24 feet in diameter and is adaptable to spur gears as well as the herringbone type. This planer operates on the right- and left-hand sections of the gear simultaneously. It has two tool-heads which have reciprocating motions in opposite directions, the tools moving from the sides to the center of the blank while the latter is rotated through a small arc in order to produce the helical teeth. This machine is of the templet or form-copying type.

The carriage upon which the two tool-slides are mounted is adjustable along horizontal ways to suit the diameter of the gear. This machine is very flexible in regard to the range of diameters it will accommodate, as indicated in Fig. 12, which shows the cutting of a relatively small herringbone pinion. The two tool-heads *A* and *B* (Fig. 11) carry planer tools of the usual form, no special shape of cutting edge being required. On the side of each tool-slide is a templet or former *C*, which controls the path followed by the tool as it feeds inward, thus producing teeth of the right curvature.

The tools cut from the outer edges of the gear blanks toward the center and in a horizontal plane. In conjunction with this planing movement, the gear blank is rotated for forming the helical teeth by a rotating mechanism consisting of change-gears and a worm meshing with worm-wheel *D* connected to the main spindle. For gears larger than 9 feet in diameter, a faceplate is used having herringbone teeth cut in the periphery, and an auxiliary drive is provided in connection with worm-wheel *D* to insure a smooth rotating movement.

When the tools reach the center of the blank and reverse for the return stroke, the gear also rotates in a reverse direction. When the tools reach the bottom of the tooth, the cutting operation is stopped automatically. After each tooth is machined, the tools are withdrawn and the work indexed for planing the next tooth. This indexing movement is transmitted through the large worm-wheel *E*; it is derived from a small motor and controlled by a push-button.

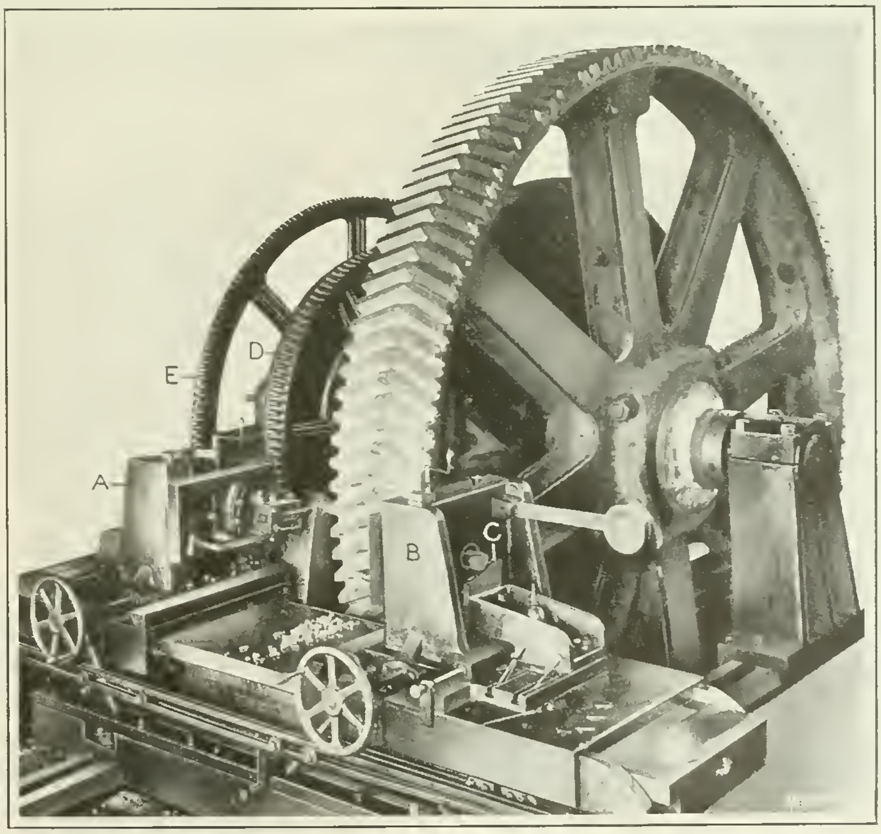


Fig. 11. Double-helical Gear Planer for cutting either Herringbone or Spur Gears of Large Pitch

The rotating movement applied to the gear while planing, as well as the power for driving the planing tools, is derived from a reversible motor. Trip-dogs on the tool-slides control the stroke through an electric switch and a controlling apparatus. This machine is used for planing steel pinions from the solid as well as for finishing cast teeth. The latter may have the teeth cast to within say, 3/8 to 1/2 inch of the finished size. For herringbone gears, a tool clearance of about 2 inches is required at the center for all pitches. The teeth may be connected at the apex or center (see Fig. 11) in order to give additional strength, in which case tool clearance is provided by coring the teeth below the finished surfaces at this point. When gears are cast solid, tool clearance is obtained by turning a groove at the apex 2 inches wide and slightly below the full depth of the teeth.

Cutting Herringbone Gears on a Gear Shaper

When a Fellows gear shaper is used for cutting herringbone gears, a narrow clearance space equal to about one-half the depth of the teeth may be used. The pull stroke is first used to cut one-half of the teeth on all of the blanks in a lot. Then the cutter and the helical guides of the machine are changed for cutting teeth of the opposite hand or inclination. The machine is also adjusted to cut on the push or downward stroke.

Fig. 13 shows a gear shaper cutting the upper section of a herringbone gear. Instead of using one machine for finishing both sides, two machines may be utilized, in which case gears are cut on one side in one machine and are then transferred to the other for finishing the opposite side. This method is adapted to quantity production. The cutting of a herringbone gear by this method must be done carefully in order to obtain accurate right- and left-hand sections in proper alignment. If the mating pinion is not free to float, greater accuracy is necessary in the alignment of the teeth than where the pinion can float. When the rows of teeth on both sides of the gear are in alignment with each other, the term "matched herringbone gear" is sometimes used to distinguish between this form and the "staggered herringbone gear." Methods of cutting both of these classes of gearing on the Fellows gear shaper will now be considered.

Aligning Matched and Staggered Herringbone Gears

In cutting matched herringbone gears it is evident that some means must be provided for securing proper alignment of the teeth. One method is illustrated in Figs. 14 and 15. It consists in making two master gears, one right-hand and the other left-hand. These master gears are of the same diameter, thickness, pitch, and helix angle as the gears to be cut, and can be made from cast-iron blanks. A spacing washer of the same thickness as the clearance groove in the gears to be cut is also made and placed between the master gears, after which the two gears and spacing washer are placed on an arbor. Now the advantage in making these masters in two pieces is that they can be set in the proper alignment with each other and then be bolted or doweled together; they are then used in setting the cutter for cutting the second part of the herringbone gears.

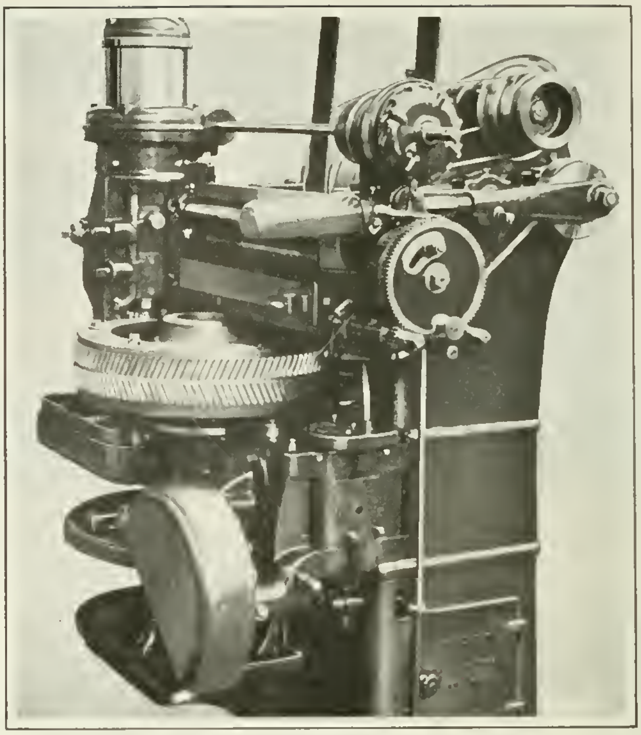


Fig. 13. Cutting a Herringbone Gear on a Gear Shaper

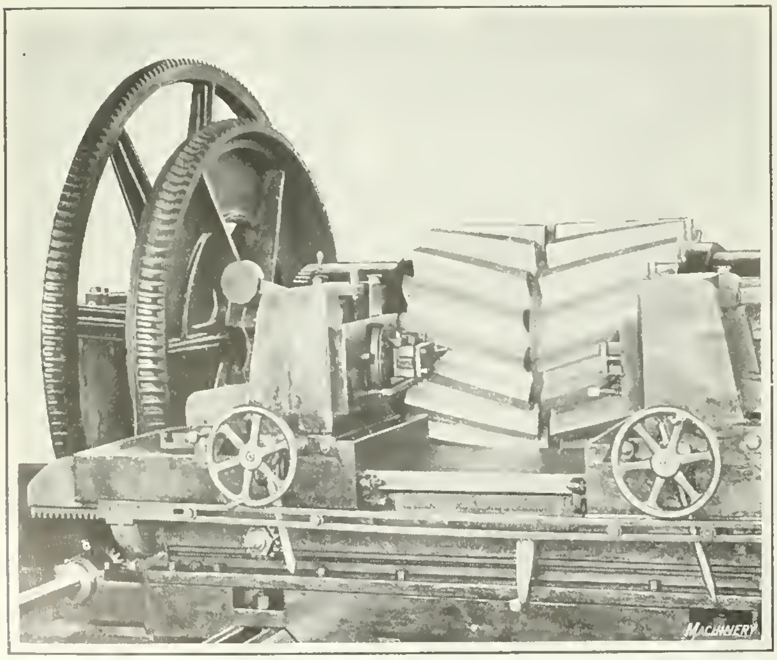


Fig. 12. Cutting a Herringbone Pinion on a Double-helical Planer

Before explaining how the cutter is set, the adjusting of the two master blanks to align the teeth will be explained. The apparatus includes a V-block *A* placed on a surface plate, an arbor *B* on which the gears are held, and two straightedges *C* and *D*. Rectangular block *E* is forced into the space between the two rows of teeth, and straightedges *C* and *D* are secured to the block by means of a clamp.

With the straightedges balanced on the tops of the teeth, if the teeth in the two gear blanks are not in alignment with each other, these two straightedges will not be parallel, as illustrated on an exaggerated scale in Fig. 15. To determine when the teeth are set parallel to each other, a dial indicator is used. The straightedges are balanced on the tops of the teeth, so that they can be clamped very lightly and the gears adjusted so that the straightedges are parallel. Then the gears are clamped or doweled together and serve as masters for setting the cutter.

The method of aligning master staggered herringbone gears is similar to that just explained, with the exception that the teeth of one side must be in alignment with the spaces of the other side. This necessitates cutting a notch in one of the straightedges, as shown in Fig. 16, so that it will straddle the tooth on the gear which must be in alignment with the tooth space on the opposite gear. This arrangement brings the straightedge on one gear lower than the straightedge on the other gear, so that the

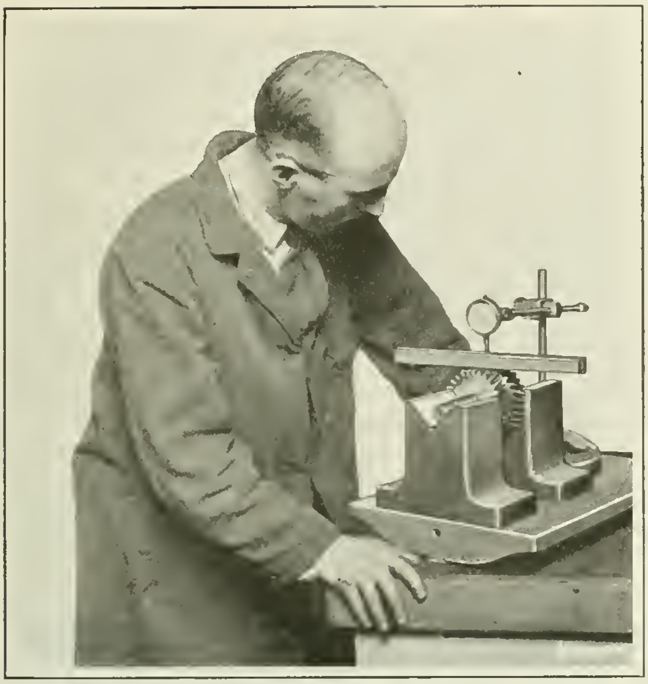


Fig. 14. Aligning Master Gears which are used for setting Gear Shaper Cutter before cutting Second Half of Herringbone Gear

problem is to get the straightedges parallel with the surface plate. When this is done, the rows of teeth are staggered relative to each other, and in correct alignment.

Cutting the Gears

After the masters are made, the next step is to cut the gears. First, the teeth on one side of the blank are cut to the proper depth. No particular setting of the cutter relative to the work is necessary for this side, as far as the alignment of the teeth is concerned. For cutting the other side, some sort of a locating fixture is used. This fixture *A* (see Figs. 17 and 18) is clamped to the work-spindle and trued up. Then the master gear is placed on the fixture, and the locating pin *B* is brought into contact with the teeth of the lower gear, after which the gears are clamped.

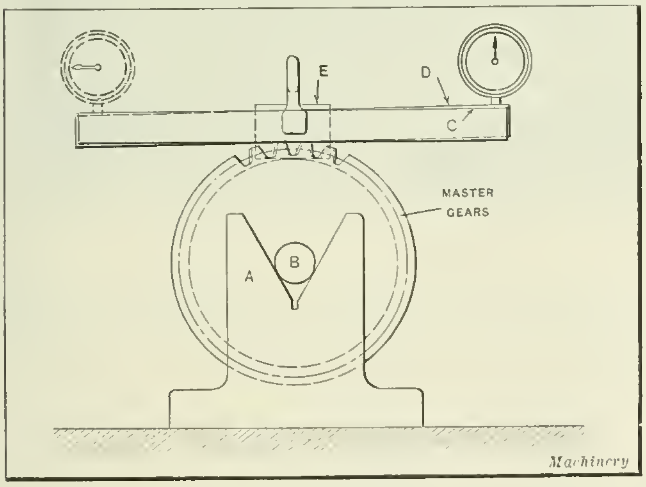


Fig. 15. Diagram illustrating Method shown in Fig. 14

The cutter is then placed on the cutter-spindle and left free to be rotated by hand. A wrench is next placed on the rack screw, which is exposed by lifting guard *A*, Fig. 19, and the cutter-slide is moved until the cutter is in alignment with the teeth of the top section of the master gear. The pitch dial is rotated with a crank-wrench placed on shaft *B*, until the locating pin *C* drops into place. The apron must also be closed, as will be seen by observing the position of the apron-locking plungers at the rear of the machine. The crank-wrench is now placed on the pinion-shaft *D* of the saddle, and the cutter is advanced toward the work; at the same time the cutter is moved on the spindle so that the teeth of the cutter and the teeth of the gear can be brought into mesh. When the cutter has been fed in to the proper depth, and is in correct alignment with the teeth, the nut on the cutter-spindle is tightened.

The cutter has now been set so that the row of teeth in the unfinished half of the blank can be cut in alignment with the row of teeth already completed, and to the same depth. The pitch dial is next set to the proper pitch, and in so doing, the cutter is backed away from the work, permitting the removal of the master blanks and the substitution of the gears to be cut. The locating pin, which is used for aligning the gears, must be a good fit in the bushing of the fixture, and care should be exercised in clamping the blanks to see that this pin is not forced back. In making these adjustments, either the matched or staggered master gears are used, according to the type of gearing to be cut. Accurate methods of aligning one-piece triple gears, consisting of a herringbone and spur gear combination, will be found in December, 1919, Machinery, page 309.

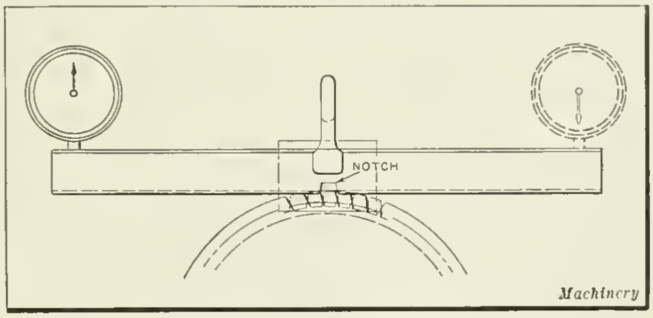


Fig. 16. Arrangement for aligning Staggered Herringbone Gears

Cutting Internal Herringbone Gears

Fig. 20 shows a gear shaper cutting an internal herringbone gear. As there is quite a large recess below the teeth, it is possible to cut the lower section first by using the pull stroke, and then cut the upper section by employing the push stroke. This is the general practice when the design of the gear will permit. The lower end of the gear casting has an internal flange, which fits over a projection on the faceplate and centers the gear. A large washer, in conjunction with the regular work-arbor at the center, is used for clamping the gear blank to the faceplate.

Cutting Herringbone Gears by End-milling

Herringbone gears are sometimes cut by the end-milling process, although this method is not as commonly employed

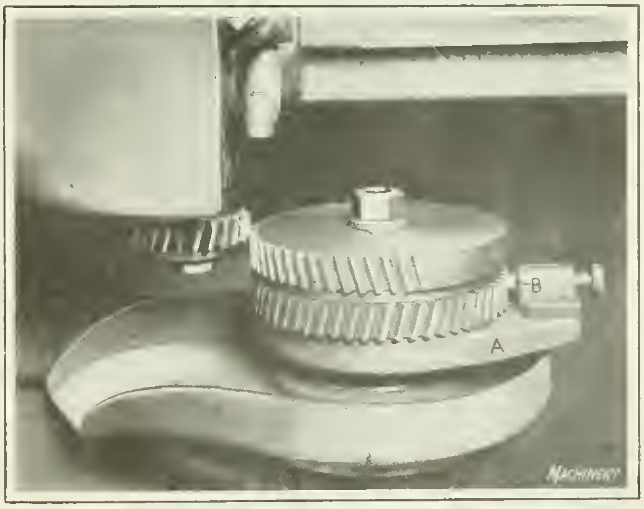


Fig. 17. Locating Fixture used in cutting Second Half of Herringbone Gear

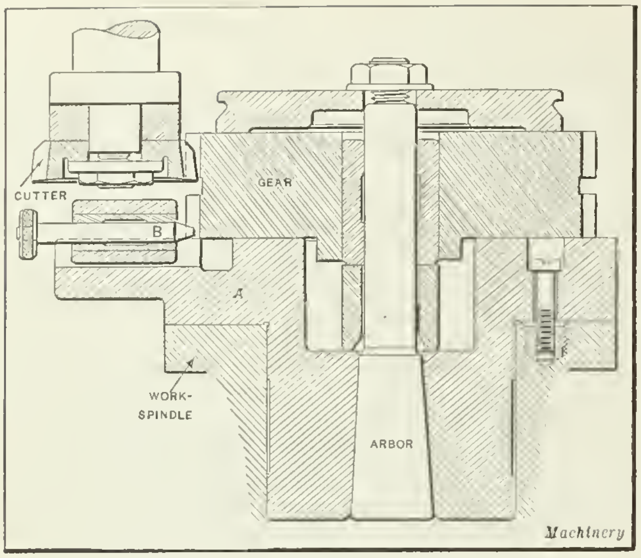


Fig. 18. Locating Fixture Similar to Type shown in Fig. 17

as hobbing and planing. One design of machine using an end-mill has a horizontal cutter-spindle located at the same height as the center of the gear, which is supported by a horizontal work-spindle. The cutter is carried by a slide which feeds horizontally, while the gear blank is revolved at a rate depending upon the helix angle of the teeth.

An end-mill type of machine operating in this way, used at the plant of the Woodard Machine Co., Wooster, Ohio, was described in detail in September, 1921, MACHINERY. It is the general practice to use this machine for gears up to about five inches circular pitch, and to plane the teeth of larger gears. When the teeth are formed by end-milling, all the teeth on one side of the gear are finished first, and then the teeth on the opposite side are cut. When cutting the first half, the cutter feeds in to the center of the gear face; then it returns rapidly through the milled space, after which the gear is indexed for cutting the next tooth space. When one half of the gear is cut in this manner, the cutter is moved to the other side, the feeding movement is reversed, and the operations are repeated.

When using this machine for cutting from the solid, a gear having 160 teeth of approximately 3.5 circular pitch, two cuts were taken for milling each tooth space with a feeding movement of about 1½ inches per minute. The gear was made of cast steel having a carbon content of approximately 0.40 per cent. The end-mill type of machine is especially adapted for cutting shrouded or semi-shrouded gears, since this reinforcement at the ends of the teeth would interfere with the use of either a hob or a planing tool.

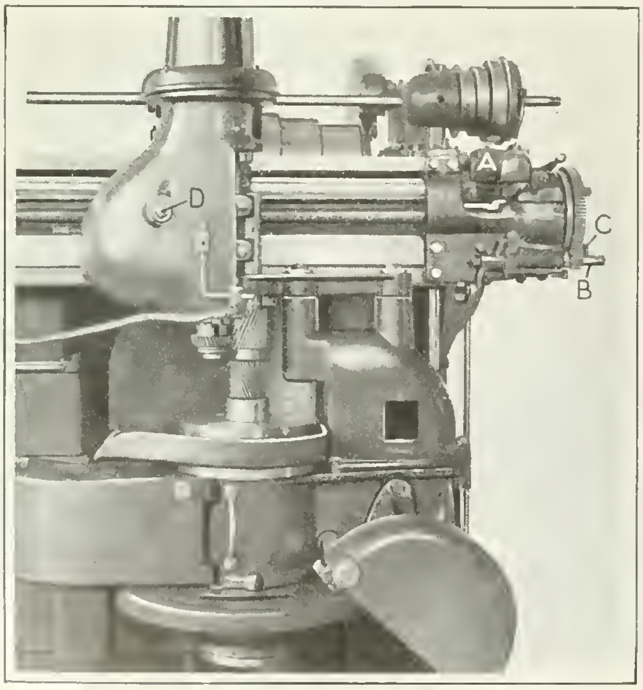


Fig. 19. Cutting a Herringbone Pinion on a Gear Shaper

While an end-mill reproduces its shape in a helical gear with a fair degree of accuracy, this is not true of an ordinary disk cutter, although the latter is more efficient for milling than an end-mill. The disk cutter, however, is seldom used for cutting helical types of gearing, except when this work is done on a small scale with an ordinary milling machine. Any type of formed cutter is inferior to cutters that are used in machines designed to generate the tooth curves. This is partly because the shapes of the tooth spaces vary for different numbers of teeth; while this is cared for automatically in a generating process, if formed cutters are used different shapes must be employed for cutting gearing varying considerably in size, as in the case of a herringbone gear and its mating pinion. Even when two formed cutters of different shapes are used, these shapes are only correct for a given number of teeth. In view of this, and because of the cost and difficulty of making formed cutters of different shapes for each pitch, the formed cutter method is not as practicable as the hobbing and planing processes.

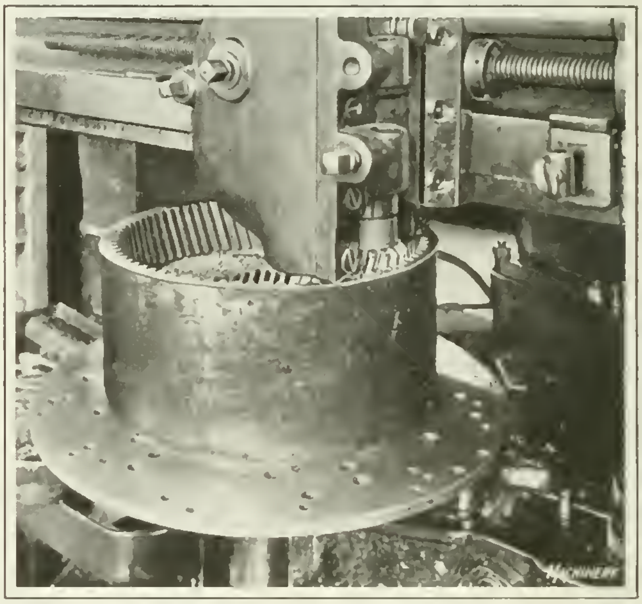


Fig. 20. Cutting an Internal Herringbone Gear

* * *

THE BRITISH AUTOMOBILE INDUSTRY

In a speech made by Sir Herbert Austin at a recent meeting of the National Union of Manufacturers in England, Sir Herbert said he anticipated that this year Great Britain would import 50,000 American-made motor vehicles, compared with a home production of 75,000. In his opinion there were too many automobile manufacturers in Great Britain, and they would probably have to combine and economize, to reduce costs. It is evident that the British automobile manufacturers are intent upon cutting costs, and that the productive capacity of existing plants is being carefully investigated. There has been a hesitancy on the part of manufacturers to buy sufficient equipment to meet their requirements, but with a good season for the industry fairly well assured, buyers are now entering the new tool market with greater freedom.

The Institution of Automobile Engineers of Great Britain will hold its summer meeting at Liverpool, beginning June 18. During this meeting the members of the institution will visit many works devoted to industries differing from those with which they are brought into contact in their daily work.

Tap Drill Sizes of Tap and Die Institute

In connection with the standardization work of The Tap and Die Institute, the standard tap drill sizes given in the accompanying tables have been adopted. Table 1 is for machine screws, and it covers pitches conforming to the A.S.M.E. standard and special machine screws, as well as older standards. Table 2 covers screw threads of fractional sizes ranging from 1/16 inch up to 4 inches in diameter; this table also includes U. S. standard and special pitches.

The drills listed in each table are commercial sizes, and the drill diameter is selected to give approximately 75 per cent of the standard thread depth. This depth is commonly employed in manufacturing practice, and the percentage of thread depth might be further reduced without danger of making the tapped thread weak in proportion to the strength of the bolt or screw. In fact, tests have shown that a depth of 50 per cent is ample for a U. S. form of thread, so far as strength is concerned. The practical advantage of using tap drills which are somewhat larger than the root diameter of the tap is that the tapping operation requires less power and tap breakage is greatly reduced. In accordance with commercial practice, the tap drill sizes are designated by the use of numbers and letters for certain diameters not indicated by fractional dimensions.

TABLE 1. TAP DRILL SIZES FOR A. S. M. E. STANDARD AND SPECIAL MACHINE SCREW THREADS, ADOPTED BY TAP AND DIE INSTITUTE

Screw No. and Threads per Inch	Outside Diameter, Inches	Tap Drill Diameter, Inches*	Decimal Equivalent of Tap Drill Diameter	Screw No and Threads per Inch	Outside Diameter, Inches	Tap Drill Diameter, Inches*	Decimal Equivalent of Tap Drill Diameter
0-80	0.0600	3/64	0.0469	10-24	0.1900	25	0.1495
1-56	0.0730	54	0.0550	28	0.1900	23	0.1540
64	0.0730	53	0.0595	30	0.1900	22	0.1570
72	0.0730	53	0.0595	32	0.1900	21	0.1590
2-56	0.0860	50	0.0700	12-24	0.2160	16	0.1770
64	0.0860	50	0.0700	28	0.2160	14	0.1820
3-48	0.0990	47	0.0785	32	0.2160	13	0.1850
56	0.0990	45	0.0820	14-20	0.2420	10	0.1935
4-32	0.1120	45	0.0820	24	0.2420	7	0.2010
36	0.1120	44	0.0860	16-18	0.2680	3	0.2130
40	0.1120	43	0.0890	20	0.2680	7/32	0.2187
48	0.1120	42	0.0935	22	0.2680	2	0.2210
5-36	0.1250	40	0.0980	18-18	0.2940	B	0.2380
40	0.1250	38	0.1015	20	0.2940	D	0.2460
44	0.1250	37	0.1040	20-16	0.3200	G	0.2610
6-32	0.1380	36	0.1065	18	0.3200	17/64	0.2656
36	0.1380	34	0.1110	20	0.3200	I	0.2720
40	0.1380	33	0.1130	22-16	0.3460	9/32	0.2812
7-30	0.1510	31	0.1200	18	0.3460	L	0.2900
32	0.1510	31	0.1200	24-16	0.3720	5/16	0.3125
36	0.1510	1/8	0.1250	18	0.3720	O	0.3160
8-30	0.1640	30	0.1285	26-14	0.3980	21/64	0.3281
32	0.1640	29	0.1360	16	0.3980	R	0.3390
36	0.1640	29	0.1360	28-14	0.4240	T	0.3580
40	0.1640	28	0.1405	16	0.4240	23/64	0.3594
9-24	0.1770	29	0.1360	30-14	0.4500	V	0.3770
30	0.1770	27	0.1440	16	0.4500	25/64	0.3906
32	0.1770	26	0.1470	.....	......	.....	......

Machinery

*The tap drills listed are commercial sizes, and allow for approximately 75 per cent of the standard thread depth.

TABLE 2. TAP DRILL SIZES FOR STANDARD AND SPECIAL SCREW THREADS OF UNITED STATES STANDARD FORM, ADOPTED BY THE TAP AND DIE INSTITUTE

Nominal Size and Threads per Inch	Tap Drill Diameter, Inches*	Decimal Equivalent of Tap Drill Diameter	Nominal Size and Threads per Inch	Tap Drill Diameter, Inches*	Decimal Equivalent of Tap Drill Diameter	Nominal Size and Threads per Inch	Tap Drill Diameter, Inches*	Decimal Equivalent of Tap Drill Diameter
1/16-64	3/64	0.0469	3/8-20	21/64	0.3281	7/8 -27	27/32	0.8437
72	3/64	0.0469	24	Q	0.3320	5/16- 9	53/64	0.8281
5/64-60	1/16	0.0625	27	R	0.3390	1-8	7/8	0.8750
72	52	0.0635	7/16-14	U	0.3680	12	59/64	0.9219
3/32-48	49	0.0730	20	25/64	0.3906	14	15/16	0.9375
50	49	0.0730	24	X	0.3970	27	31/32	0.9687
7/64-48	43	0.0890	27	Y	0.4040	1 1/8-7	63/64	0.9844
1/8-32	3/32	0.0937	1/2-12	27/64	0.4219	12	1 3/64	1.0469
40	38	0.1015	13	27/64	0.4219	1 1/4-7	1 7/64	1.1094
9/64-40	32	0.1160	20	29/64	0.4531	12	1 11/64	1.1719
5/32-32	1/8	0.1250	24	29/64	0.4531	1 3/8-6	1 7/32	1.2187
36	30	0.1285	27	15/32	0.4687	12	1 19/64	1.2969
11/64-32	9/64	0.1406	9/16-12	31/64	0.4844	1 1/2-6	1 11/32	1.3437
3/16-24	26	0.1470	18	33/64	0.5156	12	1 27/64	1.4219
32	22	0.1570	27	17/32	0.5312	1 5/8-5 1/2	1 29/64	1.4531
13/64-24	20	0.1610	5/8-11	17/32	0.5312	1 3/4-5	1 9/16	1.5625
7/32-24	16	0.1770	12	35/64	0.5469	1 7/8-5	1 11/16	1.6875
32	12	0.1890	18	37/64	0.5781	2-4 1/2	1 25/32	1.7812
15/64-24	10	0.1935	27	19/32	0.5937	2 1/8-4 1/2	1 29/32	1.9062
1/4-20	7	0.2010	11/16-11	19/32	0.5937	2 1/4-4 1/2	2 1/32	2.0312
24	4	0.2090	16	5/8	0.6250	2 3/8-4	2 1/8	2.1250
27	3	0.2130	3/4-10	21/32	0.6562	2 1/2-4	2 1/4	2.2500
28	3	0.2130	12	43/64	0.6719	2 3/4-4	2 1/2	2.5000
32	7/32	0.2187	16	11/16	0.6875	3-3 1/2	2 23/32	2.7187
5/16-18	F	0.2570	27	23/32	0.7187	3 1/4-3 1/2	2 31/32	2.9687
20	17/64	0.2656	13/16-10	23/32	0.7187	3 1/2-3 1/4	3 3/16	3.1875
24	I	0.2720	7/8-9	49/64	0.7656	3 3/4-3	3 7/16	3.4375
27	J	0.2770	12	51/64	0.7969	4-3	3 11/16	3.6875
32	9/32	0.2812	14	13/16	0.8125	....	......	......
3/8-16	5/16	0.3125	18	53/64	0.8281	....	....	......

Machinery

*The tap drills listed are commercial sizes, and allow for approximately 75 per cent of the standard thread depth.

TAP DRILL SIZES

By GEORGE C. HANNEMAN

The accompanying table of tap drill sizes will be of value to both the designer and the man in the shop. It gives the theoretical percentage of a full thread (from 50 to 100 per cent) obtainable when using standard sizes of drills for the holes to be tapped, the percentage to be employed being left to the judgment of the user. To illustrate the use of the table, suppose that it is desired to drill a hole that will tap out with a ½–13 tap and give about 75 per cent of a full thread. Referring to the table, it will be found, in the column under ½–13, that a 27/64-inch drill will leave enough stock for 78 per cent of a full thread, and this size of drill would therefore be used. In actual practice, the percentage of thread given in the table is not obtained exactly, as drills usually cut a little over size; on the other hand, in materials of a tough nature, particularly copper,

TAP DRILL SIZES FOR SCREWS WITH U. S. FORM OF THREAD

This Table shows the Percentage of a Full Thread Obtainable with Drills of Standard Sizes

Size of Screw																			
Number 0-80		Number 1-72		Number 1-64		Number 2-64		Number 2-56		Number 3-56		Number 3-48		Number 4-48		Number 4-40		Number 4-36	
Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread
57	100	54	100	55	100	51	94	1/16	100	48	99	49	96	44	96	46	96	48	100
56	83	53	75	54	89	50	79	52	97	5/64	99	48	85	43	85	45	92	5/64	94
3/64	81	1/16	58	53	67	49	64	51	82	47	90	5/64	77	42	68	44	80	47	93
55	49	52	53	1/16	52	48	49	50	69	46	77	47	76	3/32	67	43	71	46	86
								49	56	45	73	46	66	41	59	42	57	45	83
										44	56	45	63	40	52	3/32	56	44	72
												44	48			41	49	43	64
																		42	51
																		3/32	50

Number 5-44		Number 5-40		Number 5-36		Number 6-40		Number 6-36		Number 6-32		Number 7-36		Number 7-32		Number 7-30		Number 8-36	
41	98	42	97	43	100	36	97	38	100	40	99	32	97	35	100	7/64	96	30	98
40	91	3/32	96	42	87	7/64	88	37	94	39	95	31	86	34	99	35	95	29	77
39	86	41	89	3/32	86	35	86	36	87	38	90	⅛	72	33	94	34	92	28	65
38	80	40	83	41	80	34	83	7/64	79	37	84	30	62	32	86	33	88	9/64	64
37	71	39	78	40	75	33	77	35	77	36	78			31	76	32	81	27	55
36	63	38	72	39	70	32	68	34	75	7/64	71			⅛	64	31	72		
7/64	53	37	65	38	65	31	55	33	69	35	69			30	55	⅛	60		
35	51	36	57	37	58			32	61	34	66					30	52		
		7/64	48	36	51			31	50	33	61								
										32	54								

Number 8-32		Number 8-30		Number 9-32		Number 9-30		Number 9-24		Number 10-32		Number 10-30		Number 10-24		Number 12-28		Number 12-24	
⅛	100	31	100	29	100	29	95	⅛	96	24	94	26	99	29	100	11/64	95	20	100
30	87	⅛	90	28	90	28	84	30	90	23	89	25	93	28	92	17	93	19	92
29	69	30	82	9/64	89	9/64	84	29	76	5/32	83	24	88	9/64	91	16	84	18	86
28	58	29	65	27	81	27	74	28	68	22	81	23	83	27	85	15	78	11/64	82
9/64	57	28	54	26	74	26	69	9/64	67	21	76	5/32	78	26	80	14	73	17	79
27	49	9/64	54	25	68	25	63	27	61	20	71	22	76	25	75	13	67	16	72
				24	61	24	58	26	55	19	59	21	72	24	70	3/16	61	15	66
				23	57	23	53	25	51	18	51	20	67	23	67	12	58	14	63
				5/32	51	5/32	48					19	55	5/32	62	11	54	13	57
				22	49									22	61	10	51	3/16	52
														21	57			12	50
														20	54				

Number 14-24		Number 14-20		1/4-28		1/4-24		1/4-20		Number 16-22		Number 16-20		Number 18-20		Number 18-18		5/16-24	
12	98	16	100	6	99	9	100	13	100	4	100	13/64	100	1	100	2	100	G	95
11	94	15	95	5	96	8	94	3/16	96	3	93	6	98	A	92	1	91	17/64	84
10	90	14	92	4	88	7	91	12	94	7/32	83	5	96	15/64	92	A	83	H	86
9	85	13	88	3	80	13/64	86	11	91	2	80	4	91	B	83	15/64	83	I	75
8	79	3/16	84	7/32	67	6	85	10	87	1	67	3	85	C	77	B	75	J	66
7	76	12	81	2	62	5	82	9	83	A	58	7/32	76	D	71	C	69	K	58
13/64	72	11	78	1	47	4	76	8	78	15/64	57	2	72	¼	65	D	64	9/32	58
6	70	10	75			3	68	7	75	B	51	1	61	F	54	¼	58		
5	67	9	71			7/32	58	13/64	72			A	52	G	48	F	49		
4	61	8	66			2	54	6	71			15/64	52						
3	53	7	63					5	68										
		13/64	60					4	62										
		6	58					3	57										
		5	56					7/32	48										
		4	51																

Machinery

bronze, and soft iron, the tap raises the thread a little, thus producing a fuller thread than that indicated in the table, especially after the tap becomes slightly dull.

While the sizes of drills required to give 100 per cent full threads are given in the table (in some instances), it must not be assumed that full threads are usually cut or even that they can be cut under ordinary conditions. To cut a 100 per cent thread is a slow process which must be done by hand, and is never required except in making thread gages, scientific apparatus, and similar work.

As good general practice for machine tapping, the writer would suggest using a drill that will give about 75 per cent of a full thread. This percentage rarely needs to be exceeded, and is just about right for tapping machine steel or cold-rolled steel with good tools when sufficient lubricant is supplied, provided the tap is not one of the smallest sizes. For very small sizes, it will be found impossible to tap more than 60 per cent or possibly 65 per cent of a full thread without undue tap breakage. Very large taps do not have to cut more than 75 per cent of a full thread as a rule, because a fuller thread is not required in the larger sizes to give the necessary strength. In some cases even 60 per cent of a full thread is sufficient, and it is only a waste of time and an added expense for taps and

TAP DRILL SIZES FOR SCREWS WITH U. S. FORM OF THREAD (CONTINUED)

This Table shows the Percentage of a Full Thread Obtainable with Drills of Standard Sizes

Size of Screw

5/16-18		Number 20-20		Number 20-18		Number 22-18		Number 22-16		Number 24-18		Number 24-16		3/8-24		3/8-16		Number 26-16	
Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread	Number or Diameter of Tap Drill	Per Cent of Full Thread
C	98	F	97	1/4	97	J	96	17/64	99	N	97	L	100	P	91	M	98	O	100
D	92	G	91	F	87	K	90	H	98	5/16	82	M	95	21/64	82	19/64	96	P	92
1/4	86	17/64	83	G	82	9/32	90	I	91	O	77	19/64	93	Q	75	N	90	21/64	86
F	77	H	83	17/64	75	L	77	J	85	P	68	N	86	R	63	5/16	77	Q	81
G	71	I	74	H	75	M	71	K	80	21/64	60	5/16	73	11/32	55	O	73	R	74
17/64	63	J	66	I	66	19/64	68	9/32	80	Q	55	O	69	S	47	P	64	11/32	67
H	64	K	60	J	60	N	61	L	69	R	46	P	60			21/64	59	S	62
I	56	9/32	59	K	54	5/16	47	M	63			21/64	54			Q	53	T	49
J	49	L	46	9/32	54			19/64	60			Q	49						

Number 26-14		Number 28-16		Number 28-14		7/16-20		7/16-14		Number 30-16		Number 30-14		1/2-20		1/2-13		1/2-12	
5/16	92	11/32	99	Q	99	3/8	96	S	96	U	100	T	99	7/16	96	Y	96	25/64	100
O	88	S	93	R	92	V	93	T	85	3/8	92	23/64	97	29/64	72	13/32	94	X	95
P	81	T	81	11/32	86	W	79	23/64	84	V	90	U	88	15/32	48	Z	87	Y	89
21/64	75	23/64	80	S	82	25/64	72	U	75	W	79	3/8	81			27/64	78	13/32	87
Q	71	U	69	T	71	X	62	3/8	67	25/64	73	V	79			7/16	63	Z	80
R	64	3/8	60	23/64	70	Y	51	V	65	X	65	W	69			29/64	47	27/64	72
11/32	58	V	58	U	60	13/32	48	W	55	Y	57	25/64	64					7/16	58
S	54	W	47	3/8	53			25/64	50	13/32	54	X	57						
				V	51							Y	50						

9/16-20		9/16-12		5/8-18		5/8-11		11/16-16		11/16-11		3/4-16		3/4-10		13/16-10		7/8-20	
1/2	96	29/64	100	9/16	86	33/64	91	39/64	96	37/64	92	43/64	96	5/8	96	11/16	96	13/16	96
33/64	72	15/32	87	37/64	65	17/32	79	5/8	77	19/32	79	11/16	77	41/64	84	45/64	84	53/64	72
17/32	48	31/64	72			35/64	66	41/64	57	39/64	66	45/64	58	21/32	72	23/32	72	27/32	48
		1/2	57			9/16	53			5/8	53			43/64	60	47/64	60		
														11/16	48	3/4	48		

7/8-14		7/8-9		15/16-9		1-20		1-14		1-8		1 1/16-8		1 1/8-12		1 1/8-7		1 3/16-7	
25/32	100	47/64	97	51/64	97	15/16	96	29/32	100	27/32	96	29/32	96	1 1/64	100	61/64	92	1 1/64	92
51/64	84	3/4	86	13/16	86	61/64	72	59/64	84	55/64	86	59/64	86	1 1/32	86	31/32	84	1 1/32	84
13/16	67	49/64	76	53/64	76	31/32	48	15/16	67	7/8	77	15/16	77	1 3/64	72	63/64	76	1 3/64	76
53/64	50	25/32	65	27/32	65			61/64	50	57/64	67	61/64	67	1 1/16	58	1	67	1 1/16	67
		51/64	54	55/64	54					29/32	57	31/32	58			1 1/64	59	1 5/64	59
				7/8	43					59/64	48	63/64	48			1 1/32	50	1 3/32	51

1 1/4-12		1 1/4-7		1 5/16-7		1 3/8-12		1 3/8-6		1 1/2-6		1 5/8-5 1/2		1 3/4-5		1 7/8-5		2-4 1/2	
1 9/64	100	1 1/16	100	1 1/8	100	1 17/64	100	1 5/32	100	1 9/32	100	1 25/64	99	1 1/2	96	1 5/8	96	1 23/32	97
1 5/32	86	1 5/64	92	1 9/64	92	1 9/32	86	1 11/64	94	1 19/64	94	1 13/32	93	1 33/64	90	1 41/64	90	1 47/64	92
1 11/64	72	1 3/32	84	1 5/32	84	1 19/64	72	1 3/16	87	1 5/16	87	1 27/64	86	1 17/32	84	1 21/32	84	1 3/4	87
1 3/16	58	1 7/64	76	1 11/64	76	1 5/16	58	1 13/64	79	1 21/64	79	1 7/16	79	1 35/64	78	1 43/64	78	1 49/64	81
		1 1/8	67	1 3/16	67			1 7/32	72	1 11/32	72	1 29/64	72	1 9/16	72	1 11/16	72	1 25/32	76
		1 9/64	59	1 13/64	59			1 15/64	65	1 23/64	65	1 15/32	66	1 37/64	66	1 45/64	66	1 51/64	70
		1 5/32	61	1 7/32	51			1 1/4	58	1 3/8	58	1 31/64	59	1 19/32	60	1 23/32	60	1 13/16	65
								1 17/64	51	1 25/64	51	1 1/2	53	1 39/64	54	1 47/64	54	1 53/64	59
														1 5/8	48	1 3/4	48	1 27/32	54
																		1 55/64	49

Machinery

power to attempt to tap a fuller thread. Only in the case of cast iron, and occasionally brass, would more than 75 per cent of a full thread be required, and even with these metals it is not advisable to attempt to obtain too full a thread, as this will result in tearing off the top of the thread so that nothing will be gained.

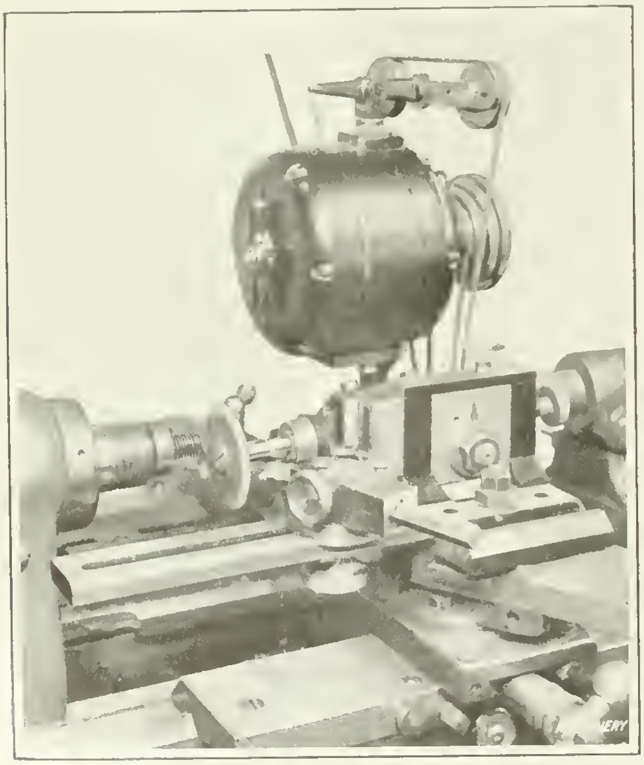
On big production work, manufacturing costs can often be cut down considerably by experimenting with the machine tapping operations until it is determined just how small a percentage of a full thread can be depended upon to meet requirements. Usually this will be found to be less than 75 per cent of a full thread. In some cases it has been possible to cut down tap breakage nearly 90 per cent by using a tap drill only one size larger than the one originally selected. Further information on tap drill sizes is given on page 866 of MACHINERY'S HANDBOOK.

* * *

GRINDING THREADS ON HARD RUBBER

Parts made of hard rubber have previously been threaded by the methods ordinarily employed for metals, a single-pointed threading tool or a self-opening die-head being used; but the nature of hard rubber is such that the cutting tool leaves a very ragged thread. In addition, the action of the rubber on chasers or threading tools is like that of an abrasive, so that tools require frequent sharpening.

Samples of hard rubber rods, to be used in making electrical plugs, were recently sent to the Precision & Thread Grinder Mfg. Co., Philadelphia, Pa., and it was found that threads of good quality could be formed readily by grinding. As illustrated, the grinding wheel is mounted on a multi-graduated precision grinder, held on a lathe carriage. The piece of hard rubber to be threaded is held in the draw-in collet of a Porter-Cable tool-room lathe. With this equipment a well-formed thread was produced at one passage of the wheel; in other words, the time required to form a complete thread by grinding is equivalent to the time required for the carriage to travel the length of the thread, which is approximately 1¼ inches. The grinding wheel, dressed to a 60-degree angle, retains its sharp edge indefinitely, if the wheel selected is adapted to this operation. The multi-tooth effect of the wheel imparts a fine finish to the thread.

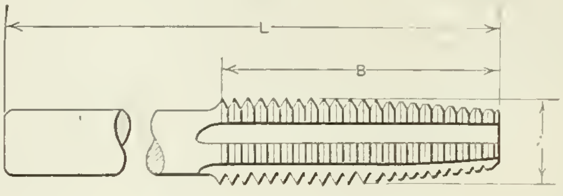


Grinding Threads on Hard Rubber, using a Multi-Graduated Precision Grinder

DIMENSIONS FOR TAPPER TAPS

The standard dimensions for tapper taps recently adopted by the Tap & Die Institute are given in the accompanying table. C. M. P.

DIMENSIONS FOR TAPPER TAPS



L = 12 or 15 inches for all sizes up to and including 1 inch in diameter; for all larger sizes L = 15 inches.

Diameter A of Tap, Inches	Number of Threads per Inch			Length B of Thread, Inches	
	U. S. Standard	S. A. E. Standard	Whitworth Standard	U. S. and Whitworth Standards	S. A. E. Standard
¼	20	28	20	1⅝	1¼
5/16	18	24	18	1 13/16	1⅜
⅜	16	24	16	2	1½
7/16	14	20	14	2¼	1 11/16
½	13	20	12	2¼	1 11/16
9/16	12	18	12	2½	1⅞
⅝	11	18	11	2½	1⅞
11/16	11	16	11	2½	1⅞
¾	10	16	10	2¾	2
13/16	10	....	10	2¾	....
⅞	9	14*	9	3	2
15/16	9	....	9	3	....
1	8	14	8	3½	2⅝
1⅛	7	12	7	3½	2⅝
1¼	7	12	7	3½	2⅝
1⅜	6	12	6	4	3
1½	6	12	6	4	3
1⅝	5½	....	5	4	....
1¾	5	....	5	4½	....
1⅞	5	....	4½	4½	....
2	4½	....	4½	4½	....

Machinery

*Also made by members of The Tap & Die Institute with 18 threads per inch.

* * *

THE VALUE OF A GOOD REPAIR SHOP

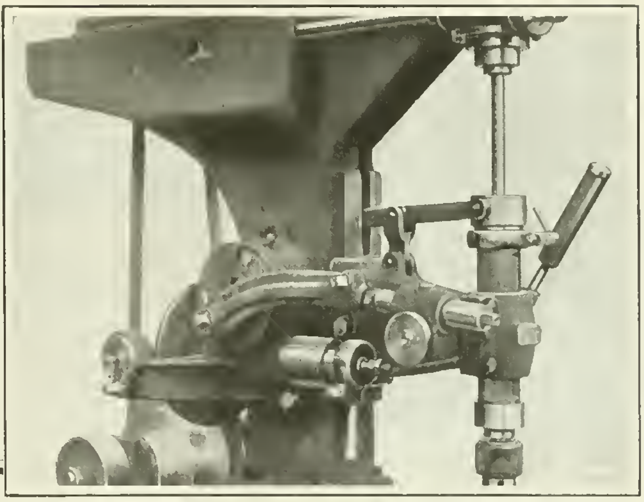
By CHARLES W. LEE

Why is it that every cent put into the repair shop of an industrial plant is considered a dead expense, while the cost of equipment used in the manufacturing departments seems to be considered a proper investment? It appears to the writer that it is just as desirable to be able to perform repairs economically as it is to manufacture economically, and if this is true, adequate equipment in the repair shop is just as necessary as in the manufacturing plant. This alone is a real argument for a good repair shop as an investment, but the following experience will bring out the point more forcibly.

Recently a new works manager was engaged by the directors of a large manufacturing plant. He found the repair shop to be the weakest spot, and the first thing he asked for in the way of additional equipment was machinery worth $30,000 for the repair shop. His proposal was considered unreasonable, but he kept on fighting for his repair shop equipment until he got it. At the end of the first year, more than $30,000 worth of additional products had been made in the factory without additional plant equipment or operators, simply because when a machine broke down in the factory it could be repaired promptly, instead of having to stand idle, waiting for the repairs to be done, as had formerly been the case.

Automatic Feeding Device for High-speed Drilling

By CHARLES E. BERNITT



THE manufacturers of small cast-iron, brass, or aluminum parts are continually demonstrating the advantage of using extremely high speeds for drilling small holes. A number of manufacturers have recently brought out sensitive drilling machines provided with ball bearings that are capable of sustaining spindle speeds as high as 12,000 and 15,000 revolutions per minute to meet the demand for this kind of work. Obviously, such high spindle speeds demand an exceedingly rapid feeding movement. For example, if it is required to drill a 1/16-inch hole in soft brass, and the drill point is correctly ground and all conditions are favorable, it might be found that the most efficient cutting speed is around 200 feet per minute. This requires a drilling speed of about 12,000 revolutions per minute, and assuming that the feed is 0.0025 inch per revolution, the rate of penetration should be approximately 30 inches per minute, or ½ inch per second. Thus it is evident that the operation of drilling small holes often appears more like punching than drilling. This is especially true of through holes in thin material.

Many types of feeding arrangements are used for this work, including the regular hand-feed lever which is undoubtedly the best means of feeding except for the fact that it prevents the operator from using both hands in loading and unloading the fixture or otherwise handling the work. The foot-treadle feed is used to some extent, but it is rapidly losing favor due to its lack of sensitiveness and the attendant breaking of drills.

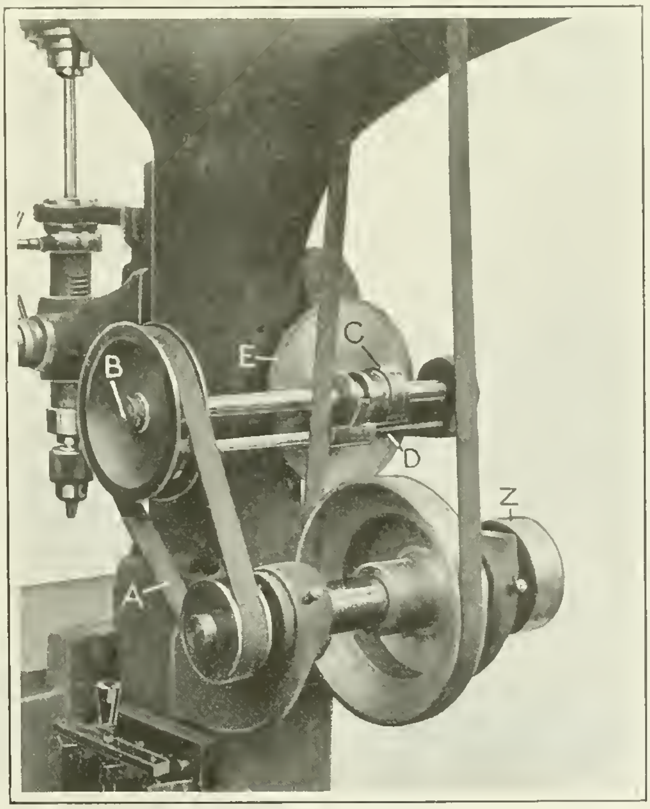


Fig. 1. Friction Drive employed to operate Automatic Feeding Device

To overcome these objections, several types of gravity feed and friction feed mechanisms have been brought out by different makers of sensitive drilling machines, which have resulted in an increase in production. An automatic feed of the friction type is shown in the heading illustration attached to a high-speed sensitive drilling machine built by the Avey Drilling Machine Co., of Cincinnati, Ohio. While this device might be classed as a positive feed type, to distinguish it from the weight or gravity feed types, it is nevertheless operated by a friction disk and pinion, which permit slippage when the drill is subjected to undue torsional stresses. The pressure of the leather-faced driving pinion on the disk may be adjusted to suit the size of drill being used.

A means of instantly varying the number of strokes per minute, and provision for changing the depth of stroke and rate of feed are other desirable features incorporated in this feeding device. The position of the spindle in relation to the work, when in the upward position, can be changed without moving the head on the drilling machine column. Front and rear views of the device are shown in the heading illustration and Fig. 1, respectively.

The rear shaft *B*, Fig. 1, is driven by means of a belt *A* from a pulley mounted on the end of the machine countershaft. On shaft *B* is mounted the leather-faced pinion *C* which engages the friction disk *E*. The position of pinion *C* can be adjusted by means of screw *D* to change the number of strokes per minute. The countershaft is driven by a motor mounted on the drilling machine column, which is connected by belt to pulley *Z*.

In Fig. 2 is shown an assembly view of the feeding mechanism, exclusive of the machine countershaft and the spindle, drill, and chuck. The friction disk *E* is mounted on the end of shaft *F*, which is designed to allow an endwise adjustment through the worm *G* and bushing *H*. The key in bushing *H* transmits motion from shaft *F* to worm *G*, and thence to worm-wheel *Y*. The worm-wheel is mounted on a double-row ball bearing, as shown in the sectional view. On the outer face or flange of the worm-wheel shaft is a T-slot which carries crank block *I*. In order to change the depth or length of the drill stroke, block *I* is adjusted to and from the center of the worm-wheel by means of screw *J*, and is clamped in the desired position by stud *K*.

On stud *K* is a bushing *L*, which has a bearing in crank-arm *M*. The rack bushing *N* has a sliding bearing in the oscillating yoke *O*, and engages pinion *P*, mounted on the end of the rack pinion, which imparts an up and down motion to the spindle quill. Rod *Q* is threaded in the end of crank-arm *M*, the latter having a split clamp as shown, so that when screw *R* is loosened, rod *Q* can be turned in order to decrease or increase the effective length of the crank arm, as desired. This adjustment also changes the position of the drill spindle in relation to the work.

The bushing *S* in the worm-box has a coarse thread on its outer surface. Attached to this bushing is a lever *T* which, when turned down, draws bushing *S* outward and thus moves shaft *F* and disk *E* away from the friction pinion *C*, so that the feeding motion will be stopped without disconnecting the drive to the spindle. When lever *T* is in the upward position, the disk is held against the friction pinion by the pressure of spring *U*. This pressure can be varied to suit different sizes of drills by loosening the clamping nut *V* on lever *T* and screwing bushing *S* in or out. After the adjustment is made, lever *T* is set and clamped in the required position.

feed, and then decreasing to zero at the bottom of the stroke. This is, of course, characteristic of all crank motions, and the advantage of such a feature in drilling thin work is apparent. The drill enters the work and penetrates the scale at a comparatively fine feed, and when under the scale the feed increases rapidly to maximum and then slows up as the drill breaks through.

The choice of the proper rate of feed for any given material is a matter of actual test, and the wide range of feeds available with this device is of great advantage. In changing the position of the friction pinion to increase or decrease the number of strokes per minute, the maximum feed, in inches per revolution, is increased or decreased proportionately. For example, assuming that the devise is adjusted for fifteen strokes per minute and a 2-inch stroke, the maximum feed would be twice that obtained if the device were set for a 1-inch stroke and 15 strokes per minute. With a stroke of 1 inch and 15 strokes per minute, the maximum feed would be one-half that obtained with a 1-inch stroke and 30 strokes per minute. As any part of the stroke can be utilized for actual drilling, it is evident that almost any feed can be readily obtained.

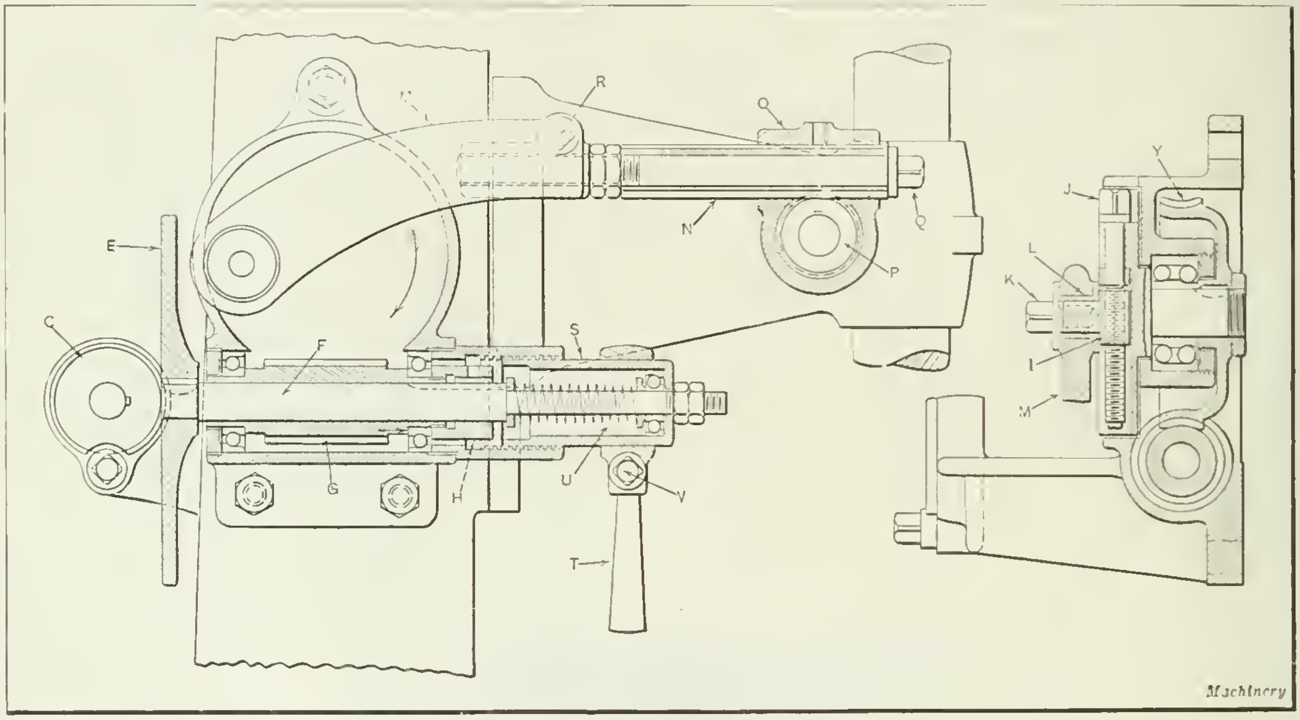


Fig. 2. Sectional View of Automatic Feeding Device for High-speed Drilling

This type of feeding device is adapted to numerous classes of work, the most common of which is the drilling of one or more holes through a plate or flat piece, which can be shifted from one hole to the other on each returning stroke of the spindle. Some parts do not require extreme accuracy in the location of the holes, and for such work greater speed can be attained by employing a fixture clamped in place under the spindle, so that the operator simply inserts a piece in the fixture and holds it there while the drill is being automatically fed downward. During the return stroke, the drilled piece is replaced by a new piece, and the operation repeated. When accuracy is essential, the feeding device is set to give a lower number of feeding strokes per minute and thus allow the operator time in which to clamp and unclamp the piece in the fixture.

The most efficient device for holding work for the rapid production of small parts is a revolving disk mounted on the table of the machine and designed to hold several fixtures properly spaced on the outer rim of the disk. With such an arrangement, provision is made for indexing the disk from one fixture to the next on the return stroke of the spindle. This permits the operator to load and unload one fixture while a piece is being drilled in the fixture directly under the spindle.

The feeding motion, with this device, is not uniform, the drill starting at zero and increasing rapidly to a maximum

* * *

CATALOGUES WANTED BY ENGLISH LIBRARY

The public library of Coventry, England, of which Charles Nowell is the librarian, is endeavoring to bring together a representative collection of catalogues in the engineering industry, and is asking manufacturers to send their catalogues to this library for its files. The catalogues are arranged in a carefully classified order in the commercial and technical library branch, and form a useful adjunct to the books and periodicals filed in the library.

* * *

One of the problems under investigation by the Bureau of Mines is the contraction and shrinkage of metals and alloys in casting. These data are of especial interest to foundrymen and others in the metal and alloy industry. Results of measurements on the linear contraction of a series of light aluminum alloys have been published as Technical Paper No. 287 of the bureau, and an investigation is now under way on the contraction of a series of commercial brasses and bronzes. The report may be obtained from the Bureau of Mines, Washington, D. C.

Quality Control in Gear Manufacture

Equipment Employed for Inspecting the Hob, Hobbing Machine, and Finished Gear

By S. O. BJORNBERG
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Chicago, Ill.

THE process of manufacturing gears has reached such a state of perfection that efficiencies as high as 98 per cent have been reached by the use of gears in power transmission. There are several methods employed in making gears, but when it is a question of quantity and quality production combined, the hobbing process is very generally used. The finer the quality desired of the gears, the more accurate must be the hob that produces them, and so we find that the ground hob is rapidly coming to the front. This statement, however, must not be taken to mean that a ground hob invariably produces good gears, because there are at least two other factors that influence the quality, one of these being the hobbing machine, and the other the hobbing machine operator.

As the quality of the finished gear is necessarily a product of the hob, machine, and operator, it is desirable to keep variations due to each of these three factors within predetermined limits. For this purpose, the Illinois Tool Works have developed a number of instruments and formulated a set of rules, the combination being called "quality control." This article will briefly describe the various instruments, and explain their use in checking the accuracy of the hob, inspecting the condition of the hobbing machine, and testing the finished gear.

Requirements of a Good Hob

A hob may be likened to a hardened steel screw with a predetermined profile of the thread, portions of which have been cut away to form a series of teeth with cutting edges. In order to produce good gears, a hob must meet the following requirements:

1. The profile of the hob teeth must be uniform and conform within close limits to the theoretical outline, a rack tooth, which is properly modified, usually forming the basis of the hob tooth profile.
2. The cutting edges on the flanks of the teeth must lie in the path of a true helix which bears a definite ratio to the pitch of the gear teeth to be cut.
3. The cutting edges at the top of the teeth and bottom of the tooth spaces must be concentric with the axis of the hob.

Two machines or instruments have been developed for shop use in checking the finished hob for these requirements, these being, respectively, the contour or profile testing machine, and the lead and concentricity testing machine, described in the following.

The Contour Testing Machine

The contour testing machine, shown in Fig. 1, consists essentially of a base *A*, a hob support *B*, and a slide *C*. The hob support is made to conform to the pressure angle of the hob tooth, which is usually either 14½ or 20 degrees. Slide *C* carries an indicator operated by a lever which is so arranged that a movement of the indicator pointer through one dial division represents a movement of 0.0002 inch of the knife-edge of the lever. To record the results shown by this machine, use is made of the chart shown in Fig. 2. The vertical center line on this chart represents the tooth profile, and the curves at each end, the corrections made on the hob teeth for approach and interference. Curve *A* represents the maximum limit, curve *B*, the minimum limit, and points *C*, *D*, *E*, *F*, *G*, and *H* the maximum depth at which the hob cuts for 12, 16, 21, 23, 28, and 32 teeth, respectively. The straight portion of the tooth may vary 0.0002 inch, while the deviation of the pressure line may be plus or minus 0.0005 inch. The dimensions in ten-thousandths of an inch indicate the distances of curves *A* and *B* from the vertical center line at the various intersections.

In checking, the hob is so mounted on support *B*, Fig. 1, that the knife-edge of the lever is in line with the cutting edge of a hob tooth. Then, with the micrometer for operating slide *C* set at zero, the knife-edge of the lever is moved up to the hob tooth by means of the auxiliary screw on the slide. When contact between the hob tooth and the knife-edge has been established, as illustrated, the auxiliary screw is locked and the slide then advanced in steps of 0.010 inch by the micrometer screw. The indicator reading for each of these steps is recorded on the chart. Hobs whose profile exceeds the tolerances established are, of course, rejected, and must be reground until they come within the required specifications.

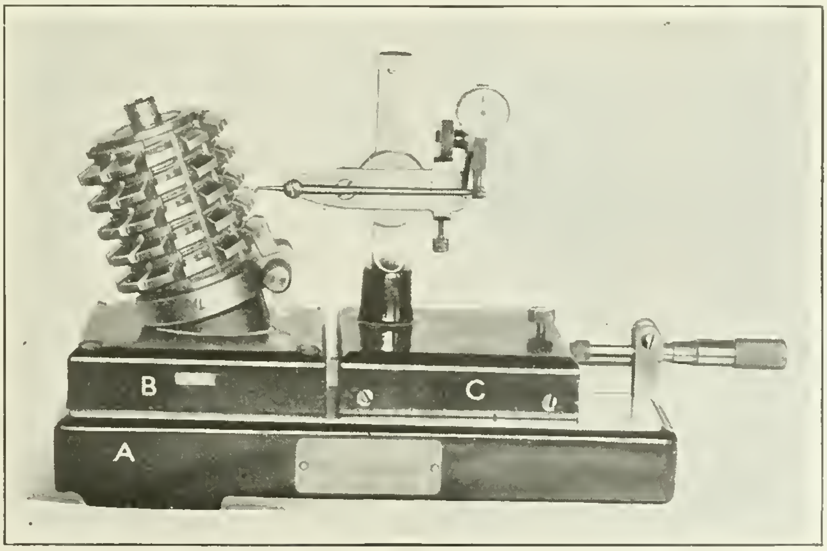

Fig. 1. Machine developed for testing the Profile of Hob Teeth

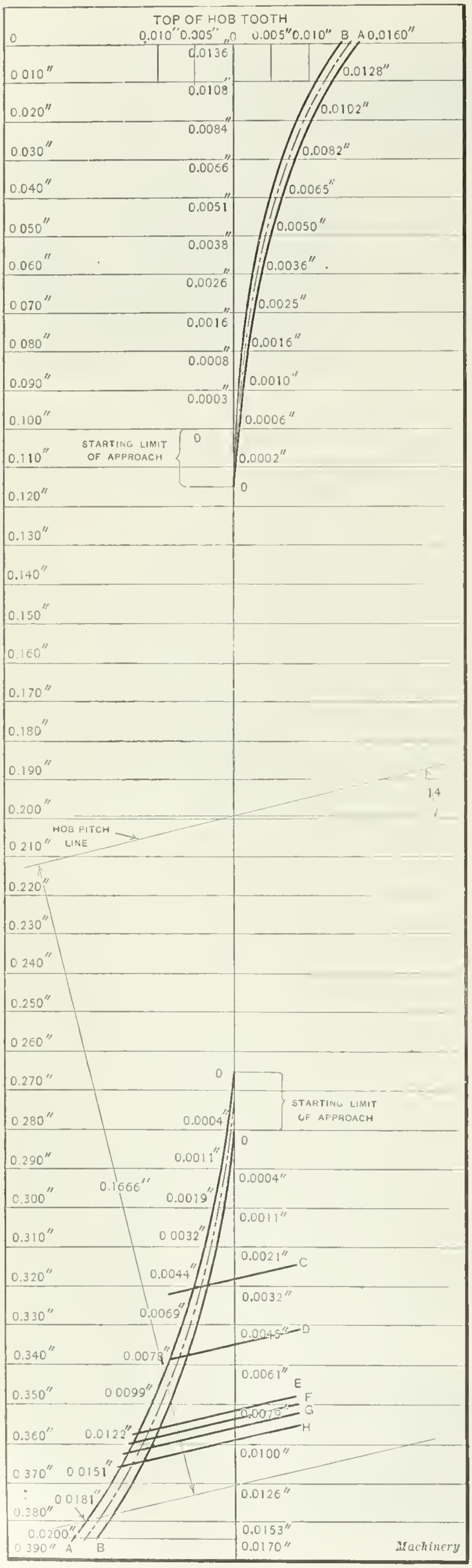

Fig. 2. Chart on which the Results obtained by the Use of the Machine in Fig. 1 are recorded

Determining the Lead and Concentricity

The hob is next checked for correctness of lead on the lead and concentricity testing machine shown in Fig. 3. This machine has four bearings cast integral with the base *A*, for supporting the main shaft *B*, which carries wheel *C*, and an auxiliary shaft on which pinion *D* and handwheel *E* are mounted. An indicator bracket is located at *F*. One end of shaft *B* is a master screw, while the other end is machined to receive the hob. To check the lead of the hob, the indicator point is brought in contact with the cutting edge on either flank of a tooth. Then the indicator point is adjusted to zero, and the hob is advanced by turning handwheel *E* until the indicator point comes in contact with the cutting edge of the next tooth. This is continued until all the teeth have passed the indicator point, after which the process is repeated for the cutting edges on the other flank of the teeth.

The readings of the indicator are plotted on the chart shown in Fig. 4, the figures at the top of the chart representing ten-thousandths of an inch. A graph obtained by drawing a line through the points plotted shows how much the cutting edges of the hob teeth deviate from the true helical path. Ground hobs of 6 to 10 diametral pitch, showing a variation in lead of not over 0.0002 inch from tooth to tooth, have been produced with the "weave" per revolution less than 0.0005 inch.

After the lead test is completed, the indicator is shifted so that it bears on the top of the teeth, to test the concentricity of the cutting edges at the top of the teeth and at the bottom of the tooth spaces. As before, the hob is rotated till every tooth has passed under the indicator point, and the readings are recorded. Commercially ground hobs should not show a variation of more than 0.001 inch in this test.

Testing Resharpened Hobs

A hob that has satisfactorily passed the three tests outlined, when properly mounted on a good machine, will produce gears of the desired accuracy. However, like all cutting tools, it will need sharpening in time, and as it is easy to spoil the accuracy of a hob in sharpening, it may be well to note a few points that should help to avoid trouble from this source. Fig. 5 shows the common way of sharpening the hob, that is, by indexing from the back of the teeth and grinding with the cone side of the wheel. As most hobs are ground with the tooth faces radial and as the wear of the wheel may cause a variation in the height of the teeth, it is advisable to check the hob for concentricity and radial cutting edges after each resharpening. This is done with the fixture shown in Fig. 6, which is provided on the right-hand side with an indicator for checking the radial height of the hob teeth. On the left-hand side there is a small support which has fingers that enter the gashes of the hob and indicate whether or not the tooth faces are radial.

Inspecting the Condition of the Hobbing Machine

A good hob, even when properly taken care of, will not produce good gears unless the hobbing machine on which it is used is in good repair and certain rules are observed in operating the machine. One of the first tests, and perhaps the most important one, that the machine should be subjected to is the velocity ratio test for determining whether the hob and work-arbors rotate with uniform velocity for a given gear ratio. The equipment for making this test was fully described in the article "Testing Gear-hobbing Machines," in December MACHINERY.

After a hobbing machine is found to have a uniform arbor velocity, it is necessary to observe a few rules in operating the machine in order to obtain good results. For instance, all chips or other foreign matter must be removed from the hob arbor, spacing collars and clamping nut before the hob is mounted, as any material caught between the shoulder or the collars would cause the arbor to spring and the hob to run out of true. It also has been found that the threads on the hob arbor or in the clamping nut are not always square with their axis and thus cause springing of the arbor. It is a good policy therefore to place an indicator on the hub of the hob after it has been mounted on the machine, and test it for "run out," so as to make sure that no trouble will arise from this source.

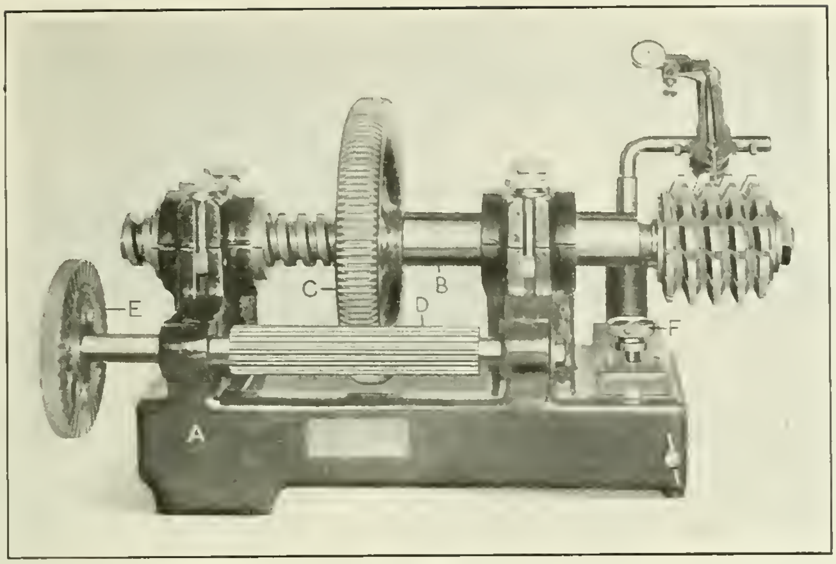

Fig. 3. Machine for testing the Correctness of Lead and the Concentricity of Cutting Edges

End play of the hob arbor and looseness of the outboard bearing are also possible sources of trouble, and must be looked out for, and corrected when they are found to exist.

The next item to consider is the condition and mounting of the change-gears. Tightly meshing gears may set up vibrations in the machine, while gears poorly machined or not meshing deep enough will invariably produce poor teeth on the gear blank being cut. Again, a work-arbor running out of true, or gear blanks with too large holes or so mounted as to cause the work-arbor to spring, are all factors to be avoided or corrected.

TOOTH NO.	READING	LEFT SIDE OF TOOTH											RIGHT SIDE OF TOOTH										
		+10	+8	+6	+4	+2	0	-2	-4	-6	-8	-10	+10	+8	+6	+4	+2	0	-2	-4	-6	-8	-10
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Machinery

Fig. 4. Chart for recording the Results of the Lead Test

Testing a Gear Produced with the Hob

Until recently it was customary to test a finished gear in a fixture called a "vernier machine." In this fixture, a master gear is located on a stationary stud and the gear to be tested is put on a stud mounted on a slide. As a spring actuates this slide, an indicator bearing against it will show the amount of eccentricity of the teeth, as well as the "jump" between them, when the gears are rotated. If the slide is locked in a position corresponding to the center distance at which the gears are to run, the diameter and backlash can also be checked.

However, the tests made on this simple fixture give no information as to the correctness of the tooth profiles or the spacing of the teeth. In order to check these two important factors, additional instruments have been provided. One is the involute-curve testing machine shown in Fig. 7. Instruments of this type are practically all based on the fact that the end of a taut string being unwrapped from a cylinder will generate an involute curve. However, in this case, the string assumes the shape of the straight edge *aa* of slide *A*, as it is theoretically rolled from the base circle cylinder *B*. One end of the string is represented by the end of lever *C* which contacts with the tooth profile. The other end of the lever transmits motion to the dial indicator *D*. In order to check a tooth profile at a certain number of points approximately equal distances apart, the right-hand end of the gear sector *E* is made to remain in contact with the periphery of the base-circle cylinder *B*. This causes a movement of the gear sector when cylinder *B* is revolved, the movement of the sector being transmitted through a pinion to the pointer on dial *F*, which is suitably calibrated.

To use the instrument, a disk *B* corresponding in diameter to the base circle of the gear to be tested is mounted on the hub of lever *G* and locked with a nut. The gear itself is put on sleeve *H*, and held in position by pin *I* of slide *J*, the slide being clamped to lever *G* by means of a binding screw. Slide *K*, carrying the base-circle disk, gear, etc. is now moved toward slide *A* by turning the threaded knob *L* until the base-circle disk is pressed firmly against face *aa* of slide *A* under the influence of the coil spring beneath the knob. Slide *A* and the gear are next so adjusted by means of the handwheel at the left-hand end of this slide and a clamp on slide *K* that the tooth contact point of lever *C* barely touches the extreme outer part of the tooth profile.

If now the dial of indicator *D* is set at zero and a reading is taken on dial *E*, starting points are obtained for checking the involute curve. In moving slide *A* to the right in increments as indicated on dial *F*, the hand of indicator *D* should remain stationary while the tooth contact point of lever *C* travels almost to the full depth of the tooth, except at the very beginning and end of the travel, where the corrections for approach and fillets cause a slight movement of the dial hand. Should it be desired to check the other side of the tooth, indicator *D* may be mounted on the second post provided for this purpose, or the gear may be turned over. Having found the tooth contour to be correct, it is insured that there will be uniform angular velocity of the gears during the contact of any two teeth. But to maintain this angular

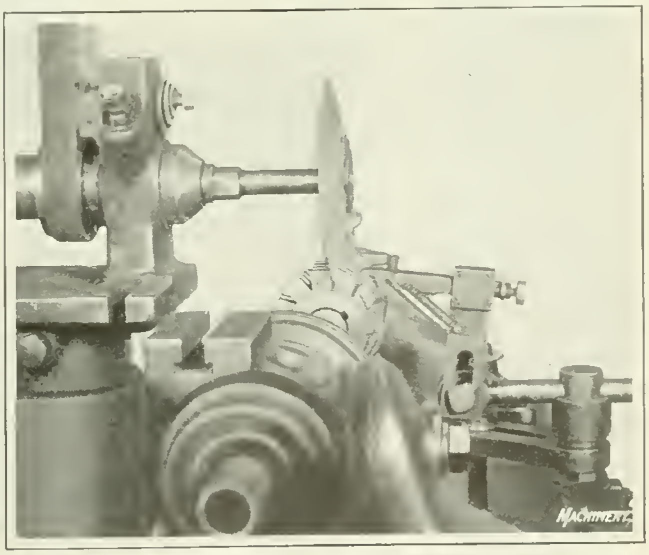

Fig. 5. Set-up commonly employed for resharpening Hob Teeth

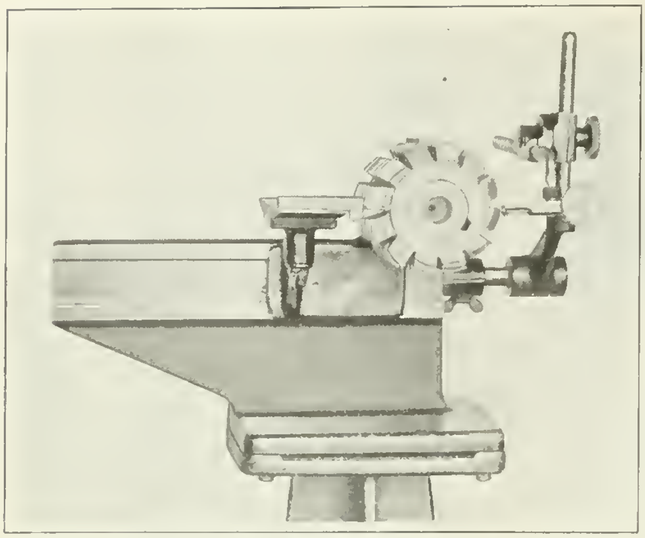

Fig. 6. Checking the Radial Height and the Face of Teeth on Resharpened Hobs

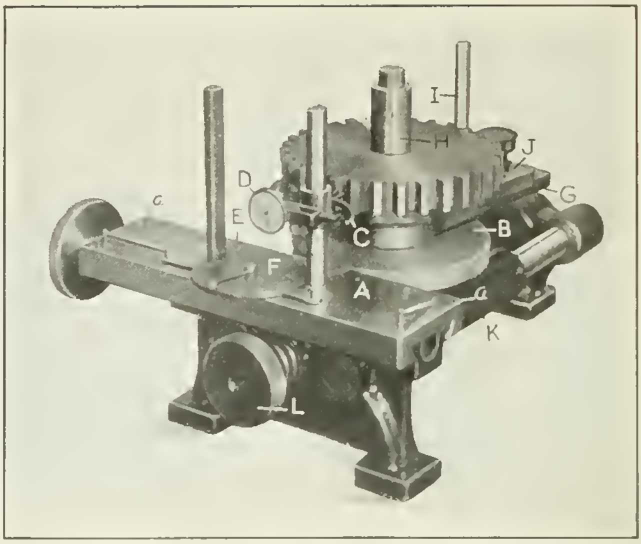

Fig. 7. Involute Curve Testing Machine used for inspecting a Finished Gear

velocity during a complete revolution, it is essential that the spacing of the teeth be correct also. This is tested by a device described in the article "Inspection of Spur Gears," which was published in February, 1922, MACHINERY.

After the gears have passed the tooth-spacing test, they are often subjected to one more test before being pronounced satisfactory. This final test is the so-called "run-in" test which determines the bearing of the teeth. The ideal bearing for spur gear teeth is one that is uniform over the greater portion of the working surface of the tooth, fading ont at the base line and just at the top part of the profile. The "run-in" test consists of mounting two gears on arbors which are located so that the gears mesh properly, revolving one arbor by power and retarding the other by some such device as a Prony brake. In this manner, the tooth surfaces are caused to roll and slide over each other under pressure, and, in a brief space of time, they become brightened sufficiently to show whether or not the bearing is as it should be.

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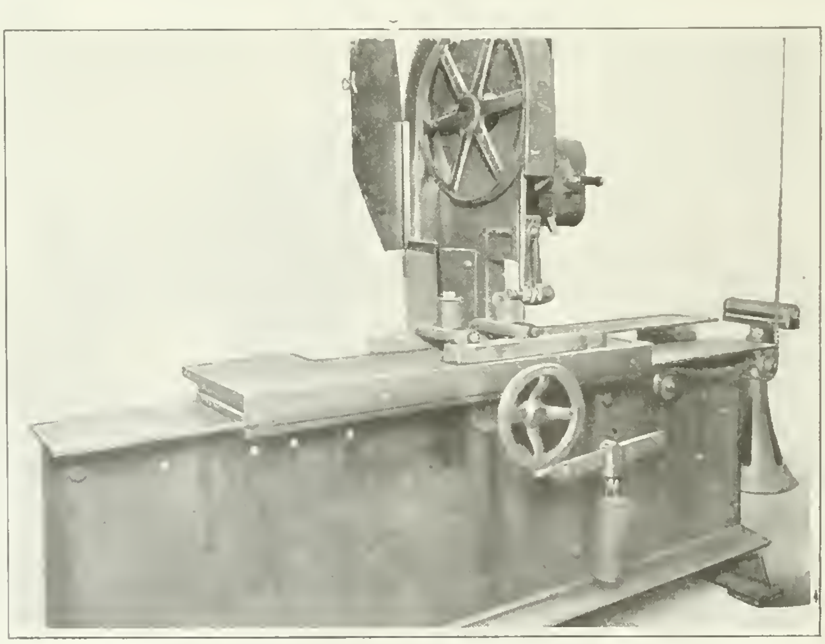
MAKING STEEL PARTS ECONOMICALLY

During the last few years there have been times when it was difficult for the manufacturer to buy forgings in small quantities. This suggested to the engineers of Sleeper & Hartley, Inc., Worcester, Mass., the possibility of cutting out blanks from rectangular stock and turning these blanks to the required shape. The adoption of this method led eventually to the design and construction of a special band saw. It is stated that by employing this means of manufacture, steel parts can be produced at a cost of three or four cents per pound.

The slitting band saw, which is here illustrated, is of a simple design, but has been found so serviceable that it is believed machines of this type would be of value to other manufacturers. The machine is similar to standard makes of band saws in so far as the drive for the saw is concerned; in fact, the design of a standard make band saw pulley arrangement has been embodied in the construction and used in connection with a feeding table. The machine is driven by a one-horsepower motor running under no load at 1200 revolutions per minute. The motor is located under the table at the rear. The feed of the table is by a weight hung over a pulley near the ceiling, from which the cable passes down to pulleys on the table.

There is a brake lever on the handwheel at the front of the machine, by means of which the feed may be regulated to suit the thickness of stock being sawed. The method of procedure is simple: The bar or flat stock is bolted to the machine table in the proper location, and after being sawed out is finished by turning in a lathe, or by finishing in any other suitable way.



Band Saw with Feeding Table for slitting as well as cutting off

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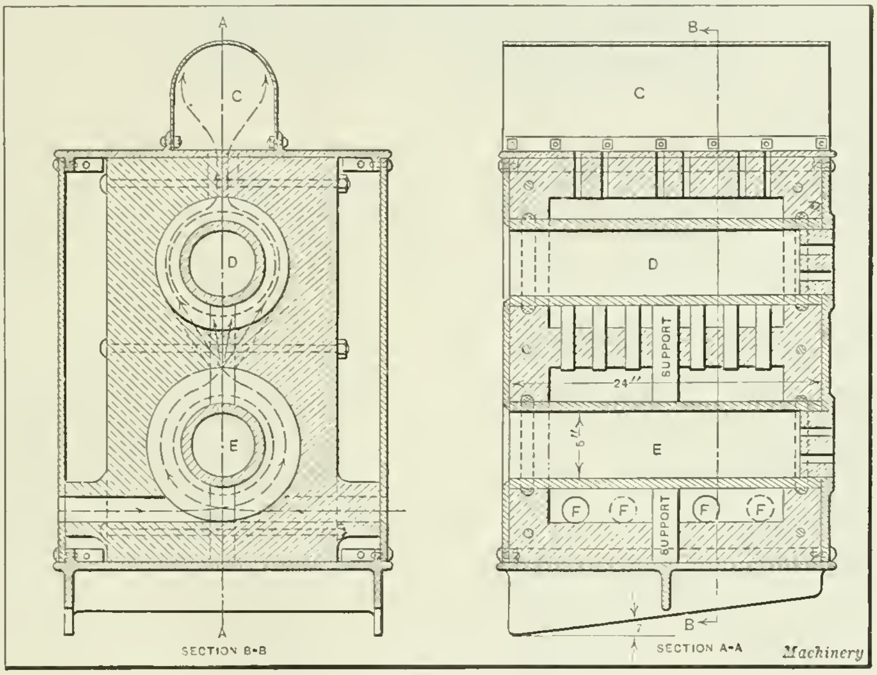
VALUE OF SUPERHEATERS

The real value of superheaters on locomotives is questioned by William H. Wood, a mechanical engineer of Media, Pa., who states that while fuel savings of some 10 per cent are effected through the use of superheaters, it costs 35 per cent of the cost of the fuel to keep the engines in repair. He claims that one of the reasons that there are so many locomotives constantly out of repair on the railroads is that the maintenance service has greatly increased since the adoption of superheaters on locomotives. Whether or not the experiences of the railroads agree with Mr. Wood's statements is not on record, but the subject is one that should be easy to investigate and the facts can doubtless be ascertained by railroad executives without a great deal of trouble.

Difficulties in Hardening High-speed Steel

By O. G. SIMMONS

THE impossibility of hardening some high-speed steels under normal conditions, even though heated and quenched according to the instructions of the manufacturers, was an unlooked for result of experiments recently conducted by the writer. The muffle furnace shown by the cross-sectional views in the accompanying illustration was employed for these experiments. This furnace has a low-temperature chamber *C*, an intermediate-temperature chamber *D*, and a high-temperature chamber *E*. The design is such that when chamber *E* has been heated to 2300 degrees F., the temperature of chamber *D* will be about 1750 degrees F., and that of chamber *C* approximately 600 degrees F. City gas was used for fuel, and was mixed with air before delivery to the four burners *F*, two of which are placed on each side of the furnace.



Muffle Furnace of Special Design which was used to determine the Hardening Qualities of Different High-speed Steels

The intermediate- and high-temperature chambers each consist of an air-tight tube made from refractory material. The plug at the rear end of these chambers has holes to support the protecting tube of a platinum thermo-couple and a refractory pipe having a valve for controlling the volume of gas discharged into the chamber to obtain any desired atmospheric condition. It will be seen that the base of the furnace is constructed at an angle of 7 degrees with the center line of the chambers, and consequently by mounting the furnace on a horizontal base, the chambers are inclined 7 degrees. This, of course, raises the front end of the chambers slightly above the rear end, and so when gases are introduced at the rear, they are carried to the front end for discharging.

The high- and intermediate-temperature chambers are supported in refractory tile, which is sealed with lime, the whole being contained within steel side walls, a cast-iron base, and a cast-iron top. The insulating effect of the lime prevents the side walls from ever having a higher temperature than 200 degrees F. The high-temperature chamber is heated to 2300 degrees F. from the normal room temperature in one hour and forty-five minutes. Approximately 410 cubic feet of gas per hour is consumed in heating to this temperature, and 260 cubic feet per hour is required for maintaining it.

Heat-treating Angle-iron and Carbon Steel Pieces

Specimen angle-iron pieces, highly polished prior to heating, were held at 2000 degrees F. for ten minutes in a carbon monoxide atmosphere, and immersed in oil. These specimens came out with a surface clean from scale or oxide and the polishing marks clearly visible. In the following experiments, the specimens were heated by placing them consecutively in the three chambers. A carbon steel die was heated to a temperature of 1540 degrees F. in a carbon monoxide atmosphere, and held at that temperature for four minutes. After immersing in oil and withdrawing, the surface of the hardened die was found to be without scale and purplish-black with gray spots. A similar die was also successfully hardened by heating in a chlorine gas atmosphere and immersing in water. This die had a clean surface of a light gray color with some purple spots.

The two dies were put to work after very little stoning, and while the production from these dies was excellent, it was not exceptional. Later tests indicated that, owing to the unusually clean surfaces, dies hardened by these methods would cut tissue paper without stoning in some cases and with very little in others.

Several high-speed steel double-end boring tools, ¾ by 1¾ by 8 inches, were held in the high-temperature chamber for four minutes in a carbon monoxide atmosphere. These specimens came out clean without being blistered or oxidized, and were gray in color. They looked like steel taken from an acid cleaning bath, having a stained but smooth surface. These tools had been surface-ground all over before hardening. When fractured, the grain showed velvety throughout, and was beautiful in appearance. Only one make of steel was used for these cutters.

High-speed steel end-mills of different makes were heat-treated in accordance with the hardening instructions of the steel manufacturer in each case. Specimens of one make of steel were hardened in a carbon monoxide atmosphere by keeping them in the high-temperature chamber for 4½ minutes and quenching in oil. They were tempered at 1050 degrees F. Specimens from another lot of the same make of steel were held for various lengths of time— from four to fourteen minutes—in the high-temperature furnace and quenched and tempered as before. In each case the specimen hardened clean, without scale, and was black in color.

Some of the end-mills in the first lot were extraordinary in cutting ability. This was likewise true of some held in the high-temperature chamber for a longer period. End-mills made from some other makes of high-speed steel were treated with as good results; however, certain makes would not harden at all. Some steels would harden only in spots, but this was probably due to the method of holding the piece, or because it was not agitated sufficiently while in the high-temperature chamber to heat it uniformly. During these experiments the temperature of the high-temperature chamber varied only 15 degrees, as shown by two thermocouples which were moved to different positions in the chamber. Many high-speed steel hobs were tried with practically the same results, that is, those made from certain steels would harden with a clean surface, while others would not harden, although the temperature chamber was varied from 2250 to 2450 degrees F.

Conclusion

The high-speed steel specimens that would not harden when heated to the specified temperatures in the presence of certain gases, and especially carbon monoxide gas, would harden by quenching after being heated in an open coke fire, coal fire, semi-muffle gas furnace or oil-fired furnace. The writer tried discharging hydro-carbon gases in the intermediate- and high-temperature chambers, and whenever this was done he was able to harden any make of high-speed steel. However, there is an objection to the use of these gases, because at the high temperature of about 2300 degrees F., the carbon disassociates from the gas and floats about in the form of a black cloud, which hides the work. This objection may not be serious, but it is always preferable to see the work. It was found impossible to produce scale on a specimen piece, no matter how long it was left in the high-temperature chamber in the presence of these gases. Among the hydro-carbon gases, ordinary coal gas was used. This gas gave almost as clean results as some of the other gases. Chlorine gas was also discharged into the chambers for some high-speed steel parts, but at the high temperature employed, this gas becomes so dangerous that the experiments with it were discontinued before anything valuable was determined.

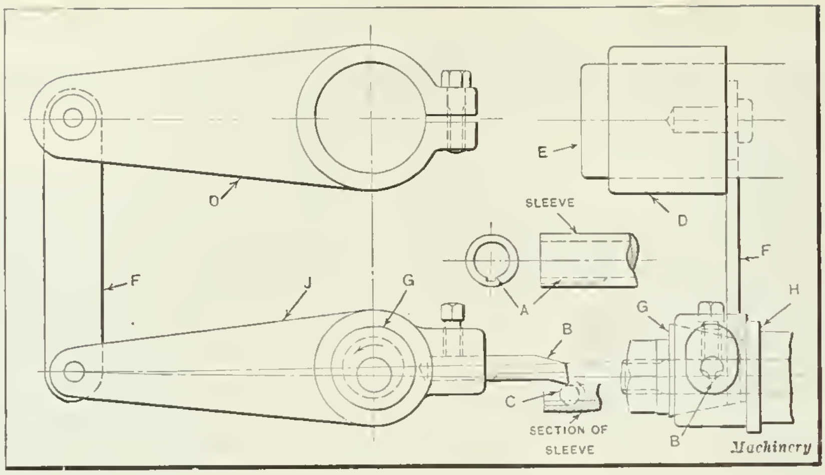
In conclusion, these experiments would indicate that the mere heating of some makes of high-speed steel to certain temperatures, and cooling, will not harden them; that some high-speed steels will remain soft when heated to the so-called hardening temperature in the presence of carbon-monoxide gas and cooled in oil; and that other experiments should be conducted to determine the different atmospheres necessary (preferably the one atmosphere) to enable any make of high-speed steel to be hardened.

* * *

KEYWAYING ATTACHMENT

By E. M. LONG

A milling machine attachment designed by the writer for use in cutting keyways on the inside of small steel sleeves is shown diagrammatically in the illustration. The keyway, which is indicated at *A*, is ⅛ inch wide, 0.070 inch deep and ⅞ inch long. The sleeves are of steel, and are bored out to a diameter of ⅝ inch. In cutting the keyway, the point of tool *B* follows the path indicated by the dotted line at *C*, the cutting action being similar to that of a fly cutter.



Side and End Views of Keyway-cutting Attachment

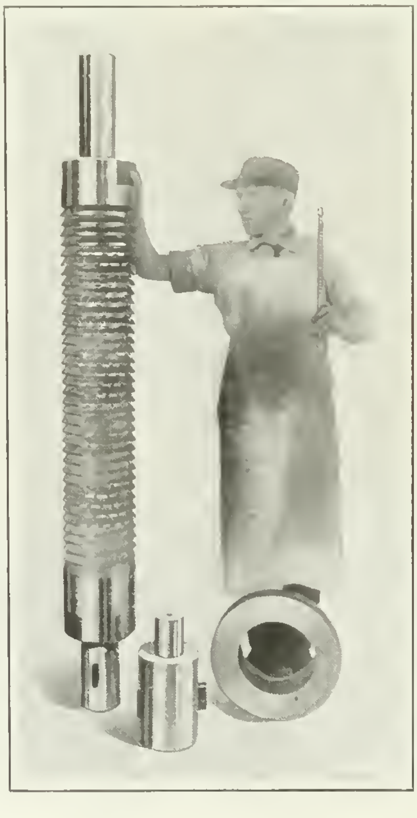
The attachment consists primarily of the over-arm pendant *D*, attached to the regular over-arm *E* of the machine, a link *F*, and a cast-iron tool-holder *J*. A hole is bored through the tool-holder to fit the taper of the eccentric *G*. This eccentric, with its special washer *H*, is mounted on the regular milling machine arbor. The link *F* supports the outer end of the tool-holder. By running the milling machine spindle in the direction indicated by the arrow, the working point of the tool is made to follow the circular path indicated by the dotted line *C*.

The time required to cut a keyway is about one minute. The sleeve is held in a special chuck mounted on a regular milling machine vise. The table of the milling machine is fed forward, the same as when using a regular milling cutter, and the spindle is run at a speed of approximately 400 revolutions per minute. The keyways cut with this attachment are practically free from burrs.

* * *

BROACH OF EXTRAORDINARY SIZE

What is believed to be the largest broach of its type ever made has recently been produced in the shops of the J. N. Lapointe Co. New London, Conn., for broaching roller bearings used on freight cars and locomotives. The accompanying illustration gives an excellent idea of its size. It is about 7 feet high, 9½ inches in diameter, and weighs approximately 900 pounds. The bushings that are broached by means of this tool are made of chrome-nickel steel, the broach removing about ⅛ inch of metal on the diameter.



Broach of Unusual Dimensions

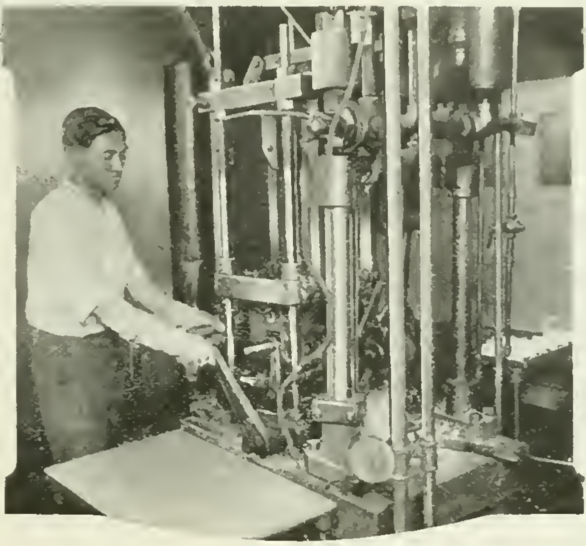
The broach is made up in sections of four teeth each, and these sections are put on an arbor that is ground true, so as to insure that the broach will cut round holes with accuracy. The weight of the broach is compensated for by means of a special fixture attached to the face of the broaching machine. This fixture slides on a way that is lined up with the pulling head of the machine. The production obtainable with this broach is from 20 to 25 bushings per hour. The broach is used on the No. 5 machine built by this company.

* * *

The Diesel engine is becoming well established for ship propulsion. There are now more than 130 vessels of over 2000 tons driven by Diesel engines, 78 of these (aggregating over 500,000 tons) being equipped with Diesel engines built according to the system of Burmeister & Wain, Copenhagen, Denmark.

Types of Die-casting Machines

By CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



ALTHOUGH many types of die-casting machines have been used in different stages of the development of the die-casting industry, those now in general commercial use are either of the plunger type or of the compressed air type.

A diagram of the plunger type machine is shown in Fig. 5. In this design, the operation of the machine is as follows: Compressed air is admitted to cylinder *A*, thus operating the rocker arm *B*, which advances a piston in cylinder *C* (located within the melting pot), and forces the molten metal up through the nozzle into the dies, clamped in a framework directly above the nozzle. The cylinder *C* is submerged in the molten metal to the depth shown by the dotted line. On the release of the piston, the metal flows by gravity through a slot in the end of the cylinder until it reaches its own level. Thus, with every release of the piston, the cylinder is refilled, preparatory to the next stroke.

The dies are aligned on four posts of the framework, which is hinged to the machine so that it may be thrown into a horizontal position for opening and closing the dies. A view of the plunger machine with the carriage tilted back and the dies opened is shown in Fig. 1, and the same machine with the frame clamped in its vertical position over the melting pot is shown in the heading illustration. As soon as the cast has been made, the frame is unlocked by means of the handle at the front of the machine, and thrown back on its hinge where it is supported by a floor stand. The long lever *A*, Fig. 1, opens the dies through toggles *C*, and the various handles on the upper or ejector die are used to withdraw the cores and advance the ejector-pins after the dies are opened.

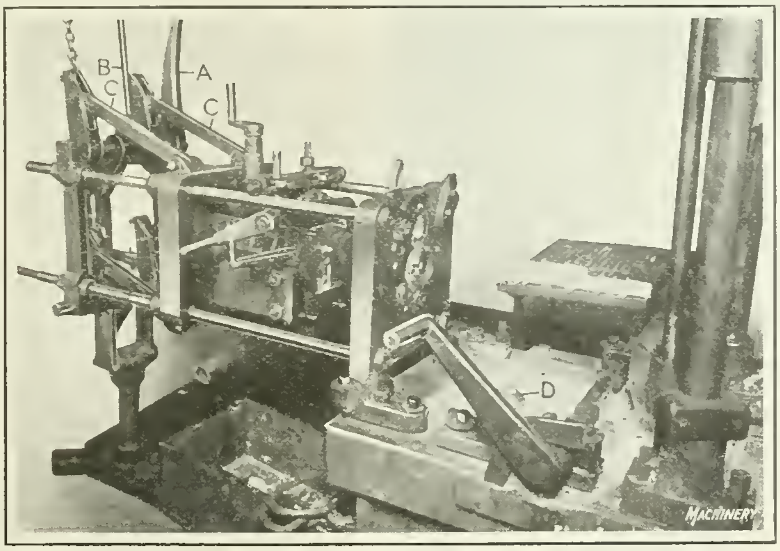


Fig. 1. Plunger Type Die-casting Machine with Die Carriage hinged back, showing Melting Pot and Carriage Lock

After the casting has been ejected, the dies are closed, the cores adjusted, the ejector-pins withdrawn, and the carriage raised to its vertical position with the aid of an air hoist connected to the frame by rod *B*. The hoist is allowed to swing as the frame is raised. The dies are then clamped over the nozzle *D* of the melting pot, after which the machine is once more in readiness to make a casting.

The compressed-air machines, that is, those in which compressed air is applied directly to the molten metal to force it into the dies, are of two types—the valve type shown diagrammatically in Fig. 3, and the gooseneck type shown in Fig. 4. The valve type is not extensively used at present by the company with which the writer is connected, the plunger type and the gooseneck type machines being preferred. The valve-type air-pressure machine consists of a bell-shaped container *A*, Fig. 3, which contains molten metal to about the level shown by the dotted line. A valve stem is operated through the container by the long lever shown.

The dies are placed directly beneath the nozzle of the container, and the air valve is opened after the valve stem has been raised, so that the metal is forced through the nozzle into the dies. The air pressure is then released, the nozzle closed by the stem, and the dies run out from under the machine on a track *B* so that they may be opened to remove the castings. The lever *C* actuates a clamping arrangement for raising the dies and locking them between the nozzle of the container and the clamping arrangement. The main objection to this type of machine is the fact that the valve corrodes, which causes the nozzle to leak, and produces unsatisfactory results. In addition to this objection, it is necessary to recharge the container frequently which is a rather awkward procedure, as the cover has to be removed.

Gooseneck Die-casting Machine

The gooseneck air-pressure machine is of the horizontal type. A view of the machine with the dies open is shown in Fig. 2. The special shaped air cylinder *A* (Fig. 4) is the gooseneck from which the machine derives its name. In operation, it is immersed in the molten metal, which rises to a sufficient height so that the metal runs into the gooseneck through a nozzle and fills it enough to permit the casting to be made. The incoming molten metal displaces whatever air there may be in the gooseneck, which passes out through an exhaust valve. After being filled, the gooseneck is raised until its nozzle

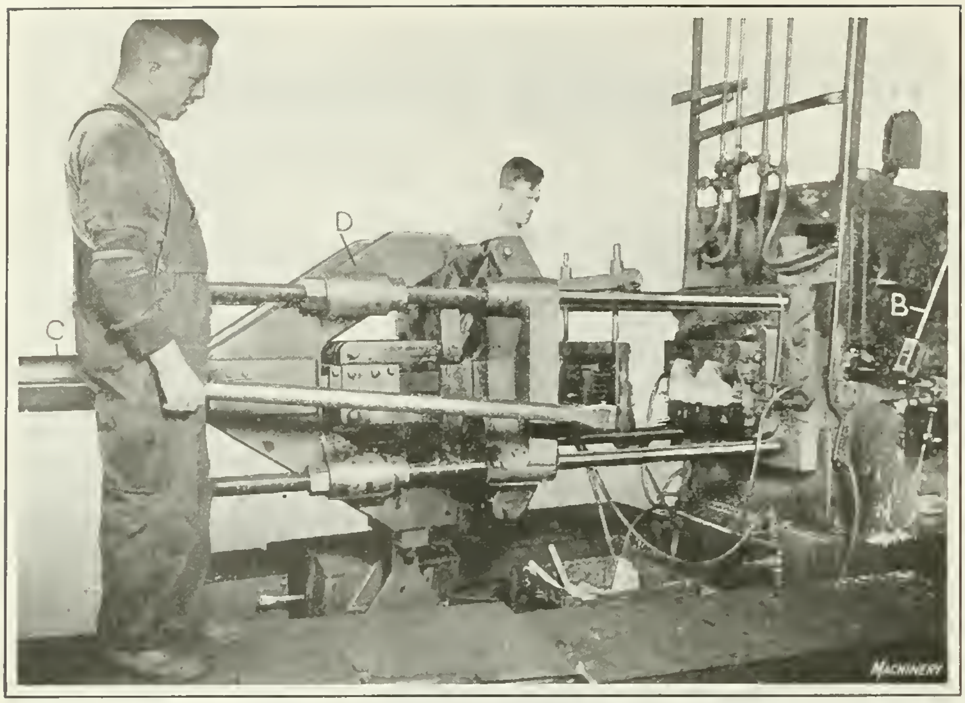


Fig. 2. Using Gooseneck Die-casting Machine for Large Castings

enters a bushing leading to the dies. The lever that raises the gooseneck and seats it tightly in this position is shown at *B* in both Figs. 2 and 4. A hook is provided on the upper part of the gooseneck for suspending it during the casting operation, which occurs when the valve in the air line is operated.

The air passes into the gooseneck through hollow link members, a construction which permits that container to be raised and lowered as described. The air is controlled by a whistle valve, which is operated by pulling a chain attached to the valve lever. The dies are attached to plates in a framework, and are clamped together by a toggle mechanism, operated by compressed air. The air cylinder is shown at the extreme left-hand end of the machine. The support for the die carriage may be moved on a track and clamped in the correct position to agree with the distance between the dies when open.

The amount of pressure required to make a casting depends on the design of the part: on large or intricate castings, several hundred pounds per square inch may be necessary. Upon the release of the air pressure, the nozzle is again lowered into the melting pot and the gooseneck recharged, the entire cycle of operations requiring but a few seconds. Although this type of die-casting machine has proved more efficient than any other used by the writer's company, especially for aluminum casting even in this machine there is considerable room for improvement in design.

Machines for Large Castings

The gooseneck machines are often made in large sizes, with a melting pot of greater size than ordinarily used and two goosenecks, for making large castings. In fact, Fig. 2 shows such a design being used for casting a calculating machine case. These cases range from about 16 to 30 inches in length. In the illustration, the casting itself is shown in the die next to the melting pot, that is, in the cover die, although in actual practice the casting would be in the ejector-die when the dies are first opened.

The air valve for operating the huge toggle *D* on this machine is at the extreme left, and is not shown, although the air cylinder is indicated at *C*. At least two operators are required for each die-casting machine, so that the duties of operating the gooseneck, locking and opening the dies, ejecting the casting, adjusting the cores, etc., can be equally divided between them. It is necessary to lubricate the dies occasionally, so as to prevent the casting from sticking in the impression. For this purpose a mixture of graphite and oil is used. The operator in the foreground in Fig. 2 has one hand on the long lever arm

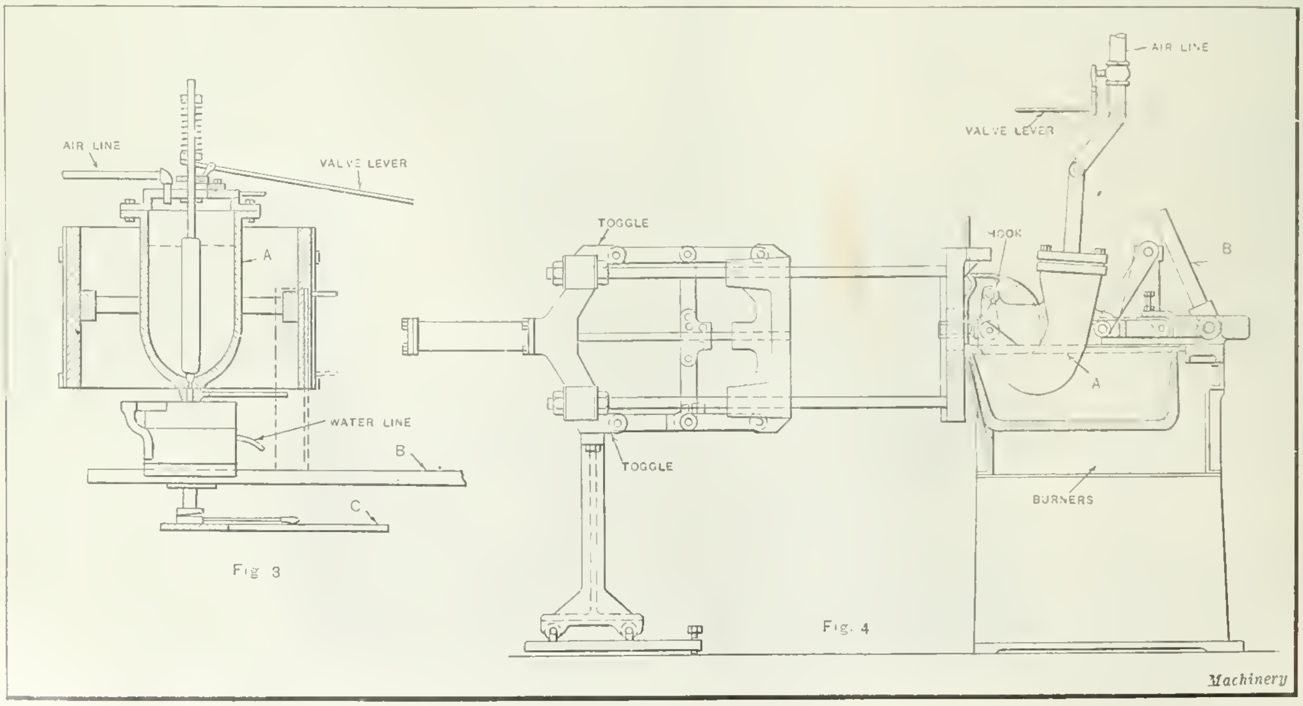


Fig. 3. Diagram showing Principle of the Valve Type Compressed-air Machine; Fig. 4. Diagram of the Gooseneck Type Compressed-air Machine

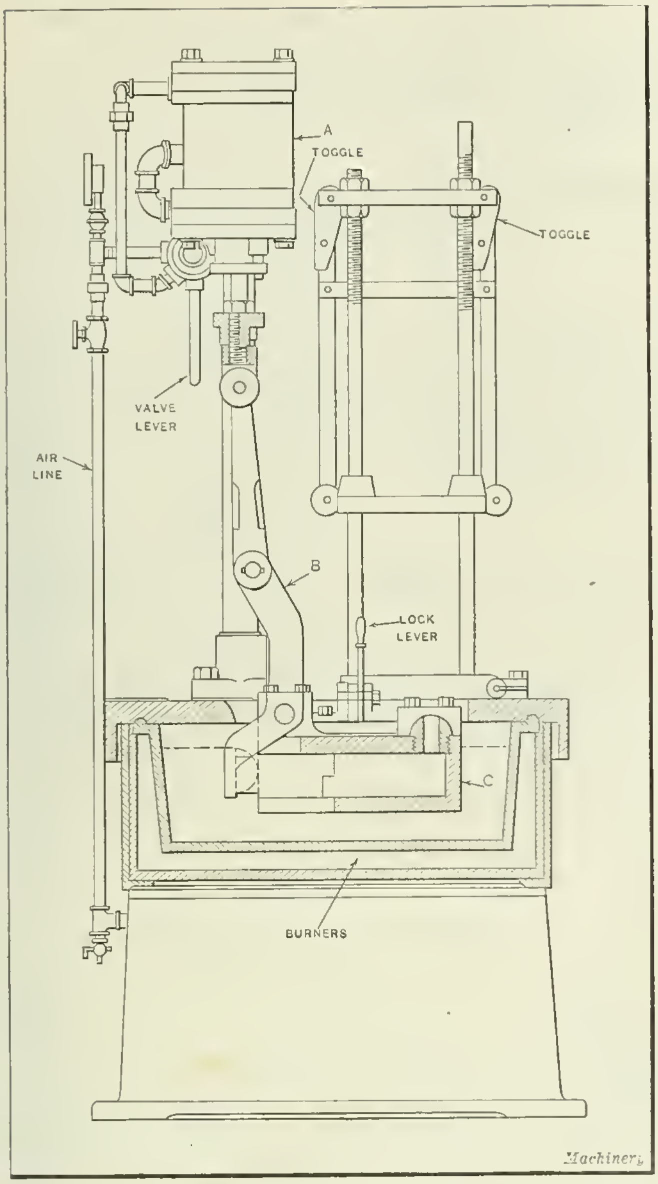


Fig. 5. Diagram of Plunger-type Die-casting Machine, with Die Carriage in Vertical Position

which operates the ejector-plate to advance the pins and remove the casting from the ejector-die.

Melting the Metal

The fuel generally used for heating the metal is gas, the burners being located beneath the melting pot, as indicated in the diagrams. For moderate sized work, the capacity of the melting pot is sufficient to melt enough metal for a large number of castings. On larger work, however, an extra pot is frequently used.

* * *

PROFILE CUTTING WITH A GAS TORCH

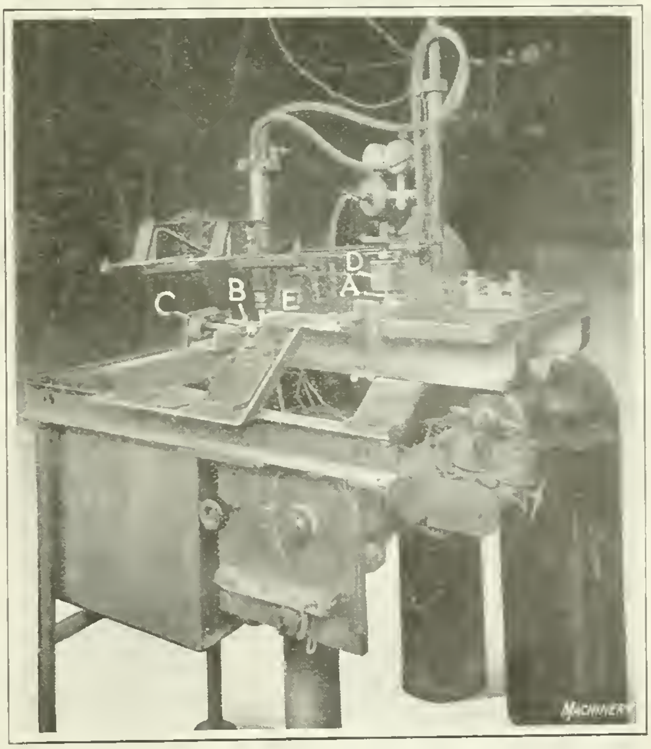
Iron cores for electric magnets used in the controlling mechanism on electric elevator switchboards constitute one class of work that is being regularly cut with an oxy-acetylene torch on the special machine here illustrated. This machine was constructed by the A. B. See Electric Elevator Co., Jersey City, N. J., for cutting out stock having an irregular outline.

A Davis-Bournonville oxy-acetylene cutting torch is used in the machine. The torch is mounted vertically in a pantograph frame, and guided, in cutting, by a master plate which is clamped to the table of the machine. The unusual feature of this arrangement is that the follower-pin *A* is magnetized, so that as it revolves it is attracted to the master plate and rolls on its perimeter instead of following in a path milled in the plate. The master plate is twice the size of the work, and is the only removable unit that is not held in place by magnetic attraction, which, of course, would require insulating the table from the rest of the machine, or using a magnetic chuck.

Cutting out a magnet core with this arrangement is a very simple operation. One of the cores is shown upright on the table of the machine and another is shown at *B* under the torch tip *E*, supported and located from the ends by pins and held thereto by the magnetic force produced by coil *C*. With the master plate clamped to the table, the current is switched on, which starts the motor and revolves the follower-pin. The follower-pin is carried on the pantograph frame, and so may be freely swung to any convenient starting point on the master. When this has been done, the rheostat is adjusted to supply the current for the follower-pin magnetic coil *D*. The revolving follower-pin is then attracted to the master plate, around which it immediately proceeds to roll. Previous to this, of course, the current for the magnet that holds the work in place has been switched on, and the cutting flame regulated. The various electric controls are mounted on a panel at the front of the machine so that they can be conveniently reached by the operator, and the motor is located beneath the table.

These iron magnet cores are ½ inch thick, and the cutting operation consumes 30 pounds of air and 3 pounds of gas, which is the standard mixture for this thickness of stock. One pipe line from each of the oxygen and the acetylene tanks connects with the combustion chamber of the torch, and the flame is impinged on the work through two small pin-holes in the tip *E*.

The apparatus, as well as the proportions of gas and oxygen used for cutting with this machine, are those furnished by the Davis-Bournonville Co., and are as follows: For ⅛-inch stock, 10 pounds of oxygen and 3 pounds of acetylene; for ¼-inch stock, 15 pounds of oxygen and 3 pounds of acetylene; for ⅜-inch stock, 20 pounds of oxygen and 3 pounds of acetylene; for ¾-inch stock, 30 pounds of oxygen and 3 pounds of acetylene; for 1-inch stock, 30 pounds of oxygen and 4 pounds of acetylene; and for 2-inch stock, 45 pounds of oxygen and 4 pounds of acetylene. For thicknesses of stock greater than 2 inches the quantities of gas and air are increased accordingly, in the same proportion.



Machine with Magnetized Follower-pin for guiding Torch when cutting Profiles

Sharpening Square Broaches

By GEORGE E. HODGES

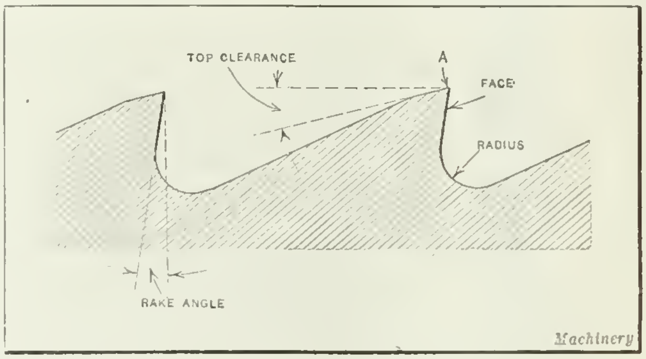


Fig. 1. Sectional View of Broach Teeth

Cutting tools must be kept sharp to function properly. Accordingly, it is a fundamental principle of cutter design that adequate provision be made for resharpening. This has been done in the case of square broaches of approved S. A. E. design, but in spite of this fact, incorrect or inefficient methods are commonly employed in sharpening these broaches. While the average shop may have limited facilities for broach grinding, there is no excuse for the quite general practice of sharpening broaches by grinding the face of the teeth, especially when the established rake angle is satisfactory. Perhaps of as great importance as the maintenance of the correct rake angle (see Fig. 1) is the maintenance of the correct radius at the bottom of the tooth. The face of one tooth and the back of the preceding tooth should be tangent to this radius, so that the chip will meet no obstruction that will prevent it from curling properly. It is difficult to grind the face of a broach tooth without gouging the back of the preceding tooth or cutting the face back so that it is no longer tangent with the radius. The gouging of the teeth (due to the broach running out) which results from grinding the face, usually prevents the chip from curling properly.

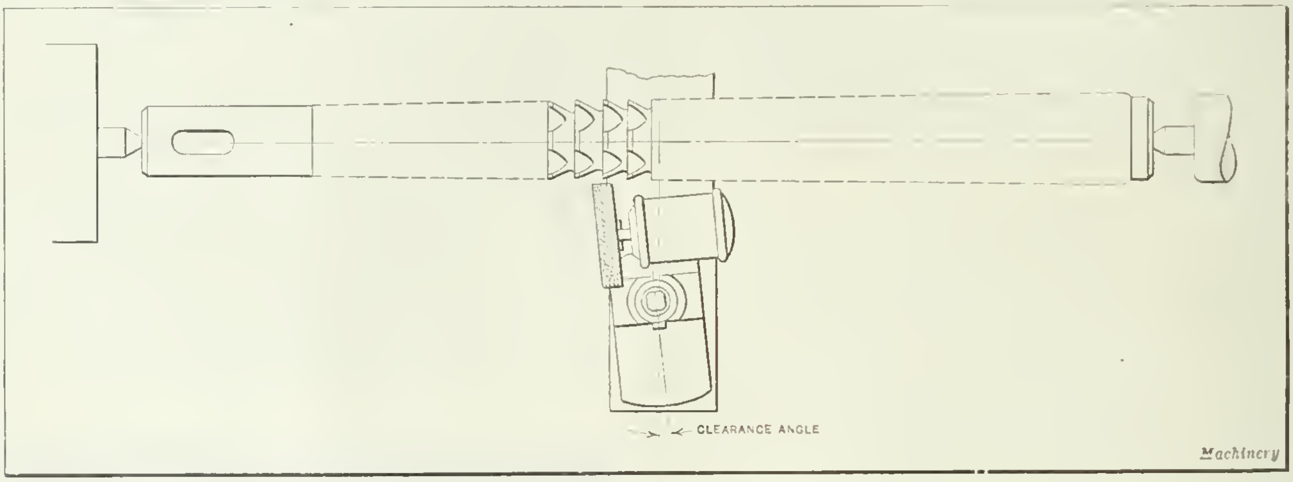


Fig. 2. Method of regrinding Tops of Worn Broach Teeth to Correct Clearance Angle

The broach teeth are worn down on the land at *A*, so that the original top clearance angle is destroyed. It is this land or top clearance that should be corrected in resharpening the broach. Ordinarily the teeth can be honed to an edge. If the land becomes too wide to permit the required clearance and edge to be readily obtained by honing, the following method may be used:

The broach is placed on lathe centers and the toolpost grinder mounted at right angles to the broach. The wheel is dressed straight across. The compound rest is then swung to the required angle, as shown in Fig. 2, the usual practice being to make the clearance angle from 1½ to 2 degrees. The compound rest is next fed in by hand until the wheel touches the high point of the tooth, after which the broach is rotated on the centers by hand, and the wheel fed in until the tooth is properly relieved. The ground teeth are finally smoothed up with an oilstone. All broaches run out or are distorted somewhat after being in use, due to the strains set up. The broach is corrected in this respect when sharpened with a toolpost grinder so that no straightening is necessary.

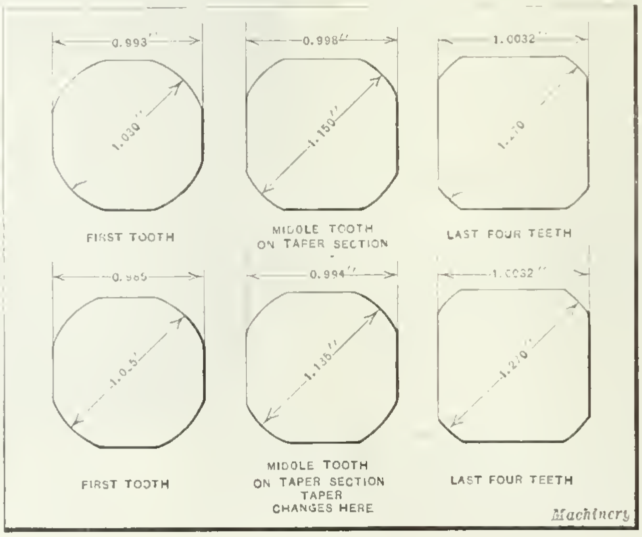


Fig. 3. Tooth Dimensions of 1-inch S. A. E. Broach before and after Grinding

The broach when received from the makers is usually proportioned as shown by the three views at the top of Fig. 3. There is a uniform taper on the corners and flats. The slight taper on the flats prevents undue drifting of the tool in the work. The advantage of a uniform taper is that such a design permits the broach to be readily retapered when necessary. Retapering is required as soon as the broach shows signs of excessive wear, which usually appears in the form of fine grooves on the teeth at the small or starting end of the broach. This is caused by the breaking down of the teeth at this point. There are two reasons why the teeth give way at this end: First, because of the greater width of the chip taken; second, because the broach is usually less hard at the starting end than at the finishing end. The greater hardness of the teeth at the finishing end results from the fact that the thinner and narrower teeth are cooled more quickly in the quenching operation of the hardening process.

In the retapering operation, the tool is straightened carefully so that it runs true within 0.008 inch to 0.010 inch. It is then retapered on a cylindrical grinding machine, and the teeth are relieved. Two tapers are introduced, the one from the starting end being less abrupt than the one at the finishing end. This is considered good practice, as the starting teeth are required to take a wider chip and consequently the depth of cut must be less. The broach is next retapered on the flats. This is done on a surface or planer type grinding machine, using a magnetic chuck. The broach is shimmed up to give the required taper, each side being ground separately. If a magnetic chuck is not available, a pair of dividing head centers may be used. In this case, the dividing head center is raised to provide the required taper. The flats are then relieved. The three upper views in Fig. 3 show a 1-inch S. A. E. broach of the permanent fit type. The three lower views show the dimensions of the same teeth after regrinding. When it is more generally known that a liberal amount of regrinding is possible on broaches of this type, they will be more popular as production tools.

* * *

LAPPING SNAP GAGES

By CLEVE E. LONG

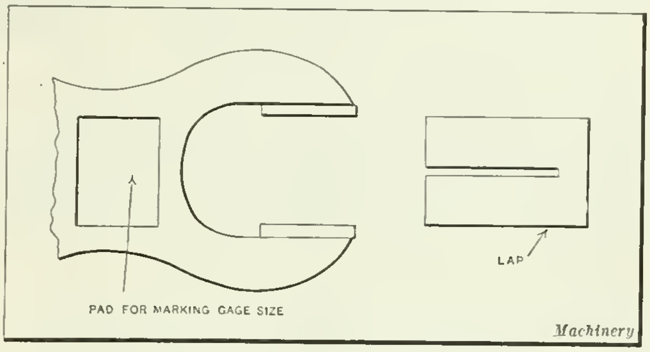
Various methods of lapping snap gages may be successfully employed. Many of the methods now in use, however, are comparatively inaccurate and needlessly expensive. It is the purpose of this article to describe a method that is so simple and reliable that it can be depended upon to give uniformly satisfactory results. The amount of stock to allow for lapping depends largely on the accuracy and quality of finish obtained by the grinding operation that precedes the lapping. Under favorable conditions 0.0003 inch should be a sufficient allowance, but the procedure would be the same regardless of the amount allowed.

As an example let it be assumed that a 1-inch gage with jaws approximately $\frac{3}{8}$ inch wide and $\frac{3}{4}$ inch long is to be lapped. The lap should be a gray iron block about $\frac{5}{8}$ inch wide and from $1\frac{1}{2}$ to 2 inches long. A slot should be cut in this block, as shown in the illustration, to allow the lapping surfaces to be sprung inward so that the lap may be entered or inserted between the surfaces to be lapped. The lap should be ground to within about 0.0002 inch of the exact size of the finished gage and then lapped to the exact size, after which abrasive or lapping dust should be rolled into the working surfaces until they become thoroughly charged. All the surplus or loose abrasive material should then be washed off with kerosene. Kerosene should also be used on the lap while rolling in the abrasive, as this aids in properly spreading and embedding the abrasive particles in the pores of the iron. A hardened roller or any convenient tool with a hardened smooth round surface can be used to press the particles of abrasive into the lap.

The slotted end of the lap is entered first between the gaging surfaces of the gage. The lap should then be moved to and fro in various directions until the amount necessary to bring the gage to the correct size has been lapped off. Usually it will be found that the gage is lapped to the desired size when the lap begins to pass freely through the gage due to the abrasive having become worn down. Thus it may be said that the lap, in a way, serves as a master gage or size block. It is very important that the lap be kept constantly wet with kerosene so that there will be no clogging of the cutting edges of the abrasive. This type of lap can be recharged as often as necessary. In the method described many gages can be lapped with the same block, because no loose particles of abrasive are allowed to remain on the lap which would wear or cut it down. This explains the necessity for washing the lap frequently with kerosene.

Less skill is required in using this method than in any other with which the writer is acquainted. With this method the surfaces of the gage can be made as smooth and as nearly parallel with each other as the surfaces on commercial gage-blocks of the most accurate type. Good workmen should be able to lap more than two dozen snap gages of the size referred to, in a day. A simple test for parallelism of the gaging surfaces is to insert a precision gage-block of the proper size between the jaws and swivel it with the fingers. If the jaws are not parallel and flat, the block will always swivel about its own center on the highest surfaces; but if the jaws are parallel and flat, the block will swivel centrally on the gaging surfaces.

The constant use of raw kerosene in lapping sometimes causes the skin on the fingers of the workman to become dry so that it will peel or crack. By adding a small amount of whale oil or some similar neutralizing oil, that trouble can be avoided.



Snap Gage and Lap used in lapping Gaging Surfaces

Sometimes a number of gages that have been lapped to exactly the desired size will be found to have changed in size by the time they reach the inspection room. The reason for this is that the gages have not been properly seasoned, even though they were apparently properly hardened and drawn. By proper seasoning, is meant the adjusting of the structure of the steel before and after hardening. All tool steel should be heat-treated immediately before hardening by heating it to about the proper hardening heat and allowing it to cool down to about 300 to 500 degrees F., then reheating to the proper hardening temperature, and quenching. The result of this adjusting of the structure of the steel is obvious, but too many workmen fail to recognize this important factor in hardening, which is necessary to relieve the strains that cause the warping and cracking of so many expensive tools.

If the gages are to hold their size under all conditions they should be seasoned, after hardening and drawing, by being subjected to a number of changes in temperature. The change in temperature should not be great enough to affect the temper of the tool, but should be sufficient to cause the tool to expand and contract as much as possible and as often as conditions and time permit. In this way the strain left by hardening will gradually be relieved before the finishing operation. Certain manufacturers of accurate angle-plates, surface plates, etc., take a roughing cut on their castings and then place them in the open where they are subjected to the action of the sun and rain for several months in order that the strains in the metal may be relieved. This method would also serve in the case of gages if time permitted.

Milling Pipe Threads

A Method of Producing Accurate Interchangeable Threads

By JOHN D. SPALDING, Engineer, Pittsburg, Pa.

THE production of accurate interchangeable threads is of great importance in the pipe manufacturing industry. Practically all pipe, as well as couplings, flanges, and valve fittings of various kinds, must be threaded. In the manufacture of oil-well supplies, accurate threads must also be cut on tool joints, drive shoes, packers, and similar equipment.

Accurate Pipe Threads Necessary

A pipe screw thread serves not only as a fastening but also as a seal or joint which must prevent leakage under any pressure that the pipe itself will withstand. This requirement alone demands an accurate thread. The solution of the manufacturing problem of producing interchangeable pipe threads is rendered more difficult by the fact that practically all pipe threading must be done without a coordinated system of gaging or inspecting, such as would be possible if all the parts to be assembled were threaded in one plant. The need for perfect interchangeability of all pipe threads can be appreciated in considering a large power-house construction job, where the pipe may have been made and threaded by one company, the valves and fittings by another company, and the pipe flanges by a third company.

At present, dies and taps are the universally accepted standard tools for threading pipe. The development and refinement of this type of equipment has resulted from the need for intensive production, and the introduction of automatic screw machines and turret lathes unquestionably accelerated developments in the design and manufacture of thread-cutting dies.

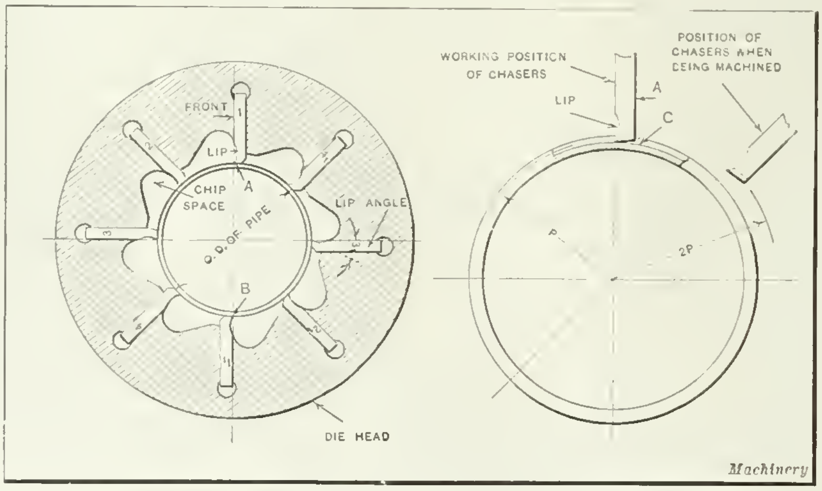


Fig. 1. Diagram illustrating Application of Chasers to Pipe Threading

The basic principle of all pipe threading by means of a die is illustrated diagrammatically in Fig. 1. Each blade or chaser of a die is essentially a lathe tool, as will be evident by referring to the side view of a chaser shown at *A*. As many chips are taken by a chaser as it has teeth engaged in cutting the metal. Pressure is constantly exerted against each blade, not only in the direction opposite that of rotation, but also in the direction of the feeding movement. The result is that the chaser breaks the chips into a number of layers or laminations. This breaking up of the chips is a source of heat generation, and unless a stream of lubricant or coolant is delivered to the work under pressure, considerable trouble from overheating is likely to occur.

The continuous cutting action of the chaser is confined largely to the first two or three teeth, so that the other teeth serve mainly to clean up the sides of the groove formed by the first teeth. Even with a die of the most improved design, it is evident that the cutting speed is limited by the amount of heat generated; but with a properly designed die, operated at the correct speed, and with a good supply of lubricant, a good thread is obtained.

Cutting Pipe Threads by the Milling Process

The art of milling a thread has long been known, but only recently have efforts been made to develop a machine especially for pipe thread milling. In view of the fact that thread milling is a comparatively new development, a brief description of the principles involved will be given. To the writer's knowledge the largest thread milling machine that has yet been placed on the market is shown in Figs. 2 and 3. This machine was designed under the direction of P. W. Martin, chief engineer of the Smalley-General Co., Bay City, Mich., and the writer, who was at the time chief drafts-

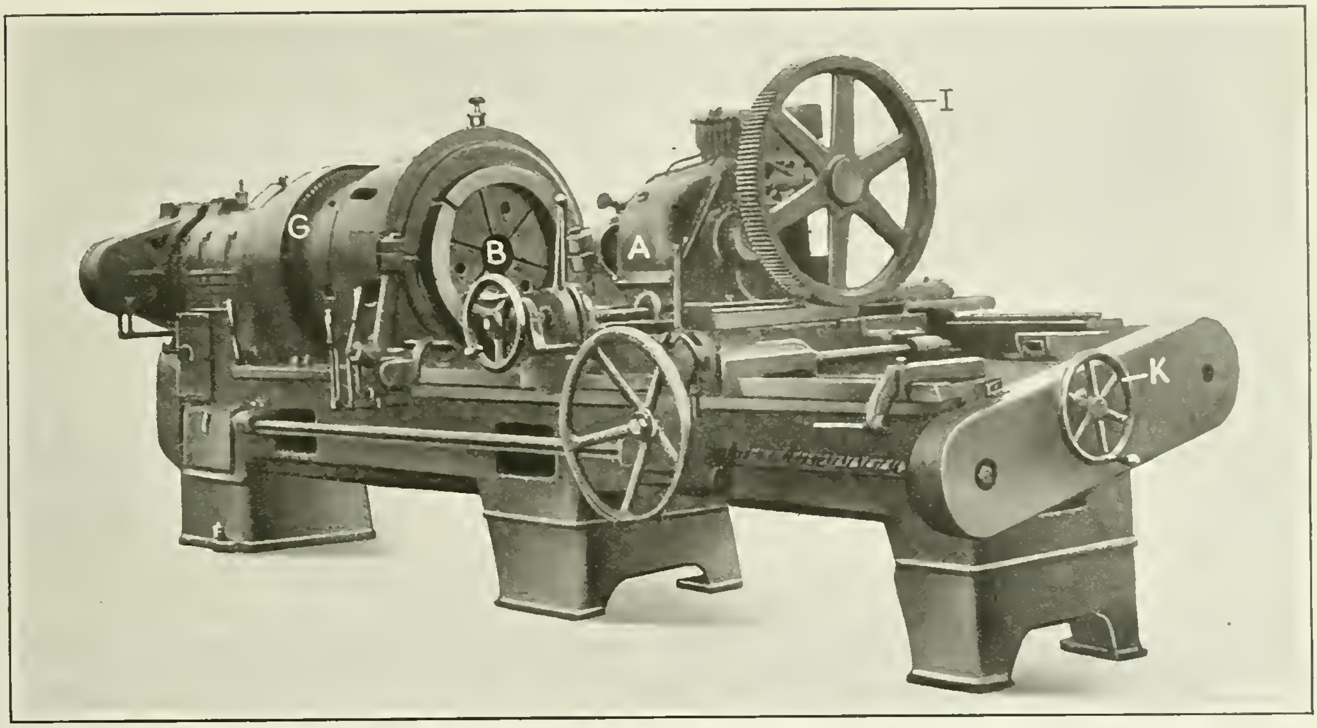


Fig. 2. Thread Milling Machine designed for threading Pipe of Any Length and Any Size up to 10 Inches in Diameter

man of that company. This machine was not designed for pipe threading exclusively, but was intended to handle the general class of heavy work encountered in the oil-well supply industry.

Machine for Milling Pipe Threads

The machine shown in Figs. 2 and 3 is similar in appearance to a heavy-duty lathe except for the milling head *A*. It consists of two basic elements, namely, a power-driven spindle with a chuck *B* for gripping and rotating the work, and a separate power-driven milling spindle *C*, in which is fixed the cutting tool or hob. The chuck is bolted to the flange of the spindle *D*, the free end running in a steadyrest or front bearing. The chuck consists of a sliding collet operated pneumatically by double-acting cylinders, the position of which is indicated at *E*, Fig. 3.

The longitudinal movement of the collet is obtained through a ball-bearing equipped yoke *F*, which transmits the motion of the air cylinder pistons to a draw-pipe, screwed into the spider of the collet. With this arrangement, it is possible to insert the pipe through the rear end of the machine and so handle work of any length. The chuck is capable of taking any length of pipe and all sizes up to 10 inches in diameter, the various diameters being provided for by using stationary collets bored out to the required sizes.

The machine is completely motor-driven. One motor drives the chuck through a series of reduction gears to the herringbone gear *G* on the chuck body. The other motor is mounted on the milling head *A* and drives the gear *I* which, in turn, rotates the milling spindle *C*, in which is mounted the hob. The motors are not shown in the illustrations. The milling head *A* is mounted on a carriage *J*, which has a longitudinal

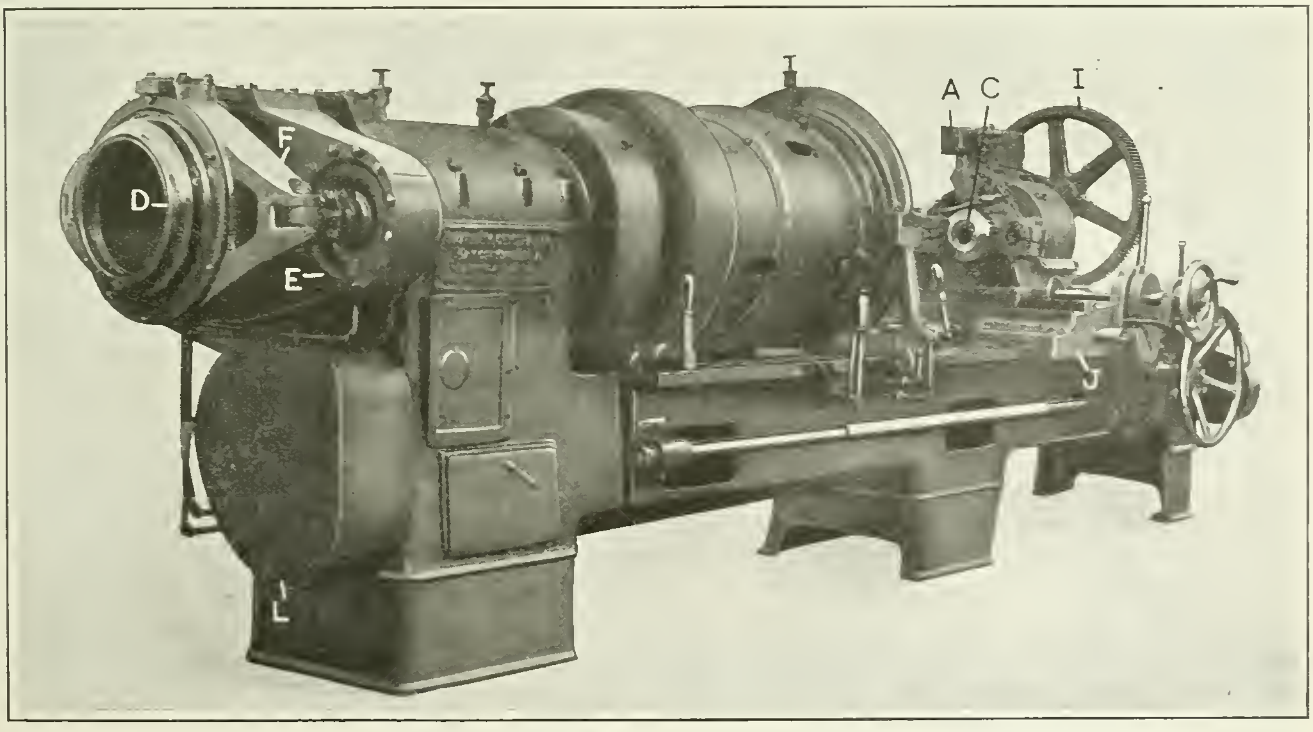


Fig. 3. View of Pipe Threading Machine showing Position of Air Cylinders E that operate the Chuck

movement with respect to the axis of the machine spindle. The cross-travel adjustment of the milling head which determines the depth of the threading cut is effected by a feed-screw with a graduated dial.

The longitudinal movement of the carriage is obtained by a mechanism similar to that used on lathes. The lead-screw *K* is connected through a set of change-gears (contained in housing *L*) to the main spindle *D*. Instead of the usual split nut arrangement, a patented clamp tube is employed on the lead-screw, at one end of which is a nut which engages the lead-screw thread. When no thread is being milled, the tube rotates with the lead-screw. At the instant that it is desired to start the milling operations on a thread, a lever on the carriage is moved, which causes a clamp to tighten around the tube, thereby preventing it from rotating and causing the lead-screw to impart movement to the carriage. A rapid traverse feature is incorporated in the machine so that the carriage may be quickly moved into place and returned to the inoperative position when the operator is putting in or taking out the work.

Types of Threading Hobs

The relative positions of the hob and the work in milling a pipe thread are indicated diagrammatically in Fig. 4. Hobs for milling different forms of threads are shown in the heading illustration. The hob shown at the extreme right-hand side is used for milling taps and die chasers. It will be noted that the teeth on this hob are staggered. This is common practice in making long hobs in which the torque in milling the thread would be too great if the regular full number of teeth were provided. With a hob of the staggered-tooth type, only half of the full-thread length cuts at one time; consequently, the torque is reduced by one half.

The tapered hob shown in the heading illustration is the type usually employed in threading tool joints. The 4-pitch tapered thread of the joint shown in Fig. 5 is milled by a hob of this type. The two hobs at the left-hand side of the heading illustration are used in cutting straight threads. The rows of teeth shown on these hobs do not form a helix as a screw thread does, but a series of parallel ridges having the same cross-sectional form or profile that the screw thread has. Hobs of this kind are made approximately ¼ inch longer than the longest thread to be milled. The hob is rigidly secured to an arbor which fits the milling spindle *C*, Fig. 3. The pipe is inserted in the chuck through the rear end of the main spindle, a sufficient length being left projecting to allow the thread to be milled.

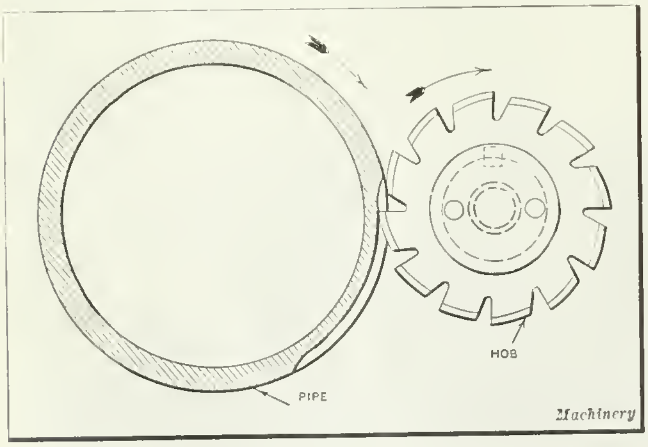


Fig. 4. Diagram illustrating Action of Thread-milling Hob

Thread Cut in One Revolution of Work

As previously described, the main spindle *D*, Fig. 3, which rotates the pipe during the threading operation, is connected through a set of gears to a lead-screw, which gives a longitudinal movement to the carriage and milling head. It is evident, then, that with the proper gear ratio, a longitudinal movement of the hob is obtained in one revolution of the work which is equal to the pitch of the thread. Hence, by having a hob equal to the length of the thread to be milled it is possible to produce a complete length of thread in one revolution of the pipe.

This can be readily understood by considering the construction of the hob, together with its feeding movement. At the end of one complete revolution, the thread is carried around the pipe, the portion starting from any one of the initial grooves ending at the point that was the beginning of the adjacent groove. Having considered the functional relationship of the several parts, let us refer again to Fig. 4.

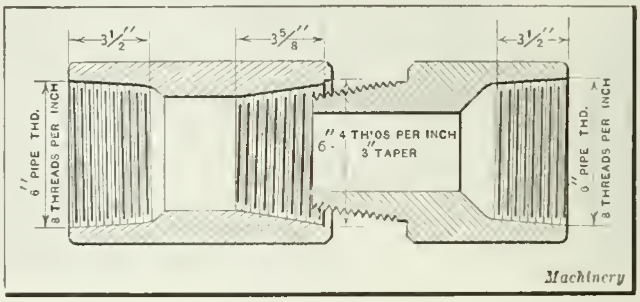


Fig. 5. Example of Work handled by Thread Milling Machine

The hob or cutter, being comparable to a cylinder of revolution, has a number of cutting teeth that successively come in contact with the pipe which is also rotated. Owing to the rotation of the hob, each tooth removes a chip as it comes in contact with the pipe. This intermittent contacting of teeth with the pipe is one of the advantages of thread milling, as the individual cutting teeth stay in the work for only a relatively short time, and then rotate through the air or stream of coolant, thus permitting the heat generated by cutting to be carried off or radiated.

Accuracy of Milled Threads

Milled pipe threads are very accurate with respect to pitch and taper. The hobs are generally made with a maximum lead tolerance of 0.0025 to 0.003 inch in a length of 1½ inches. On an 8-pitch thread this would amount to about 0.00025 inch per tooth. The lead-screw which gives the hob its required longitudinal traverse is usually of 4 pitch, or in other words, a half-revolution of the lead-screw is all that is required in milling a complete length of an 8-pitch thread.

With a possible variation of 0.025 inch in the pitch of a lead-screw in one foot, the error in lead in a half revolution would be 0.00026 inch. The taper of the hob corresponds to the taper of the work. A taper attachment of the type commonly used on lathes is provided to give the required transverse movement to the hob as it is advanced by the lead-screw. In this manner the cutting side of the hob is given a motion parallel to the thread being cut on the pipe.

The diameter of the thread is accurately maintained, as the cutter or hob is brought to the same position for every thread that is cut, due allowance being made for the wear on the hob teeth. The quality of finish obtained by milling is very satisfactory, and many tool manufacturers are now employing the thread milling process in the production of dies, taps and thread gages.

These thread milling machines can be operated by unskilled workmen, and in many instances one workman can attend to three machines. A hob is a complete threading tool. All its parts are integral, and it can be easily removed from the milling machine to permit resharpening. While one hob is being sharpened, another can be employed in its place, thereby delaying production only two or three minutes. When the hob is sent to the tool-room for resharpening, no disassembling or adjusting operations are required. A dull hob is placed on an arbor, and a grinding wheel brought in contact with the face of each row of teeth in the resharpening operation.

If a hob is of sufficient length to mill a thread on a 20-inch pipe, it may be used to thread every size of pipe below 20 inches down to pipe 2½ inches in diameter. Therefore, for any given pitch and taper of thread, it is immaterial what the diameter of the work is, so long as the hob for that particular pitch and taper is long enough to mill the longest thread required. Of course, in practice, it would be impracticable to use a hob 3 inches long to mill a thread that is only 1 inch long. In a pipe mill it would require only three or four sets of hobs to mill all pipe threads from 2½ inches up to 20 inches.

Several of the large pipe manufacturers employ thread milling machines for producing pipe thread dies and taps. In a certain plant it took an expert lathe hand approximately one day to complete a set of twelve chasers of a certain size. The time for making the chasers in a thread milling machine was found to be one-half hour or less. A special jig was made for holding the chasers, which was designed to hold twenty-four chasers, so that two sets were made in one set-up. Thus the production time was reduced to fifteen minutes per set of twelve chasers.

Proposed Method of Milling Thread Chasers

A novel application of thread milling to the manufacture of threading dies was recently suggested by Mr. Martin, chief engineer of the Smalley-General Co. One of the difficult manufacturing problems on small pipe dies with inserted chasers is that of properly machining and relieving the chasers. The difficulty is due principally to the limited working space available. It would, of course, be practically impossible to use a hob in milling a ½-inch pipe thread die by the usual method.

In order to overcome this drawback, a jig was designed to accommodate several sets of chasers. The chasers are machined in one revolution of the jig with a hob of some practical size. The lead or helix angle of a chaser is different for every diameter of pipe, and it is necessary that the helix angle be accurately maintained in milling chaser threads; a clearance such as shown diagrammatically at *C*, Fig. 1, must also be produced. In order to illustrate the proposed method of milling chasers for small pipe, let it be assumed that a jig is to be designed to accommodate two sets of chasers, each set consisting of four chasers. The die-head shown in Fig. 1 will serve to illustrate the general design of the fixture and the principle on which it operates.

In order to arrange two sets of chasers in a circle and yet maintain the original circumferential distance between the chasers on the pitch line of the teeth, it is necessary for the circle to have a pitch diameter that is twice as large as the pitch diameter of the thread the chasers are to cut. The reason for this arrangement of the chasers will be clear by referring to the diagrammatic view of the die-head shown in Fig. 1. It will be noted that the two chasers 1 and 1_1 are located diametrically opposite, as are also the three pairs of chasers 2 and 2_1, 3 and 3_1 and 4 and 4_1. Now while the spacing between a pair of chasers is equal to a half circumference, the circumferential distance from point *A* to point *B* is the same as the complete pitch circumference of the thread the chasers are to cut.

In order to obtain the proper pitch and angle of thread on each of the chasers, the hob is advanced a distance equal to the pitch of the thread while the fixture is rotated through one-half a revolution. Hence, for this particular fixture, the hob will advance a distance equal to twice the required pitch in one revolution. Thus the advance of the lead-screw in one revolution of the fixture is equal to the number of sets of chasers to be milled times the pitch of the thread, when the chasers are arranged in the fixture as shown. From the preceding description it will be clear that the threads milled on the chasers 1 and 1_1 are identical.

Each pair of chasers, as for instance the pair numbered 4 and 4_1, are also alike, so that we have two complete sets of chasers, consisting of four chasers each. Of course, the chasers are not arranged in the fixture with the cutting face on a radial line as shown in Fig. 1, but are located at a slight angle in order to produce the required clearance. Another method of producing the clearance would be to use a relieving attachment, such as that employed on a lathe. In the latter case, the faces of the chasers would be located on radial lines as shown. The writer does not know whether the method just described has been tried out, but it has been approved by several die manufacturers.

Thread-milling Oil Well Equipment

A typical threading job done by thread milling machines in the plant of a manufacturer of oil well supplies is illustrated in Fig. 5. It will be noted that two 6-inch pipe threads are specified on this tool joint. The floor-to-floor time required in milling these threads in 0.40 carbon steel is approximately seven minutes. The time required for milling the 4-pitch tapered thread (either internal or external) is from seven to eight minutes. To the writer's knowledge one company in the Pittsburg district is thread milling 6-inch pipe threads in tool joints of 0.20 per cent carbon steel and producing forty-five threads a day. Previous to the introduction of thread milling in this particular plant, when a lathe was used, only from nine to eleven threads were produced in a day.

Proposed Improvements in Pipe Threading Machine

A few engineers experienced in the design of the larger types of thread milling machines have given some attention to the development of a more advanced type of machine which will meet especially the requirements of a pipe mill. These plans call for two adjustable milling heads designed to thread both ends of a pipe simultaneously. All the additional tooling for cutting off the pipe to length, and chamfering the end while the thread is being milled could be incorporated in the new machine. It will be remembered from the foregoing explanation of thread milling practice that the pipe thread is completed in one revolution of the pipe. Therefore, it would be possible to mill the thread and chamfer the inside edge of each end of the pipe in one revolution of the machine spindle.

Some interesting tests were recently made at a large steel plant with the object of comparing the accuracy obtained by thread milling with that obtained by threading on a lathe. The tests were made on pipe of 0.40 per cent carbon which was upset for a length of 8 inches to a thickness of ½ inch. With the thread-milled pipe, the work could be held to a tolerance of plus or minus ¼ turn of the gage instead of one complete turn, as ordinarily allowed.

* * *

MEETING OF AMERICAN SOCIETY FOR TESTING MATERIALS

The twenty-sixth annual meeting of the American Society for Testing Materials will be held at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., during the week beginning June 25. The discussion begun at the annual meeting in 1922 on the fatigue of metals will be continued through the presentation of papers giving important new data. Several papers on testing apparatus are in prospect, including a description of a device for the accurate measurement of impact force. The new plan of distributing preprints of reports and papers to the members will be put into effect.

* * *

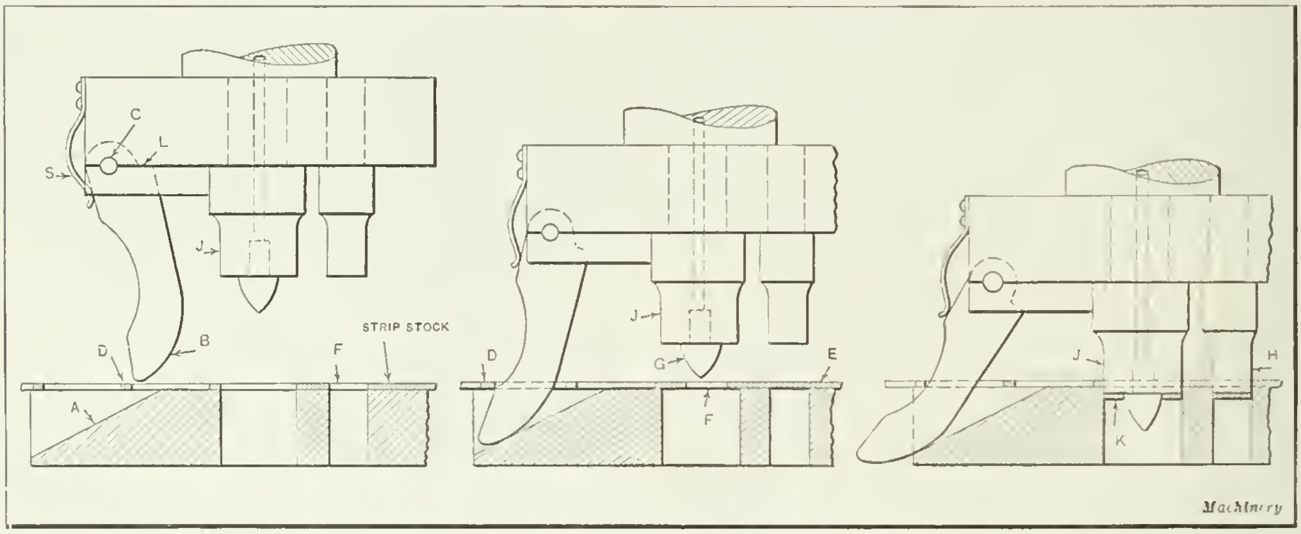
An International Air Congress will be held in London from June 25 to June 30, the object of the congress being to discuss the various problems connected with aircraft design, construction, and operation. Papers will be divided into four groups, dealing with different phases of the subject. Those visiting the congress will also have an opportunity to visit various British aircraft factories. Further information may be obtained from the general secretary, Lieutenant-Colonel W. Lockwood Marsh, 7 Albemarle St., W.1, London.

AUTOMATIC PIERCING AND BLANKING DIE FOR WASHERS

By G. R. SMITH

A progressive type of piercing and blanking die was described in November MACHINERY on page 223. The same type of die equipped with an automatic feeding device is shown diagrammatically in the illustration. This type of die can be operated automatically in a single-action press such as the Bliss No. 20 or 21. The writer believes that the die described in November MACHINERY could be readily equipped with an automatic feeding device similar to the one here shown. The illustration is intended to show the action of the feeding device, and does not represent the actual construction of the die. While this style of die is primarily intended for use in the manufacture of washers, it can also be adapted to the manufacture of various kinds of small blanks, rings, cups, etc.

The feeding device is very simple, and may be made as sturdy and strong as the work requires. It can be used on follow-dies designed to pierce and blank two, four, six, or eight washers simultaneously, or for dies designed to blank only one piece at a time, as in the case shown. Either strip or coil stock can be used. In equipping a die with this automatic feeding device, it is necessary to cut or mill a slot at an angle in the blanking end of the die, as indicated at *A*. On the down stroke of the press ram the feed-finger *B* on the punch engages the bottom of this slot, thus causing the finger to pivot about pin *C* in a clockwise direction.



Diagrams illustrating the Action of an Automatic Feeding Device for a Follow-die

The pivoting movement imparted to the feed-finger causes the front face of this member to come in contact with the bridge section *D* of the blank stock, so that the stock is fed forward into the position indicated at *E* in the central view. This brings the pierced hole *F* in the strip stock under the pilot *G* of the blanking punch. As the punch continues its downward movement, hole *F* is brought into alignment with the blanking punch *J* by pilot *G*. The view at the extreme right-hand side of the illustration shows the punch at the end of the downward stroke, at which time piercing punch *H* has pierced the central hole of another washer, and blanking punch *J* has blanked the washer *K* that was pierced on the preceding down stroke of the punch. It will be noted that the feed-finger is cut away at the front so that it will clear the bridge *D* as soon as it has advanced the stock far enough to permit pilot *G* to engage the pierced hole *F*.

The location of the feeding finger and its shape and length, as well as the angle and position of the bottom of the slot *A* in the die, must be carefully determined in order to provide the required feeding movement and insure the proper functioning of the feeding device. As the illustration is intended only to show the principle on which the feeding device operates, the actual design of the die parts may require some modification, to obtain the best results.

It will be noticed that the top of the feeding finger has a shoulder at *L*. The pivoting movement of the feeding finger in a counter-clockwise direction on the upward stroke of the ram is produced by a spring *S*. The shoulder at *L* limits the movement in this direction, so that when the punch is at the highest point of its travel, the feeding finger will be in the position shown in the view at the left-hand side of the illustration. In starting the press, one end of the strip or coil stock is placed under the piercing punch, and the center hole of the first washer is punched. The stock is then moved forward until the center hole is located under the blanking punch, in line with the pilot *G*. After the first washer is blanked, the stock is advanced so that the blanked hole in the stock is directly under the feeding finger. The press is then set for continuous operation, and the feeding finger automatically advances the stock at each stroke of the press.

* * *

PREVENTING STEEL FROM WARPING DURING THE HARDENING PROCESS

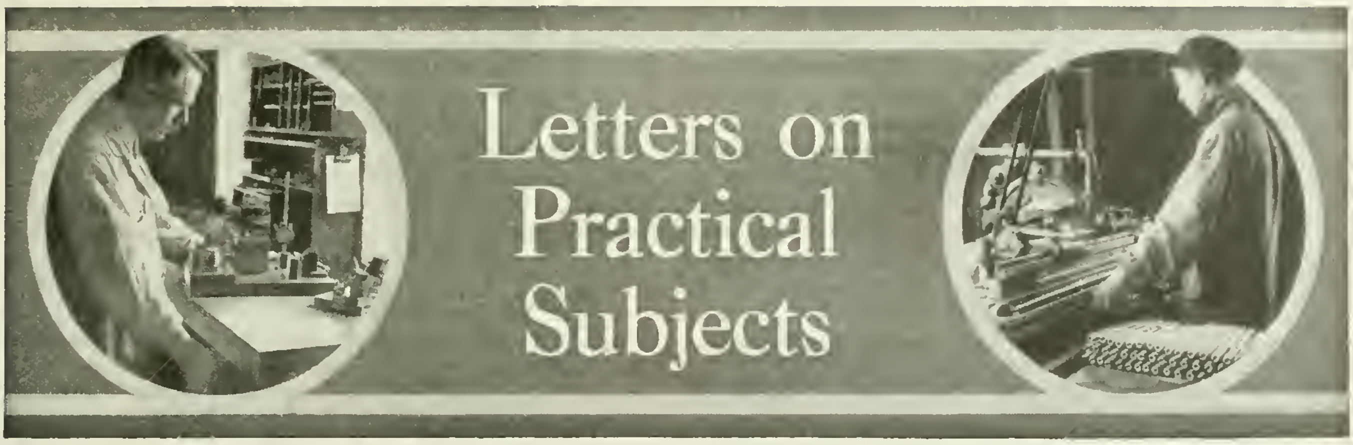
By J. H. BEEBEE

Difficulties in preventing steel pieces from being distorted or warped during the hardening operation were overcome by the writer in the following manner: The piece was first heated to a cherry red and allowed to cool in the air. It was then heated to the point of decalescence, and plunged into the hardening bath. Apparently, after the metal has been forged or machined, there are molecular strains in the steel which are removed to a great extent by the initial heating and cooling.

The writer has found that some practical machinists and graduates of technical schools are not familiar with this method of preventing warpage in hardening steel pieces. When the method described was used in hardening a mandrel 8 inches long having a diameter of ½ inch at one end and a diameter of 3/16 inch at the other, it was found that the piece was not more than 0.002 inch out of true after the hardening operation.

* * *

The industrial importance of Sweden and Norway depends largely upon the abundant water power in both countries. In Sweden there is over 6,000,000 horsepower available, of which only 20 per cent has been made use of. In Norway there is over 12,000,000 horsepower available, of which only 10 per cent is being used. Important railway electrifications are under way and plans are also being made for the "exportation" of electrical energy from both Norway and Sweden to Denmark.



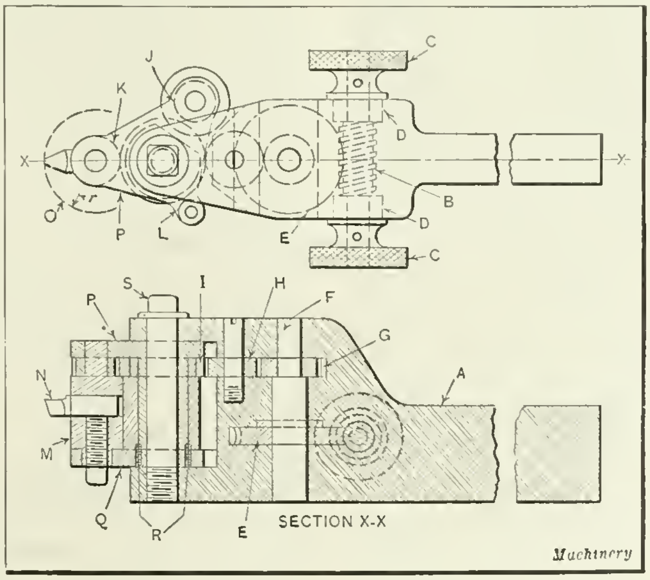
RADIUS-TURNING TOOL

The tool shown in the accompanying illustration is designed for radius-turning operations on a lathe, or radius-grooving operations on a shaper. It has a capacity for turning radii from 5/32 inch to 1½ inches and over. Provision is made for using three sizes of tool bits. When desired, the holder can be used on a surface grinder for forming or cupping out the periphery of the grinding wheel, by inserting a truing diamond in the tool-bit holder. The tool is fed through a worm and worm-wheel, in combination with spur gears. This arrangement gives a uniform feeding movement, and prevents the tool from jumping or digging in. The type of radius-turning tool shown is particularly well adapted for use in making forming cutters, as it can be adjusted to take as fine cuts as desired.

The holder *A* is made of machine steel, and is finished all over. A steel worm *B*, which can be rotated by turning one of the knurled nuts *C*, is mounted in cold-rolled steel bushings *D*. Worm *B* meshes with a bronze worm-wheel *E* on shaft *F*. A spur gear *G*, also mounted on shaft *F*, meshes with an idler gear *H*. This gear drives gear *I*, which, in turn, meshes with three other gears, *J*, *K*, and *L*. Each of the latter gears is mounted on a tool-bit holder. As shown in the illustration, gear *K* is mounted on the tool-bit holder *M*. It is apparent that by turning the knurled-head screws *C*, holder *M* will be revolved about its vertical axis, so that the point of the cutter *N* will turn the work to the curve indicated by the dotted line at *O*, or in other words, to the radius *r*. For turning smaller radii, the tool-bit holder on which gear *L* is mounted is brought into the position occupied by tool-holder *M*, and for larger radii the holder on which gear *J* is mounted is brought into position.

Each tool-head is bored to hold a different sized tool bit. In the case of the radius-turning tool shown, the small tool-bit holder takes a 5/32-inch round bit, the next larger holder *M*, a ¼-inch bit, and the largest holder, a ⅜-inch bit. The tool can, of course, be made any size. The tool-bit holders are held in a member made up of the two parts *P* and *Q*, the shank of part *P* being pressed into the hole in the shank of part *Q* and held in place by small screws *R*. The tool-head holding members *P* and *Q* can be swiveled to any desired position and can be locked in place by tightening screw *S*.

William A. LaPointe
Pittsfield, Mass.



Radius-turning Tool designed for Use in the Lathe

DRILLING, BORING AND REAMING FIXTURE FOR WATCH PLATES

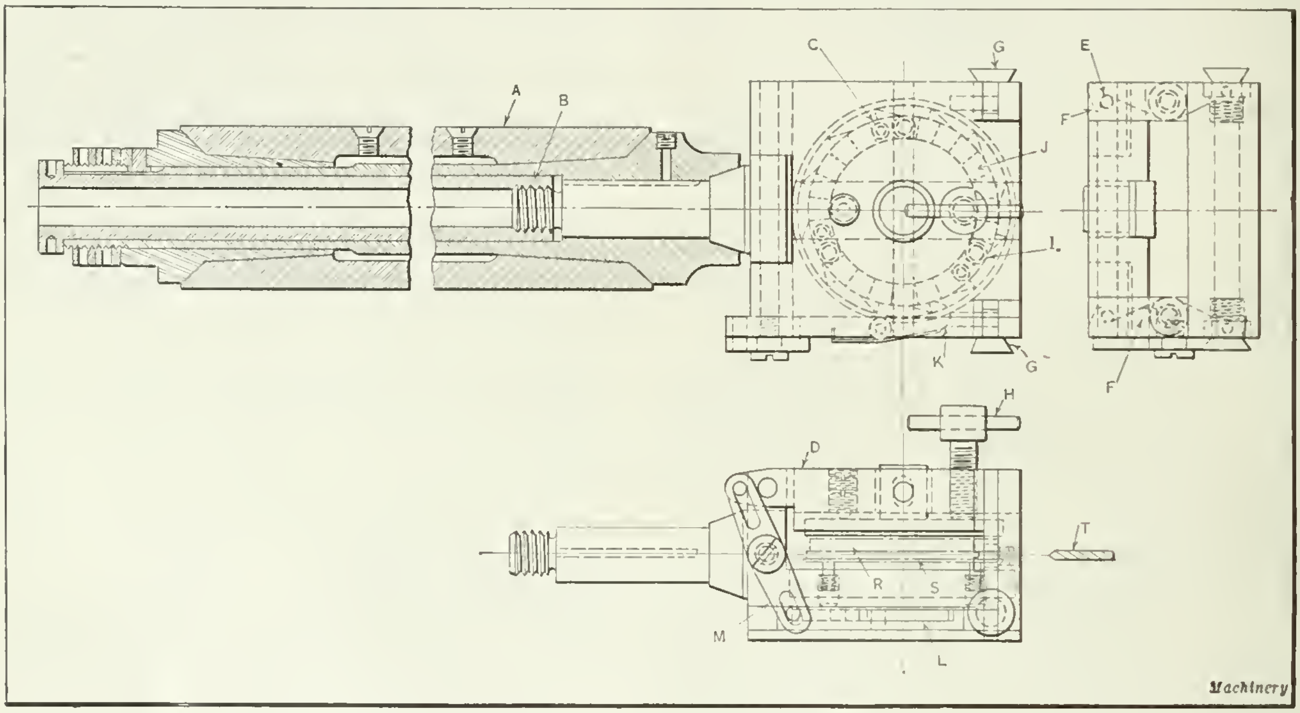
The production of pieces requiring a high degree of accuracy necessitates the use of accurate jigs, fixtures, and special tool equipment. A fixture designed for this class of work is shown in the accompanying illustration. This is used in machining the winding stem bearing in the plates of a watch. The construction of the watch was such that a part of the stem hole was cut out of the upper plate as well as the lower plate, although the center line of the hole did not coincide with the division line between the two plates. This feature made it advisable to machine the hole with the two plates assembled in the fixture in their proper relative positions, as shown by the dot-and-dash lines at *R* and *S*.

The stem bearing consisted of a hole 0.110 inch in diameter by about 0.30 inch deep, and a hole of 0.024 inch diameter which started at the bottom of the large hole and extended further into the lower plate to a depth of 0.10 inch. In drilling the 0.110-inch hole, metal was removed from both the upper and lower plate for a depth of 0.090 inch, but for the remainder of the distance (0.210 inch), the upper plate only was drilled, as there was a slot in the lower plate at this point.

Drilling and reaming the hole was unsatisfactory, as the drill would run out of alignment after cutting through the solid part, and the reamer, which was of the floating type, would not correct the error. For this reason, the large hole, after being drilled by drill *T*, was bored to size and reamed, after which the small hole was drilled. The tools for these operations were carried in a revolving turret in the tailstock, both the drills and the work being revolved, but in opposite directions, in order to produce the proper cutting speed. To obtain the required degree of accuracy with respect to the position of the hole, diameter, alignment, etc., the fixture was mounted in a holder and held securely in place by a draw-in tube *B*.

A floating drive was provided for the holder in order to prevent the side pull of the belt on the driven pulley from changing the axis of rotation of the holder. The proper location of the stem hole in the watch plates with respect to the bottom side of the lower plate, was controlled by stop-pins set in the base of the fixture, while the relation of the stem hole to the other holes in the plates was determined by three pins *C* which enter working holes provided in the lower plate for this purpose. These working holes were also utilized as locating points on all previous and subsequent operations on the watch plates.

Before placing the work in the jig, the two watch plates are assembled by engaging the dowel-pins on one plate in the dowel-holes of the other. The assembled plates are then placed in the fixture on the three locating pins *C*, after which the leaf *D* is closed, so that the two pins *E* are locked under the overhanging catch of the two releasing levers *F*. Levers *F* are automatically pushed outward when the leaf is closed, by the pins *E* coming in contact with the upper inclined surfaces of the levers. In opening leaf *D*, the operator's thumb and forefinger engage the two buttons *G* at the lower end of levers *F*, and by pressing these together pins *E* are released so that the leaf can be raised. After the leaf is closed, the binding screw *H* is brought into action so that the parts are securely located in the fixture. The work is then drilled, bored, and reamed.



Drilling, Boring, and Reaming Fixture used in machining Winding Stem Bearing of Watch

In opening the jig to remove the parts, the three ejecting pins *I*, adjacent to the locating pins *C*, push or strip the work from the locating pins. The ejecting pins are engaged by a circular cam-ring *J* in the base of the fixture, which, in turn, is operated by a pawl *K* carried by a slide *L*, which is also located in the base of the fixture. The link *M* connects slide *L* with the leaf of the fixture at such an angle that the leaf can be raised a considerable distance from the work before the cam-ring starts to operate the ejecting pins.

By the time the leaf has been opened the full distance, the ejecting pins have completed the ejection of the work and have dropped back into the next depression in the cam-ring. This action leaves the fixture free for loading without interference from the ejecting pins. The heads of these pins also act as a locking device, preventing the camplate from turning when the leaf is closed. This allows the pawl on the slide *L* to ride up over one tooth on the cam-ring and come in the correct position for the ejection of the next piece. The cam-ring therefore travels only in a clockwise direction.

In a fixture of this type, which is rotated at a speed of 3500 revolutions per minute, precautions must be taken to insure dynamic balance and to prevent the parts from being distorted through the action of centrifugal force. On account of the large amount of overhang of the fixture, it was decided to make the body of tool steel. The body was hardened, tempered, and ground to exact dimensions, so that any distortion that took place in the hardening and tempering operations was corrected. The fixture was also subjected to a hot and cold water seasoning for a period of forty-eight hours in order to prevent distortion as the fixture aged. Approximately 1,250,000 pair of watch plates have been bored in a fixture of the design shown up to the present time.
B. G. C.

INSPECTION OF RAW MATERIALS

The writer has visited many plants in which the scrap pile was loaded up with material that could either have been saved or else never put into production. In nearly all cases, work has been performed on the scrapped pieces, and they therefore represent a labor loss, as well as a loss in material. One of the many duties of a works laboratory is to act as an impartial judge in shop disputes arising over material that is spoiled in process, or that will not conform to requirements. The laboratory should gather data, determine the cause of the trouble, and recommend changes that will prevent its recurrence. These shop troubles are often very costly, and should be carefully investigated so that they may not happen a second time. If a works laboratory did nothing more than straighten out shop troubles of this nature, it would be a paying proposition in many plants.

The acceptance of raw materials that do not meet specifications is a source of unnecessary expense or loss to many manufacturers. In fact, the financial failure of a firm engaged in the manufacture of automobile transmission units was directly traceable to the continued acceptance of material that did not meet specifications. For instance, the specifications for the countershaft gear used in this company's product called for steel having a carbon content of from 0.10 to 0.20 per cent, with 3½ per cent nickel. The heat-treatment for steel of this analysis had been carefully worked out, and a steel of a different analysis could not possibly meet requirements if given the regular heat-treatment. The steel used for these gears was obtained in the form of forgings that were supplied by a nearby shop.

When it was found that many of the gears failed on the block test and even out on the road, an investigation was made. This showed that the gears that failed were made from high-carbon steel with no nickel content. Many of the gears cracked during the forging operation due to the high carbon content, and these cracks were not discovered before machining. After being machined, the heat-treating operations were carried out, causing further cracking of the forgings. As a result many extremely weak gears that soon failed were passed by the inspector. The heat-treatment department was held responsible for the failure of these gears, and much time and money were lost in trying to change the heat-treatment so as to eliminate the trouble.

After the presence of the high-carbon gears was discovered, it would have been a simple proposition to have applied a test to determine if each forging contained the required amount of nickel, but this plant had no works laboratory to initiate such a procedure, and so the program of scrapping gears that cost about $7 apiece continued. In a period of six months this firm put more material, by weight, on the scrap pile than it delivered to the shipping department in the form of finished products. As a result, the company soon became insolvent and passed into the hands of receivers.

A large number of the pieces scrapped were of steel in the form of stampings that failed in the drawing operations due to the fact that the steel was too hard to be drawn properly to the depth desired. Had there been a works laboratory engaged in testing the raw materials before acceptance, all material that was too hard for the required drawing operations, or otherwise unfit, would have been rejected and returned to the steel mill for credit.

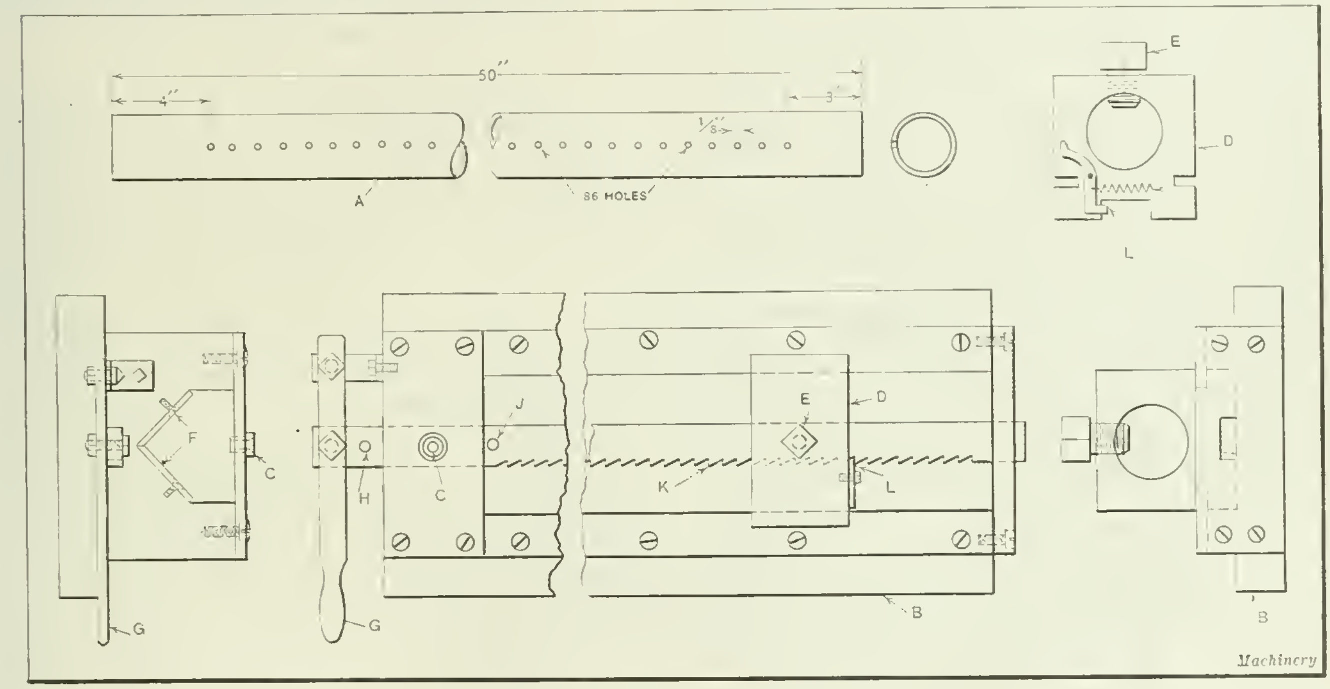
It is becoming more and more apparent to manufacturers that inspection of purchased material is necessary in order to avoid costly operations on material that will turn out to be worthless in the end. This is not because the seller intends to supply anything that is unfit for the particular purpose for which it is to be used, but because mistakes are likely to happen. In some cases, the seller may furnish material that he sincerely believes will meet requirements, but that may prove unsatisfactory because he has failed to consider or acquaint himself with every requirement of the purchaser.

Inspection of purchased materials may be made with definite ideas as to what may be accepted and what should be rejected, or it may be made to determine the analysis of the various materials tried out, with a view to determining which materials will give the best results, so that specifications for future orders may be intelligently written. The case of the firm mentioned is only one of many that could be cited to show the need for a works laboratory with a technical trained man in charge and sufficient equipment and help to provide for testing all raw materials that are required to be very close to certain specifications. The time is not far distant when a works laboratory will not be looked upon simply as an advertising point or something to be established when the surplus capital becomes too large, but will be considered just as essential as any production department.

Philadelphia, Pa. ARTHUR L. COLLINS

DRILL JIG FOR GAS-BURNER PIPE

The gas-burner pipe shown at *A* in the illustration is used to heat the shoe of an electrically driven automatic ironing machine. The iron pipe is 50 inches in length and is required to have eighty-six $\frac{1}{8}$-inch holes drilled in the side as shown. Previous to the development of the drill jig shown in the lower part of the illustration, these holes were drilled in the following manner: The pipe was clamped to a work-bench, and a prick-punch guide or templet with the required number of holes was set over it. Prick-punch marks were then made in the pipe to locate each of the eighty-six small holes. The next operation was the drilling of the holes. This required considerable time, as the pipe was set in a pair of V-blocks and had to be relocated to bring each hole or prick-punch mark into position for drilling. In order to save time on the operation, the drill jig shown in the lower views was designed



Jig used in drilling Evenly Spaced Holes in Gas-burner Pipe

In using the drill jig, base *B* is clamped to the table of the drill press so that the drill bushing *C* is in accurate alignment with the spindle of the machine. After the jig ation, the drill jig shown in the lower views was designed in the feed-block *D* by means of screw *E*. An end view of feed-block *D* is shown in the upper right-hand corner of the illustration. The end of the pipe opposite block *D* rests on the hardened plates *F*, which act as a V-block.

In performing the drilling operation, the operator keeps his left hand on the feed-lever *G*, while his right hand is used to feed the drill. The pipe is located for drilling the first hole, and after the first hole is drilled and the drill raised from contact with the work, feed-lever *G* is moved to the right until the stop *H* comes in contact with the base of the fixture. This motion moves the feed rack *K* to the right, causing the dog *L* to move outward and drop into the next tooth space.

The handle *G* is then returned to its original position so that the stop *J* comes in contact with the side of the base opposite stop *H*. The pipe is now in the correct position for drilling the second hole. This process of relocating and drilling is repeated until all the holes have been drilled. There is a little lost motion when this method of drilling is employed. The writer has seen one of the burner pipes finished in exactly three minutes eight seconds (floor-to-floor time). With the method formerly used, from thirteen to fifteen minutes was required to finish one pipe.

Cicero, Ill. JOHN BORKENHAGEN

CENTER-PUNCH LOCATING BLOCK

Ordinarily a machinist's scale and a pair of dividers are used in laying out tools and jigs when a fine degree of accuracy is not necessary. When greater accuracy is required, the button or disk method is commonly employed. All button or disk methods are necessarily slow, as there is a great deal of checking up between buttons, not to mention the time required in making the first rough lay-out and in drilling and tapping the screw holes for attaching the buttons or disks.

When accuracy is the prime object, time is a secondary consideration; nevertheless, the time consumed in locating buttons or disks enters largely into the cost of the finished product. In order to obtain greater speed in laying out accurate work, the writer designed the combination center-punch and locating block shown in Fig. 1. Those familiar with shop practice know that a center-punch mark can be indicated the same as a button. The usual objection to this method is the difficulty experienced in locating the center-punch marks accurately. The accuracy of all methods based on the location of lines, the crossing points of which are intended to determine the position of the holes, is impaired by the personal element. This element however is eliminated when blocks of the type shown are employed.

The construction of the combination center-punch and locating block is simple, the block proper being made of tool steel, hardened and ground. The hole for the punch is lapped to a gage fit on an accurately ground and lapped punch. The block is put on an arbor and ground true on the four sides and squared up on the bottom side. The round upper part is knurled to give a good grip for the fingers. The punch is of the best grade of tool steel, hardened, ground, and lapped. The point is ground concentric with the body and to an included angle of 60 degrees. The head end is beveled as shown, and is heat-treated or drawn to make it a little softer than the remainder of the punch.

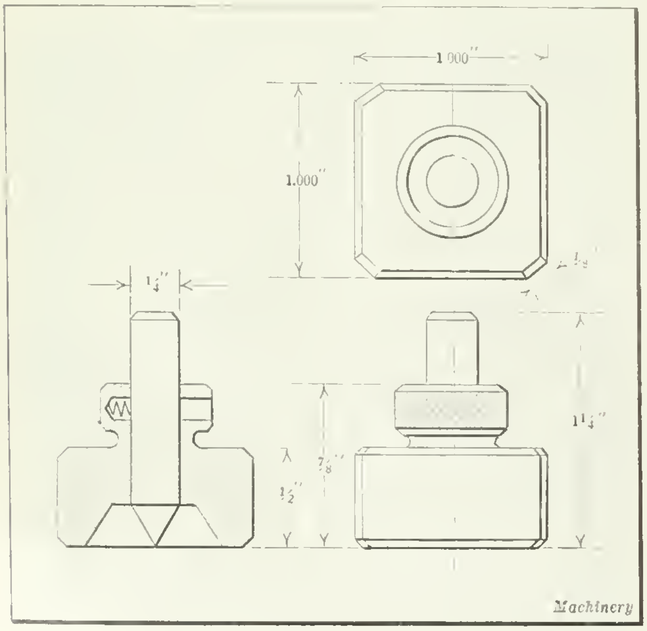


Fig. 1. Center-punch Locating Block

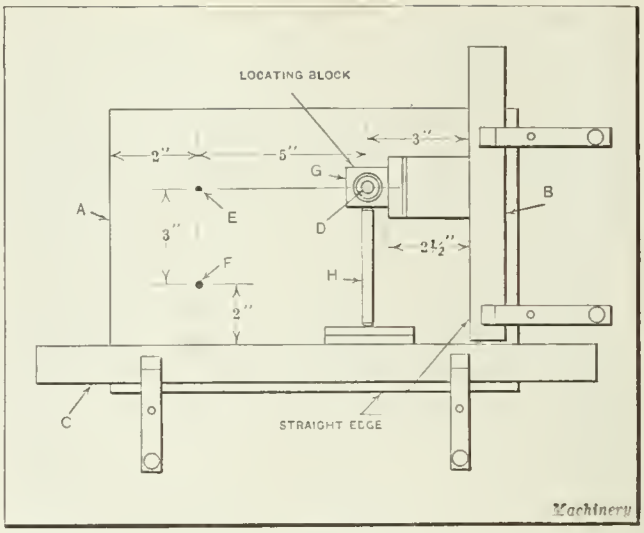


Fig. 2. Method of using Locating Block shown in Fig. 1

The combination punch and block can be employed in various ways. Referring to Fig. 2, *A* is an accurately surfaced plate on which two straightedges *B* and *C* are clamped. The straightedges are carefully located at right angles to each other and serve as gaging surfaces from which to locate prick-punch marks at *D*, *E*, and *F*. In this illustration the locating block and punch are shown at *G* in position for making the center-punch mark at *D*. The gage-blocks in contact with the inner surface of the straightedge *B* have a total thickness of 2½ inches and serve accurately to position the prick-punch mark 3 inches from the locating surface of straightedge *B*.

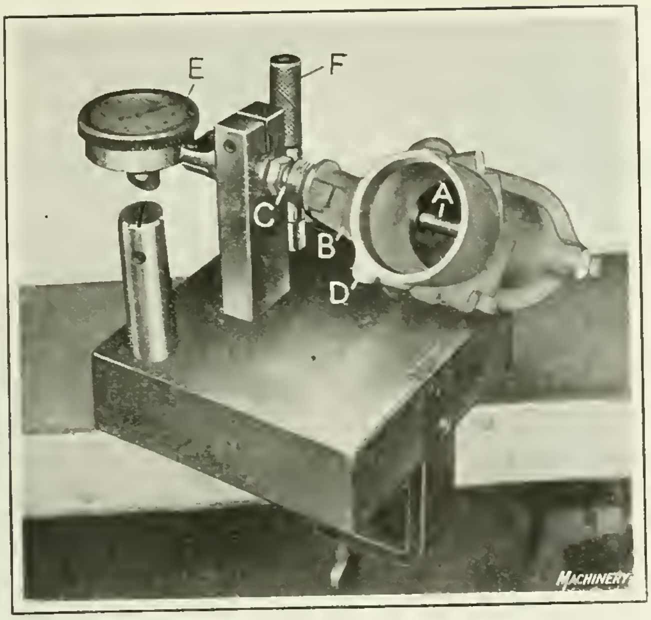
As shown, gage-blocks in combination with rod *H* locate the center of block *G* 3 inches above the center *F*. Centers *E* and *F* are located in a similar manner by the use of gage blocks and rods. In locating the block *G*, it is necessary that gage-blocks be used on one side in order that the block will be properly squared up or located parallel with the straightedges. For this reason pins such as shown at *H* can be used only on one side of the punch locating block. When the gage-blocks and the locating block have been set to the proper position, a light pressure is brought to bear against the locating block in order to keep it in contact with the gage-blocks, or with the gage-blocks and rod, as the case may be. A light tap with a rawhide or babbitt hammer will serve to locate the center mark; this can later be enlarged with a punch designed for the purpose, which is equipped with a sleeve that holds the enlarging punch vertical or at right angles to the surface of the work.

Instead of using straightedges as shown in Fig. 2, machinists' squares may sometimes be employed to advantage. Of course when a series of holes are to be located in a straight line, it is only necessary to employ one straightedge and a pin or block which can be clamped to the work to provide a suitable locating surface.

Allentown, Pa. JOE V. ROMIG

INSPECTION GAGE FOR CARBURETOR BODY

A gage used in the inspection of motorcycle carburetor bodies is shown in the accompanying illustration. The carburetor body *D* to be inspected is placed on the pin *A* and pushed back until the end of the pin strikes the bottom of the hole. If the depth of the hole is correct, the end of boss *B* will come in contact with a shoulder on the movable member *C* of the gage at the same time that pin *A* comes



Gage used in the Inspection of Carburetor Bodies

in contact with the bottom of the hole. However, if the end of boss *B* comes in contact with the shoulder on part *C* before the end of pin *A* reaches the bottom of the hole, the shouldered member of the gage will be moved outward. As member *C* is connected with the contact point of dial indicator *E*, the excess depth of the hole will be shown by the indicator. If this over-depth is greater than the tolerance allowed (about 0.002 inch), the castings are rejected.

This gage is also used to test the location of the large bored hole in relation to the nozzle hole in boss *B*. This test is made with the plug *F*, which has a "Go" and a "Not Go" diameter. The carburetor body remains in the same position on pin *A* during this test. Pin *A* is, of course, a good fit in the hole in boss *B*. Plug *F* is slid into the opening between the side of pin *A* and the side of the large bored hole in the casting. If the plug enters on both sides of the pin the nozzle hole is central with the large bored hole, or in other words the axis of the nozzle hole is on a radial line that passes through the center of the large bored hole. When a carburetor body has passed this inspection, it can be relied upon to function properly and cause no delay in the assembly room.

Providence, R. I. ROBERT MAWSON

RULES VERSUS JUDGMENT

One of the serious errors of management in many shops is that rules are permitted to take precedence over judgment, and that statements of facts applying in one case are assumed to apply in every similar case, without any further consideration of the contributing factors.

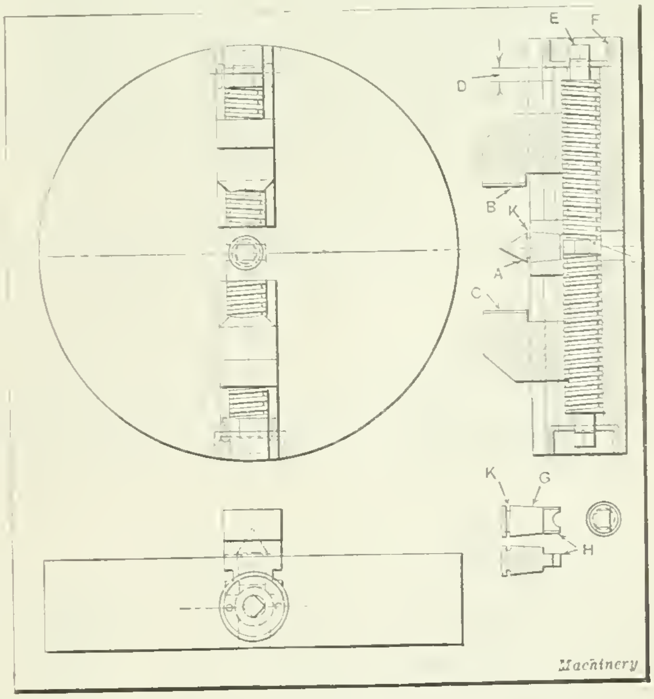
Just because a machine has certain good points, and therefore is the best for the kind of work done in the Smith shop, it does not necessarily follow that it is the best machine for Robinson, who is doing the same kind of work as Smith but under different conditions. Some years ago, a new manager took over a shop making a special machine that would produce a certain article under certain conditions in large quantities. The machine operated successfully when the pieces worked upon were of such shape that they could be put into a rotating chuck without stopping it. The product did not need to run exactly true, nor to be of an exact diameter after finishing. Under these conditions, the machine produced from four to eight times as much as a standard machine tool could have done. It was sold with such a guarantee, and had a record for actual performance, because the former manager picked only those jobs to which the conditions mentioned applied.

The new manager was of the single-track mind, and reasoned that the machine, just because it would accomplish certain results on certain products, must necessarily accomplish these results on all apparently similar articles. The first job that he undertook to handle was one that the former manager had refused, because the work could be done much more cheaply in a small lathe with a two-jaw chuck, for which purpose it did not need to be trued up (as it would have to be for the special machine). The machine was sold, but it was returned because it did not live up to the guarantee, and then the new manager became so discouraged that he decided that this special machine was really valueless, and he sidetracked it. The shop is now principally engaged in jobbing and repair work, when it could have had a profitable regular line of machine building. C. W. LEE

TWO-JAW CHUCK WITH REMOVABLE CENTER

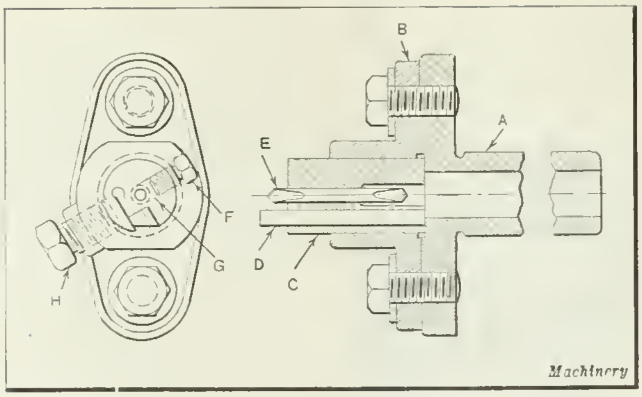
A two-jaw chuck provided with a removable center *A* is here illustrated. The chuck jaws *B* and *C* serve as a means of driving the work when it is mounted on centers and thus take the place of a dog, such as is ordinarily employed with a lathe faceplate. The jaws have the advantage that they can be tightened on rough pieces of work for which a regular lathe dog could not be used. No distortion or misalignment is caused when the work is held on centers, because the jaws are permitted to float in their slots with respect to the chuck body.

It will be noted that there is a clearance *D* between the ends of the threaded part of the chuck-jaw adjusting screw *E* and the screw-retaining cups *F*. This clearance allows the screw to move or float in its bearing in either direction. Thus each jaw has an equal bearing pressure on the work while it is located on center *A*. For example, let it be required to turn down a rod that has a rough surface at the end. The rod is center-drilled, one end being placed on the tailstock center and the other end on center *A*. The jaws are then advanced to the work. Let it now be assumed that the surface of the work is very uneven and that one jaw comes in contact with the work before the other. The jaw in contact with the work then acts as a nut and causes the screw *E* to move away from the stationary jaw. As the screw is revolved, the other jaw is brought into contact with



General-purpose Chuck provided with Means for holding Work on Centers the work, and the endwise movement of the screw stops. The continued tightening of the screw, however, causes the jaws to grip the work firmly. If it is desired to use the chuck for work that is not to be held between centers, a plug *G* is inserted in place of center *A*, to prevent the screw from floating. The projection *H* on plug *G* rests in the grooved section *J* of screw *E*. Recesses *K* cut in both the plug *G* and the center *A* provide a means of removing these members from the chuck. This chuck is not used on any special job, but is employed for general work in a railway shop.

Hannibal, Mo. E. S. Brown



Combination Centering and Recessing Tool

CENTERING AND RECESSING TOOL FOR AUTOMATIC SCREW MACHINE

When an automatic screw machine is being tooled up for the production of pieces requiring a number of operations, such as centering, drilling, reaming, recessing, turning, etc., it is often found necessary to design a special tool-holder. Such an occasion arose when a No. 0 B. & S. automatic screw machine was being tooled up for machining a certain piece requiring the use of seven separate tools. As provision was made for holding only six tools in the indexing head of the turret, it was necessary to design a special tool-holder that would permit two of the tools to be held in one turret position, in order to make it possible to perform all the operations in one set-up.

In this particular case, it was decided to combine the operations of centering and recessing. The holder designed to accommodate the centering and recessing tools is shown in the accompanying illustration. It will be noted that the holder is very compact, and that provision is made for adjusting either of the tools without interfering with the setting of the other. For instance, if it is necessary to adjust the centering tool *E*, the screw *F*, which bears against the clamping pad *G*, is loosened and the centering tool *E* is adjusted, after which screw *F* is tightened again without disturbing the recessing tool *D*. In case the recessing tool is to be adjusted, the large clamping screw *H* is loosened, the recessing tool adjusted, and the screw *H* again tightened. It can be readily seen that by this means the adjustment of the centering and recessing tools can be easily and quickly accomplished.

Referring to the construction of the holder, part *A* is a standard floating type of holder, such as is regularly used on the No. 0 B. & S. automatic screw machine. It is made of machine steel and is pack-hardened. Part *C*, which holds the recessing and centering tools is made of tool steel and is hardened. This part is made a drive fit in the hole in part *B*. The hardened and ground tool-steel recessing cutter *D* is made a snug sliding fit in part *C*. The centering tool *E*, also made of tool steel, is hardened and machined to a snug sliding fit in part *C*. The clamping pad *G* is made of machine steel, and is rounded out on one side to fit the cylindrical surface of the centering tool.

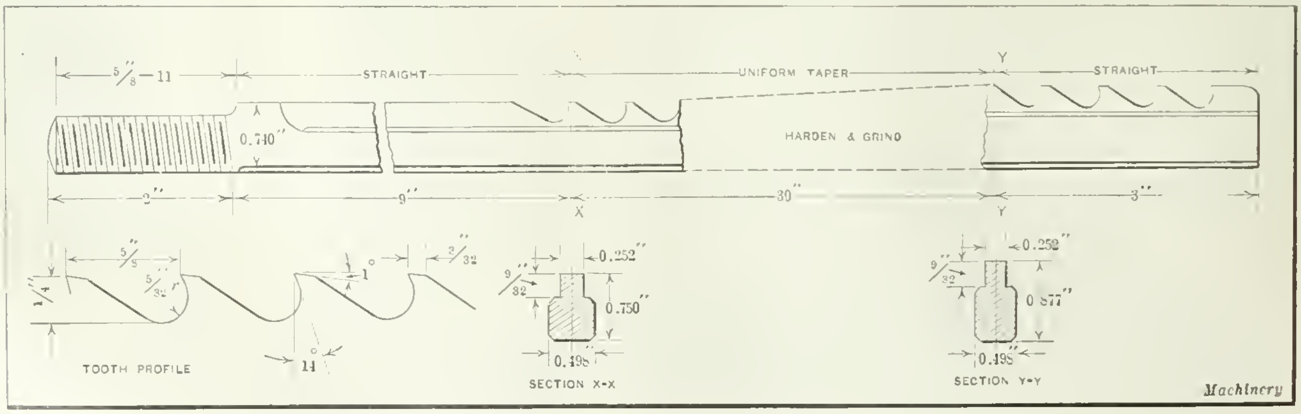
Frankford, Pa. I. Bernard Black

BROACH FOR KEYSEATING HUB

It is not an easy matter to design a broach that will stand up well and produce accurate clean-cut keyseats in hubs such as are used on Ford truck wheels. These hubs are made from steel forgings of an exceedingly tough nature. The hole in the hub is tapered and the length of the keyseat cut in the tapered hole is 4⅜ inches. Quite extensive experiments were made to determine the design of broach best adapted for this work. The design finally evolved is illustrated herewith. The chief advantage of this broach is that it can be reground on the top of its teeth when it becomes dull. This method of sharpening has proved to be economical with respect to tool life, and can be readily used in sharpening broaches of various types at a comparatively small expense.

It was found in practice that the front rake of the broach teeth should be from 12 to 14 degrees, and that the radius at the bottom of the teeth should be about two-thirds the tooth depth. The chip formed will then curl freely, so that a minimum amount of power will be required to pull the broach through the work. The top clearance should extend to within 1/64 inch of the cutting edge, leaving a land just visible to the eye. Too much land at this point will cause the tool to drag through the work and also provide surface on which particles of the work or chips can "freeze," which not only results in scoring the work but also has a detrimental effect on the teeth. No chip-breaking device is used on the broach shown, as the width of the chip taken is not sufficient to require this. If the width of the chip taken by a broach is greater than ⅜ inch, the teeth should be stagger-nicked on the tapered section. The corners should in no case be beveled off simply for the purpose of breaking up chips. Regrinding on the top of the teeth changes the size or height of the bar, but this change is easily compensated for by introducing a shim of the proper thickness.

New London, Conn. George E. Hodges

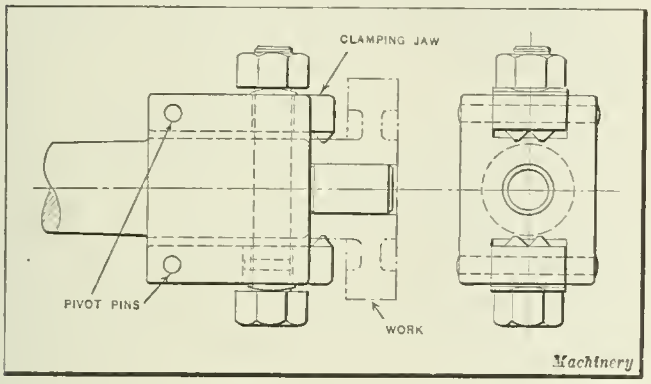


Broach designed to cut Keyway in Hub of Motor Truck Wheel

Shop and Drafting-room Kinks

STUB ARBOR FOR LATHE

A stub arbor of the design here illustrated has been used successfully in turning small gear blanks on a Porter-Cable lathe. The arbor is inexpensive to make and is very durable; it also has great driving power and is quick-acting. The work for which it was originally designed is shown by the dot-and-dash lines; the operations on the part are turning the outside diameter, and finishing the front face. The hole in the work is drilled and reamed and the hub faced in a previous operation.



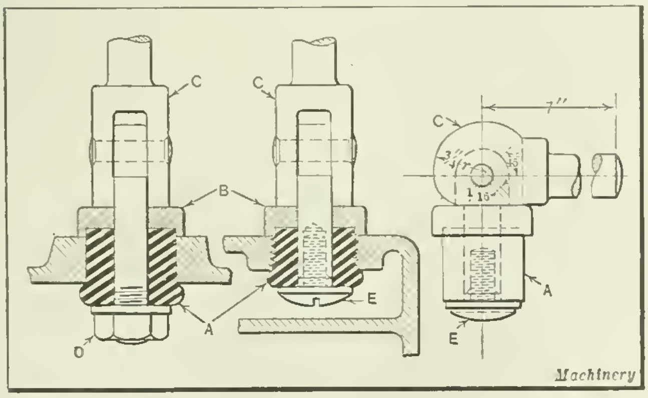
Stub Arbor used in turning Gear Blanks

The stub arbor was found to be an improvement over the expanding shell types, as well as the types provided with C-washers, especially for machining work of the kind shown. The construction of the arbor is clearly shown in the illustration. The writer's experience has been that it is best to avoid the use of expanding shell arbors whenever possible. For work having extremely small holes, expanding arbors are, of course, out of the question, and arbors requiring the use of C-washers do not permit the front face to be finished.

Eastwood, N. Y. ELMER C. COOLEY

TESTING CYLINDER WATER CHAMBERS FOR LEAKAGE

In testing cylinder water chambers for leakage, it is necessary to plug up carefully all holes leading to the chamber. As a water pressure of 80 pounds per square inch is often used in testing, an efficient type of plug must be employed. It has been the general practice in the past to use a fixture designed to permit rubber pads or plugs to be clamped to the cylinder over the holes by means of hook-bolts, straps, etc., but this method has proved rather slow.



Plugs used in sealing up Cylinder Chamber for Hydraulic Test

Automobile engine manufacturers and others who are still using the old method may increase their production by using plugs of the type shown in the accompanying illustration. The plugs *A* are made of medium hard rubber, and are a snug sliding fit in the cored, threaded, or machined holes in the cylinder castings. The rubber plugs are clamped by the action of cam *C* between collar *B* and either a nut *D* or screw head *E*, as the case may be. The nut *D* and the screw *E* should be made of brass, as iron will rust quickly. The cams should have a rise of about 0.001 inch per degree. The plugs, when clamped in either a plain or threaded hole, as shown in the views to the left in the illustration, will not be blown out by any pressure under 100 pounds per square inch.

East Cleveland, Ohio A. G. MERLIN

LINING UP CONE PULLEYS

The following method of lining up cone pulleys may be of interest to MACHINERY's readers. Difficulty is sometimes experienced in lining up cone pulleys so that the belt will run in the correct position on the pulleys; this position is shown by the full lines in the accompanying illustration. The writer has found by experience that very few millwrights and others who have to do with the installation of belt drives are aware of the fact that each of the inside faces *A* and *B* of the cones should form an angle of 90 degrees with a line connecting the two corresponding points *C* and *D*. If this condition does not exist, the belt will tend to climb to the larger ends of the cones. This causes undue stretching of the belt and greater wear on the bearings. The dotted lines show the incorrect location of the pulleys and the resulting incorrect position assumed by the belt under these conditions.

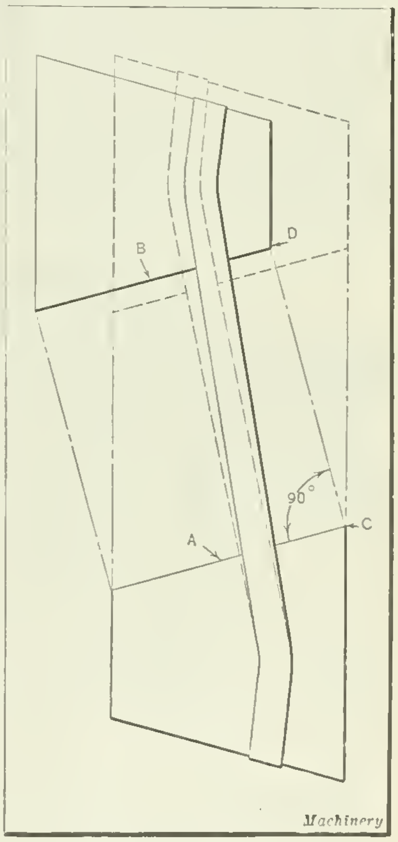


Diagram showing Correct Location of Pulleys in Full Lines

Fitchburg, Mass. J. E. FENNO

A LUBRICANT FOR THREAD CUTTING

Considerable difficulty was experienced in preventing the tool from "hogging in" when coarse-pitch threads (six to ten threads per inch) were being cut on tough carbon steel. After experimenting with a variety of cutting oils and lubricants in an effort to overcome this difficulty, it was found that the best results were obtained with a mixture of turpentine and white lead. ELAM WHITNEY

Questions and Answers

ERICHSEN VALUE

C. D. R.—What is the meaning of the term "Erichsen value" as applied to sheet metal?

A.—The Erichsen value is a factor used to indicate the workability of sheet metal. The test is conducted by supporting the sheet on a circular ring and deforming it at the center of the ring by using a spherical shaped tool. The depth of the impression or cup, in millimeters, required to obtain fracture is the Erichsen value of the metal. Erichsen standard values of sheet metals are furnished by some manufacturers for various sheet thicknesses.

CASEHARDENING WITH CYANIDE BATH

J. C. H.—Is it practicable to use a cyanide bath for casehardening when a deep case is required? If not, what are the difficulties?

A.—Cyanide baths are often used for slight or "superficial" hardening when a very thin but hard skin, only a few thousandths inch deep, is desired. If the work is left in the bath for, say, thirty minutes, the depth of the carburized part will be increased considerably; but the best results are obtained by heating for about fifteen minutes or even less, at temperatures just above the critical range. Heating for much longer periods tends to produce a skin or case which, after quenching, is too brittle and may chip off, especially if the part is subjected to shocks.

U. S. STANDARD THREAD

R. V. S.—What number of threads to the inch is considered standard for a 3/16-inch U. S. standard thread? Practically all screw-makers consider 24 threads as being standard, whereas the tap and die manufacturers list taps and dies having 32 threads per inch as standard.

A.—The standard number of threads for a 3/16-inch U. S. standard screw is 32. The U. S. standard thread was originated by William Sellers, and the following formula was used for determining the pitch:

$$p = 0.24\sqrt{D + 0.625} - 0.175$$

In this formula, p equals the pitch of the thread and D the outside diameter. In 1882, George M. Bond proposed changing the coefficient 0.24 to 0.23 for diameters below ¼ inch. If this modified formula is applied to the 3/16-inch size, a pitch will be obtained corresponding approximately to 32 threads per inch.

AMOUNT OF CARBON IN TOOL STEEL

J. M.—What percentage of carbon must steel contain in order to be tool steel? What percentage of carbon is necessary to cause hardening, when steel heated to cherry red is suddenly cooled?

A.—There are three general grades of steel, namely, low carbon or mild steel containing up to about 0.25 or 0.30 per cent carbon; medium steel containing somewhere between 0.30 and about 0.60 per cent carbon; and high-carbon or tool steel containing from approximately 0.65 to 1.50 per cent carbon, depending upon the intended use of the steel. As the carbon content is increased up to a certain maximum limit, the hardness of the steel increases when it is heated to the proper temperature and suddenly cooled. There is, however, no definite dividing line between the three general classes of steel referred to. When steel having a medium carbon content is heated and quenched, it becomes perceptibly harder, but is not hard enough for cutting tools, although if a steel containing, say, 0.65 per cent carbon is hard enough for some tool like a drop-hammer die, it might be classed as a tool steel, but it would not harden sufficiently to be used for making tools for cutting steel.

LUBRICANTS FOR DRAWING BRASS

H. B. S.—What lubricant is generally recommended for use in connection with drawing operations on brass and copper parts?

A.—This question was submitted to several manufacturers of sheet-metal products, and summaries of their replies follow, each paragraph containing the information secured from a different company:

1. For drawing operations on brass, copper, etc., we have used soap for many years. Ivory soap chips mixed with water and kept warm have proved very successful. The quantity of soap used depends largely upon the thickness of the metal and the severity of the operation.

2. The lubricant used for drawing brass shells, such as cartridge shells, consists of a solution of soap dissolved in water, the consistency being changed to suit requirements. For heavy shells the solution should be thick—almost like gelatine—and for smaller shells, very thin, so that it will run through the feed-pipes without clogging. In the first cupping operation, oil, known under the trade name of "cupping oil" is preferred, as it has more body than the soap solution, and therefore has a better lubricating effect during the cupping operation, which is a heavy one, displacing considerable metal.

3. From experience we find the best lubricant for brass and copper consists of hard soap dissolved in equal parts of warm water and pure lard oil.

SHOULD AN INVENTOR WRITE HIS PATENT SPECIFICATION?

E. H. K.—I have an invention that I believe to be meritorious. Friends have advised me to make application for letters-patent and say that I can frame my own application and conduct it through the Patent Office. Will you give me your advice in this matter?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

If you have an invention that seems to possess merit in the judgment of others and you have confidence in their opinions, it is advisable for you to seek a reliable attorney who specializes solely in practice before the Patent Office and the courts in patent matters. A patent specification is an extremely technical instrument, requiring in its preparation, skill of a particularly exacting character, which is acquired only by years of experience and a general knowledge of mechanics and the arts and sciences. In most instances where patent applications are prepared by the inventor, or one not skilled in this particular line, the specifications do not conform to the rules of the Patent Office, fail to describe the invention adequately, and are generally informal in many ways. Furthermore, the claims that constitute the fundamental and essential features of a patent are usually not properly drawn and fail to give the inventor the full protection to which he is entitled. A patent is property, and in many instances extremely valuable; therefore as much care should be exercised in its proper framing and prosecution through the Patent Office as would be given an important case in litigation before a court.

The British Metal-working Industries

From Machinery's Special Correspondent

London, March 14

THE improvement in the metal-working industries noticed during January has been maintained in February, and the machine tool industry is sharing in the general movement. Roughly, it may be said that conditions in the machine tool industry are 50 per cent better than at the beginning of the year. The improvement appears to be general, though turret lathes, screw machines, and radial drilling machines are particularly noticeable among the new orders; power presses are also in demand, which is attributable to the rapidly increasing use of hollow ware articles.

Conditions in the Machine Tool Industry

It is gratifying to note that general-purpose machine tools are selling more freely, and in the Birmingham and Manchester districts some manufacturers of such tools are working at 70 per cent of capacity. One well-known maker, within the last two months, has received orders for over £50,000 (about $235,000) worth of machine tools, including lathes, planers, and boring mills.

About half the present activity in the machine tool shops is due to overseas trade, the railway shops in India being the largest individual buyers at the moment. The home trade is divided; railway shops are coming to the fore, particularly for boring mills and lathes, and textile machinery makers are buying quite freely. The electrical trades at present are mainly interested in the heavier machine tools. Heavy grinding machines are in increasing demand, owing to their application to Diesel and other engine manufacture.

Prices of machine tools still reflect the period of slackness, and, generally, it cannot be said that makers are getting returns that are very remunerative. Present prices average 60 to 80 per cent above pre-war figures, and as business continues to improve there is no doubt that these figures will creep upward.

Small tool makers are experiencing much better business, particularly twist drill and hacksaw makers. File manufacturers are busy, but in this trade the underselling policy adopted by some concerns is ruinous to stable conditions. The majority of the makers now, however, have agreed to a schedule of minimum prices, and this move has relieved the situation to some extent.

There is a growing need to standardize hacksaw sizes and details. At present, dealers and manufacturers have to carry about 500 varieties of hacksaws in stock. It is believed that actual necessities would be met by 105 varieties, and if these 105 varieties were standardized, the floating stocks could be proportionately reduced, and the cost of manufacture would be decreased.

Railway and Other Engineering Fields

The home railways as a result of the recent regrouping, will, it is expected, adopt a progressive policy to meet the requirements of the new conditions, and large contracts for cars are likely to be placed immediately. What the exact program is to be with regard to the locomotive shops is not yet known. Some scheme of centralization will doubtless be adopted to eliminate the condition of having works scattered all over the country. Financial conditions are now such, owing to the settlement of the government compensation, as to render possible the purchase of the much-needed tool equipment for manufacturing and repair work.

The railways are being pressed for an immediate further reduction in freight rates, which, if effected, should provide a further stimulus to trade. South America is again inquiring for railway cars, and the contracts placed by India a month ago have been followed by others. Many new constructional schemes have been announced.

Iron and Steel Industries

In the iron and steel industries, the shortage of pig iron is assuming almost the proportions of a famine, and is an outstanding feature of the trade situation. Few of the great producing centers have any iron to sell having contracted for the whole output for a considerable time ahead, and are not desirous of obtaining additional business, as higher prices are considered probable. Relief will be slow as long as the insistent demand for blast-furnace coke from the Continent, due to the position in the Ruhr district, continues. The shortage not only prevents additional furnaces being blown in, but is also causing a limitation of output from those actually working. Prices have already gone up with a bound. The ruling price for machine tool castings in the Birmingham district varies between 4 and 5 cents per pound.

Steel mills are obtaining a good many orders. In many cases their works are engaged at their fullest capacity, and are booked as far ahead as June. There is, however, not much enthusiasm over the prevailing prices. Under ordinary circumstances business would be fairly profitable, but with taxation as it is, practically all of the profits are absorbed in satisfying government demands.

The Automobile Industry

Some of the manufacturers of the more inexpensive light cars are working extra shifts, and motorcycle makers generally are busy; one well-known firm of motorcycle manufacturers is purchasing additional equipment calculated to increase its output by 50 per cent. Makers of commercial vehicles find orders difficult to obtain. A contributing factor is the continued supply of second-hand trucks that have been purchased by dealers from government stocks.

Overseas Trade in Machine Tools

The foreign trade in machine tools during January showed a decided improvement over December, and viewed as a whole the total returns since last June indicate a definitely increasing trade. In January the exports, as compared with the preceding month, rose from 955 to 1337 tons, and in total value from £112,090 to £157,477. This is a substantial advance on the month, and on the monthly average of 1,014 tons for 1922. The export of tools and milling cutters also rose from £30,181 to £37,574.

Imports rose slightly from 262 to 276 tons. The value per ton of exports rose from £117 to £118, while that of imports fell from £141 to £123. The national total of imports for January rose by about 4 per cent to £100,000,000; while exports rose fully 6 per cent to £67,000,000.

In every class of machine tools, exports were considerably greater than imports both in tonnage and value. The greatest value per ton was shown by imported grinding machines at £210, while milling machines at £201, showed the highest value per ton among exports. Imported lathes at £86 per ton showed the lowest value, and £81 was the lowest exported value per ton, represented by presses, punching, and shearing machines.

The Machine-building Industries

THE present industrial situation is briefly summed up in the statement that the output of practically all basic products and materials is the largest since the boom period in the early months of 1920, and in some cases exceeds the production at that time. The steel mills are working as close to capacity as they have ever done, and the automobile industry is producing more than ever before at this time of the year. The Department of Commerce finds business confidence again reestablished throughout the country, and the Federal Reserve Bank points out that production in the basic industries, measured by the Federal Reserve Board's index, was 6 per cent higher in January than in December, reaching a volume that has been exceeded only once in the past—in May, 1917.

These statements relating to the basic industries—iron and steel, mining, transportation and textiles—are found to be equally true in many specialized fields in the machine-building industry, as verified by visits during the past month by the editor of MACHINERY to over ninety machine-building plants, manufacturing not only machine tools, small tools and other shop equipment, but many classes of industrial machinery—woodworking machinery, textile machinery, excavating and road machinery, locomotives, steam turbines, electric generators and motors, pumps and pumping engines, gas engines and general power plant equipment, hydraulic turbines, electric furnaces, tube mills, automobiles, and railroad cars. In all these plants there is great activity, most of the shops running to capacity and some having orders on hand—especially in the power plant field—that will not be completed for over a year to come. The farm implement factories, while not running to capacity, are reported to average about 70 per cent of a normal output.

In the general industrial field, equal activity is in evidence. Production in the cotton industry is the highest on record, the woolen industry is very active, and the paper mills are working to capacity, with the price of paper advancing. Contracts awarded in the building industry during February exceeded all previous records for this time of the year. High prices of materials, and wages in the building field out of proportion to wages in other industries, may adversely affect the building boom, and it is believed that later in the season there will be a serious labor shortage in this field. The extraordinary activity in the building field affects a number of metal-working industries, in increasing the demand for bolt and rivet machinery, pipe-cutting machinery, pipe-threading tools, and hardware.

Unusual Demand for Labor and Materials

The obstacles to a continuance of the present rate of production are mainly labor shortage; shortage in, and higher prices for, pig iron and steel; and, in New England and northern New York state, coal shortage. Higher wages seem inevitable in some instances as a result of the labor shortage, and there are already evidences of manufacturers bidding against each other for the available labor supply, a method that has a tendency to raise wages and prices without in any way increasing the available supply of labor. The labor shortage can be met effectively only by an increase in the efficiency of labor, so that higher wages and permanent employment may be insured right along, which, in turn, would lead to increased purchasing power and continued prosperity.

There is also a shortage in railway transportation facilities, but as a great deal of new equipment is being purchased by the roads, and as the short hauls are being more and more effectively taken care of by motor truck transportation, it is likely that transportation difficulties will not seriously hamper the continuation of present industrial activities.

The Machine Tool Industry

The improvement in the general industrial situation has naturally affected the machine tool industry favorably, but owing to the great amount of equipment available in machine shops throughout the country, the point has not yet been reached where much new equipment is required. The business of the machine tool industry averages about 40 per cent of the peak business in the early months of 1920; this is considered by many of the leaders in the industry as equal to two-thirds of a normal business, taking the word "normal" to mean the status of the machine tool industry had it developed up to the present in a uniform manner without the artificial stimulus of the war.

The stocks of machine tools are in many cases sold off or are rapidly being diminished. In the Detroit district, especially the volume of sales has been very satisfactory, some manufacturers having sold more machine tools in this district since January 1 than during the entire past year. The demand is mostly for machines developed specifically for high production in the automobile industry, and some of the makers of high-production milling machines and drilling machines are working practically to capacity. Some shops are now operating ahead of the present demand, accumulating stock in anticipation of higher prices for materials and higher wages.

When standard machines are required, quick deliveries are demanded, and in several cases the manufacturers have lost orders because they were unable to quote early deliveries. On some sizes and types of standard milling machines, one maker now quotes from ten to twelve weeks' delivery. There is a good business in high-power drilling machines, and even a fair export trade in this line. Shops making heavy railroad tools are finding a fair demand for their product, the forging machinery builders are active, and the demand for patternmaking machinery has lately shown a decided increase. The business in disk grinders is said by one manufacturer to exceed the pre-war business. Machine tool prices show a tendency toward further increases.

The Small Tool Industry

In the small tool field, some of the tap manufacturers consider business normal, although their plants are not running to capacity. Others, with less extensive plants, find it necessary to run a full force, and would even employ a small night shift if men were available. Some of the large drill manufacturers operate at 75 to 100 per cent capacity, and at least one of the well-known drill makers employs two shifts. In some instances, the operations are limited only by the difficulty of rapidly building up a new force, since the plants were practically closed down at the lowest point of the depression. Prices of drills, which were entirely too low a year ago to yield any profits whatever, have been increased, and with rising steel prices further increases may be expected. Tap prices, in some instances, have been increased 10 per cent.

There is nothing on the horizon that threatens to lessen this great industrial activity. No signs of impending industrial disturbances can be seen, and there is no likelihood of strikes in any of the basic industries. At the same time, the buying power of the public is constantly on the increase.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Lees-Bradner Gear-tooth Testing Machine. Lees-Bradner Co., Cleveland, Ohio 649
Oilgear Broaching and Assembling Press. Oilgear Co., 64 Twenty-seventh St., Milwaukee, Wis 651
Sundstrand Double-end Lathe. Rockford Tool Co., 2400 Eleventh St., Rockford, Ill. 661
Niles-Bement-Pond 14-Foot Engine Lathe. Niles-Bement-Pond Co., 111 Broadway, New York City 652
Niagara Special Forging Press. Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y 653
Bultman Fatigue Testing Machine. F. H. Bultman Co., 10271 Berea Road, Cleveland, Ohio 654
Triplex Combination Machine. Triplex Machine Tool Corporation, 60 Church St., New York City 654
Burke Heavy-duty Bench Drilling Machine. Burke Machine Tool Co., 616 Sandusky St., Conneaut, Ohio 666
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Wallace Beoding Machine. Wallace Supplies Mfg. Co., 412-420 Orleans St., Chicago, Ill 655
Clough Cylinder Refinishing Machine. Raymond M. Clough, 327 Colony St., Meriden, Conn 656
"Rollway" Relief-Valve Pump. Michigan Machine Co., 85 Porter St., Detroit, Mich. 656
Hoffman Roller Bearings. Norma Co. of America, Anable Ave., Long Island City, N. Y 656
"Thor" Portable Electric Drill. Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill 657
Foster All-geared-head Screw Machines. Foster Machine Co., Elkhart, Ind. 657
U. S. Double-spindle Hand Milling Machine. United States Machine Tool Co., Cincinnati, Ohio 658
"Fulflo" Motor-driven Self-priming Pump. Fulflo Specialties Co., Blanchester, Ohio 658
Danly Blanking Die Stop. Danly Machine Specialties, Inc., 1613 N. Lincoln St., Chicago, Ill 658
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Greenerd Cam-operated Motor-driven Arbor Press. Edwin E. Bartlett, Nashua, N. H 659
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Foster-Barker Wrenchless Chuck. Foster Machine Co., Elkhart, Ind. 662
Milburn Acetylene Generator. Alexander Milburn Co., 1416-1428 W. Baltimore St., Baltimore, Md 662
"Namco" Hardened Die-heads. National Acme Co., Cleveland, Ohio 662
Jarvis Sensitive High-speed Tapping Devices. Geometric Tool Co., New Haven, Conn. 663
Harris Semi-automatic Hob-grinding Machine. Harris Engineering Co., Bridgeport, Conn 663

Lees-Bradner Gear-tooth Testing Machine

IN the automobile industry and also in other machine-building industries where it is required to produce high-grade gears in large quantities, it is important to have a reliable means of determining the accuracy of the product. A machine that has recently been developed for this purpose by the Lees-Bradner Co., Cleveland, Ohio, provides for checking the accuracy of that portion of the tooth contour that conforms to an involute curve, and for determining the uniformity of spacing of the teeth. This equipment checks to 0.0001 inch, and is intended for use in inspecting the teeth of gears finished by grinding, as well as gears that are not ground after the teeth have been formed.

For testing the accuracy of the involute tooth form, this design of gear-tooth testing machine follows the principle that governs the tracing of an involute curve, namely, the unwinding of a string wrapped around a cylinder. In this machine, there is a disk *A* (see illustration Fig. 2) for testing gears of any given base diameter, the diameter of the disk being equal to the base-circle diameter of the gears that are to be tested with it. The periphery of this disk is accurately ground, and rolling in contact with it, there is a straightedge *B*, which is also ground accurately. The action of the straightedge in rolling on the disk is equivalent to the process of unwrapping a string from a cylinder in order to generate an involute curve.

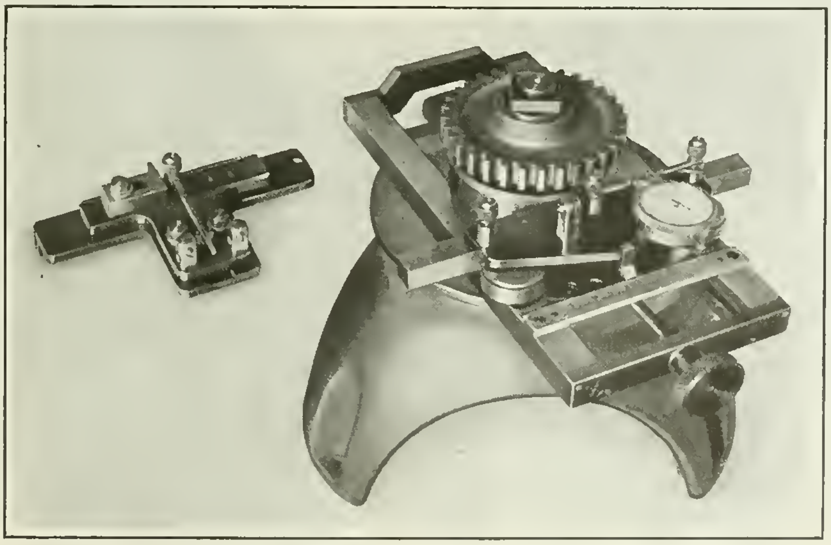


Fig. 1. Lees-Bradner Gear-tooth Testing Machine

Straightedge *B* carries a bracket on which are mounted a contact point *C*, magnifying levers *D*, and a dial indicator *E*. Contact point *C* engages successive teeth of the gear to be tested, as shown in Fig. 3, and by rolling straightedge *B* on disk *A*, Fig. 2, this contact point is caused to travel along the gear tooth from the base circle to the outside edge. As contact point *C* is directly above the position of tangency between the straightedge and the disk, it is apparent that it should generate an involute curve through the rolling action of the straightedge on the disk. But this contact point follows the curve of the tooth and if this does not conform to a true involute curve, movement will be transmitted from contact point *C* through magnifying levers *D* to indicator *E*. The error is shown by the indicator, each line of which represents an error of 0.0002 inch. The spaces between successive lines are split by dots to indicate errors of 0.0001 inch.

Charting Deviations from the Involute Form

When inaccuracies are discovered in the tooth form of gears produced in machines set up for quantity production, it may be important to locate accurately the position on the tooth where an error occurs. Or, again, it may be required to make some modification of the tooth form, as in cases where it is required to relieve the points of the teeth. For both of these purposes use is made of the graduated scale *F*. On the bracket that carries the indicating mechanism of the machine, there is a graduation mark *G* which is opposite the zero graduation at the center of scale *F* when contact point *C* engages a tooth at the base circle.

In charting a tooth form, an enlarged outline is first drawn, and on this outline circles are laid out concentric to the base circle, and spaced at uniform intervals on the gear tooth. As contact point *C* on the machine slides along the face of a tooth, graduation *G* passes over successive marks on scale *F*, and as each graduation on scale *F* is reached, reference to indicator *E* will show the exact amount of deviation from the true involute form at that particular point on the gear tooth. Hence, the necessary adjustments can be made on the gear-cutting machine to provide for either correcting an inaccuracy discovered in the tooth or obtaining a specified amount of relief at a given point.

The accuracy of the gear-testing equipment is dependent upon the straightedge rolling on the disk without slipping. Slippage is eliminated by applying spring pressure to maintain frictional contact between the two members. This spring pressure is transmitted through two disks *H*, which push against the back of the straightedge. The disks are mounted on ball bearings so that they apply the pressure without the frictional resistance caused by a sliding action. Straightedge *B* is brought into contact with disk *A* when it is changed to suit the gears to be tested, by means of a slide mechanism which provides for bringing disks *H* against the back of the straightedge in the positions required. This slide is manipulated by screw *I*.

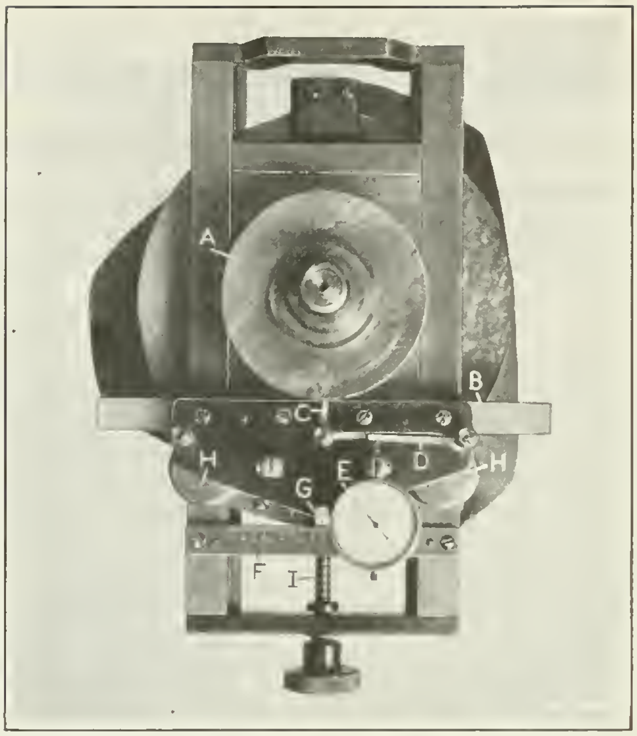


Fig. 2. Gear-tooth Testing Machine with Work removed to show Disk of Base-circle Diameter

Testing the Spacing of Teeth

In testing the accuracy of the tooth spacing on a gear, use is made of a second bracket having contact points. This bracket is shown at the left in Fig. 1, while Fig. 4 shows the machine with this auxiliary mechanism set up ready for use. On the bracket used for supporting the mechanism, there are two contact points *J* and *K* which engage the same sides of two adjacent teeth at points equidistant from the base circle. It does not matter whether the contacts come against the teeth at the base circle or at any other point along the involute curve, as the machine is used as a tolerance gage, not for measuring circular pitch.

Contact point *J* is secured to the bracket on which it is carried, and contact *K* is pivoted to magnifying lever *L* through which motion of the lever is transmitted to the dial indicator *M*. If the tooth spacing is correct, the indicator needle remains at zero when contacts *J* and *K* are brought

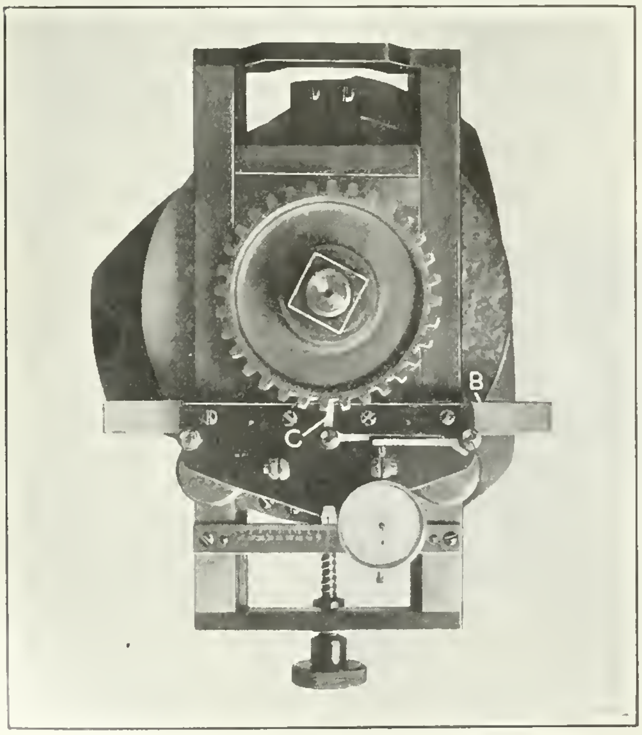


Fig. 3. Testing the Involute Form of Gear Teeth

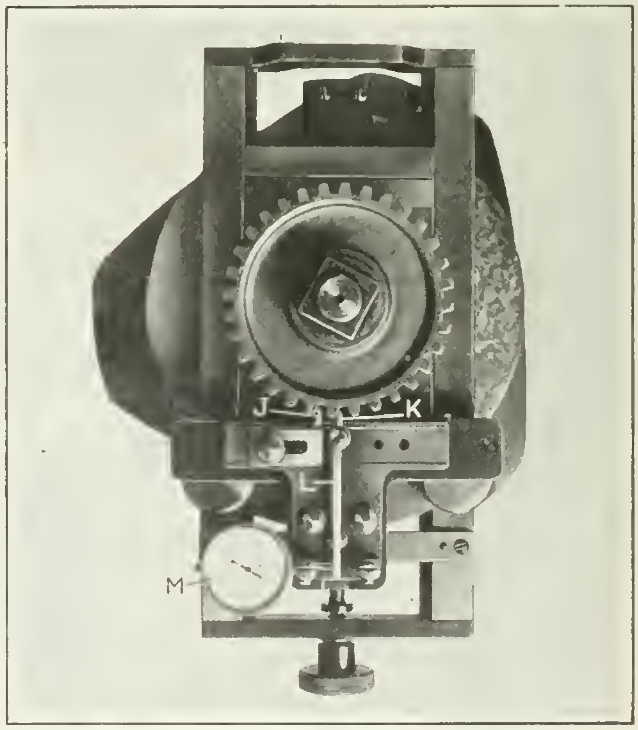
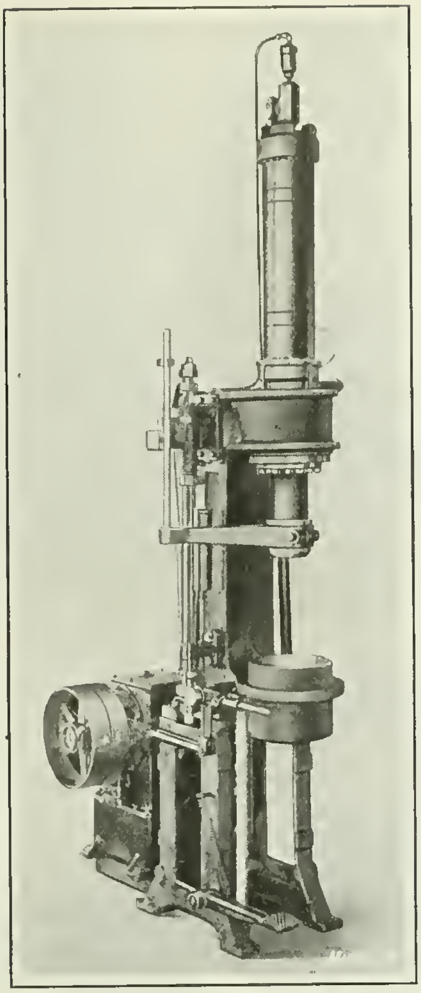


Fig. 4. Determining Accuracy of Spacing of Gear Teeth

into engagement with successive pairs of teeth, but in the event of lack of uniformity, indicator *M* shows the magnitude of error. Thus the indicator gives a definite reading of the actual condition of the gears, in addition to showing whether the error exceeds the tolerance.

OILGEAR BROACHING AND ASSEMBLING PRESS

A vertical gooseneck broaching and assembling press operated hydraulically by an Oilgear variable delivery pump is being manufactured by the Oilgear Co., 64 Twenty-seventh St., Milwaukee, Wis. On this machine the ram speed may be changed either automatically or manually at any point in the stroke. The speed changing, as well as reversing takes place instantly without shock or jar, and without overloading. It is claimed that when the driving unit is an electric motor, the motor never draws more than the rated full-load current from the line, and that when the press is driven from a lineshaft, the line is never slowed down because of any load greater than the normal full load required by the pump. The steady movement of the ram at all speeds makes the press especially adaptable for broaching, and for such assembling as pushing in bushings.


Oilgear Broaching and Assembling Press

The ram movements are controlled automatically by means of adjustable trips and tappets. The ram carries an arm on which is mounted a rod, and on this rod are two adjustable trips. As the ram moves down, the trips release two tappets and permit a control rod to be actuated by a helical spring as each tappet is released. The usual operating cycle is as follows: The operator starts the ram downward by pushing down either the hand- or foot-lever. Depressing the lever to its lowest position causes the ram to advance at its maximum speed. At the point where the ram is about to begin its working stroke, a trip releases one of the tappets and slows down the ram to the pressing speed, and at the end of the working stroke, the second trip operates the second tappet to reverse the ram instantly and return it to the starting position at maximum speed. A collar on the trip-rod engages a stop on the control rod and automatically stops the ram in the starting position, ready for the next cycle. Each new cycle is started by hand.

By changing the positions of the trips, the lengths of the rapid advancing stroke and working stroke, can be regulated to suit the work in hand, and by omitting one trip, the entire stroke can be made a working stroke. No matter what the positions of the trips, the operator can vary the speed of the ram by the manual control lever, or stop it altogether.

This broaching press is entirely self-contained. The variable delivery pump can be driven from any constant-speed source of power for supplying a flow of oil to the cylinder, the amount depending on the length of the pump stroke, which can be varied from zero to maximum in either direction by means of the control lever. Regulating the flow of oil and thereby the movements of the ram in this manner is said to result in a high efficiency of operation.

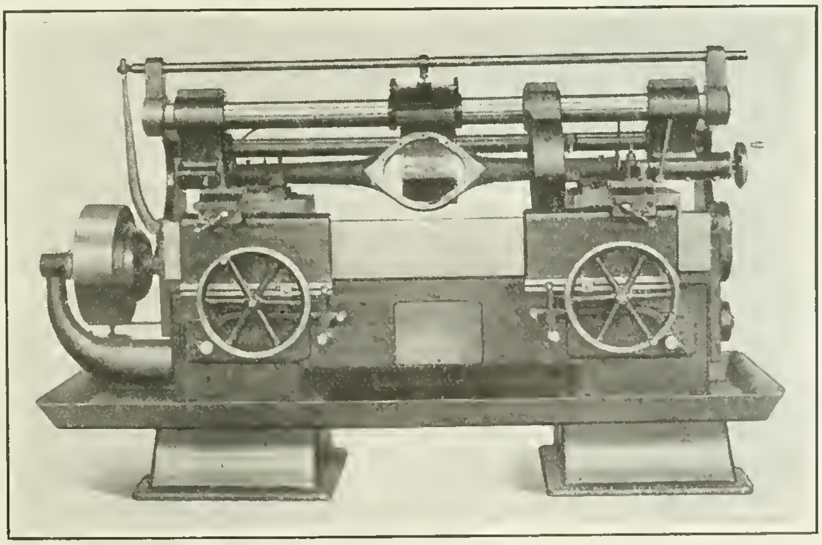
This machine is built in four sizes having capacities of 3½, 6, 10, and 14 tons, respectively. Some of the specifications are as follows: Maximum length of stroke, 18 inches; depth of throat, 8 inches; over-all height, 7 feet 2 inches; diameter of hole in table, 7¼ inches; height of table from floor, 35½ inches; speed of pump, 600 revolutions per minute; and motor size recommended, 7½ horsepower. It is said that in an automobile plant on an operation consisting of broaching 1-inch square holes and using two broaches, the production averages 625 pieces per nine-hour day.

SUNDSTRAND DOUBLE-END LATHE

For turning axle shafts, rear axle housings, camshafts, and similar parts that can be turned at both ends simultaneously, the Rockford Tool Co., 2400 Eleventh St., Rockford, Ill., has brought out the Sundstrand double-end lathe here illustrated, which is built in several sizes. The unusually narrow housing enclosing the driving mechanism makes it suited also for turning short pieces, such as four-arm spiders and universal-joint crosses.

It will be seen from the illustration that the construction of this machine is unique in that it has two overhanging arms firmly supported by housings at both ends of the bed. These arms carry two tailstocks and also support the center drive. This arrangement provides a greater adjustment of the tailstocks for various lengths of work, and thus reduces the length of bed from that necessary if the tailstocks were clamped on vees. The tailstocks and center drive are placed close to the front of the machine, making it convenient for the operator to replace work. Chips fall from the carriages into a pan which can be cleaned out from the back.

The center drive is through gearing from the main driving shaft, which extends the entire length of the bed. Pick-off gears connect the main driving shaft to another shaft geared


Sundstrand Double-end Turning Lathe

to the center drive. All these gears are hardened and ground, and those in the center-drive housing run continually in a bath of oil. Power is transmitted through sprockets and chain from the center-drive shaft to the feed-shaft. The latter transmits power through worm-gearing to the front carriages. Feed changes are made by means of the pick-off gears. The two sets of worm-gearing for the front carriages are made right- and left-hand, so that by throwing in the feed, the carriages work toward one another. The worms are constantly submerged in oil and are lifted into engagement with the worm-wheels by means of handles located at the front of the machine. On each worm-wheel shaft there is a large handwheel.

A dog on each carriage trips the feed-levers and automatically disengages the worm and worm-wheel, at the same time disengaging the rear tools. This provides a reliable knock-out, which can be depended on when working to a shoulder or facing to close diameters. The front carriages are mounted directly over the wide front vee of the bed with a view to reducing to a minimum the strain on tools under the heaviest cuts. Each carriage is 18 inches long and has a full length bearing on an 8-inch face at the front of the bed, and on a 4-inch angular surface on the front of the vee. An angular gib is provided at the bottom of each carriage to take up any wear. Adjustments can be made from the front of the machine. Stop-screws are also provided underneath the front tool-slides for tool adjustment. The width of the front tool-slides permits of several tools being clamped on at one setting.

The rear tool-slides have wide heavy bearings, and are driven by means of a rack and pinion mechanism. They operate simultaneously with the front carriages, and by means of pick-off gears at the back of the machine, independent feeds are obtained to meet the requirements of the work. T-slots are milled in the bed for longitudinal adjustment, thus permitting the rear tools to be placed in different positions for various jobs.

The starting lever for the driving pulley is operated by means of a long rod which extends the full length of the bed. When the machine is arranged for motor drive, the motor is mounted on a bracket below and to the rear of the pulley, a 10-horsepower motor running at 900 revolutions per minute being recommended. An oil pump, driven from the pulley, is regularly furnished, and a tank for the cutting coolant is located directly below the pump in the base under the chip pan. Piping extends the full length of the bed to carry coolant to any portion of the work being turned. The 36-inch lathe weighs approximately 5100 pounds, and the 60-inch machine 5500 pounds.

NILES-BEMENT-POND 14-FOOT ENGINE LATHE

The production of steam turbines, turbo-generators, and similar machinery of large size has been responsible for the development of a number of mammoth machine tools. It was to meet the demands of this class of work that the lathe here illustrated was built by the Niles-Bement-Pond Co., 111 Broadway, New York City. The men standing on the machine in the two views are of average height and give an excellent idea of the dimensions. The lathe is rated as having a 14-foot swing, but it actually swings 14 feet 6 inches over the bed, 11 feet 6 inches over the carriage, with a removable section in place, and 12 feet 9 inches over the carriage with the section removed. The bed is 50 feet long, allowing a maximum distance between centers of 34 feet.

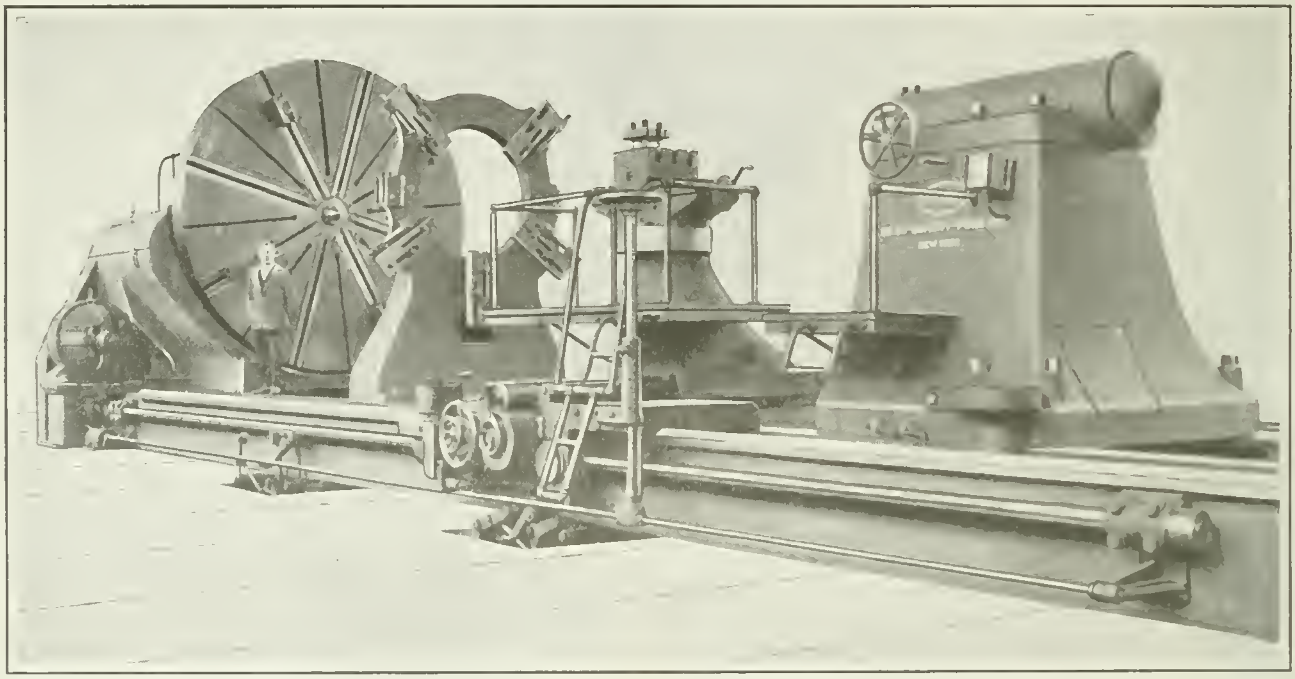


Fig. 1. Niles-Bement-Pond Lathe which swings Work up to 14½ Feet in Diameter and 34 Feet in Length

The headstock is a massive casting, having all its bearings lined with bronze and scraped to fit the shafts, which are ground to size. The driving gears in the headstock give four mechanical speed changes to the spindle. These are obtained by manipulating levers located on the head within easy reach of the operator. The gearing is made accessible for inspection by raising hinged covers. All bearings and gears are lubricated from large sight-feed oil-cups.

The driving motor is mounted on an extension of the bed in front of the head. It is of 50 horsepower capacity and has a speed range of from 500 to 1500 revolutions per minute. In connection with the mechanical speed changes previously mentioned, this gives faceplate speeds ranging from 0.23 to 24 revolutions per minute. The motor may be started, stopped by dynamic brake, reversed or run at any speed within its range, by simply turning a handwheel on the carriage to operate the master switch of an automatic controller through a shaft running along the front of the bed.

The tailstock has a long wide bearing on the bed. In addition to eight clamping bolts, it has pawls which engage ratchets in the bed so as to afford a positive insurance against the tailstock shifting under heavy end thrusts. The

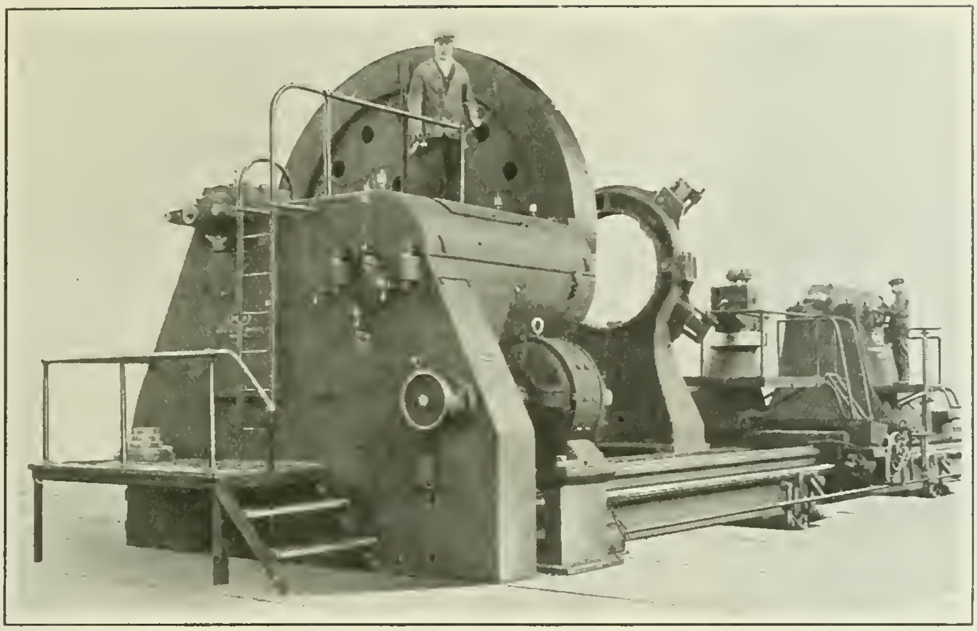


Fig. 2. View of the Heavy Engine Lathe from the Headstock End

upper part of the tailstock carries a large forged steel spindle, which is adjustable by means of a screw and nut operated through a shaft and reduction gearing from a handwheel near the front end of the tailstock. There is a cross adjustment for this part of the tailstock by means of screws enabling angular settings for cutting slight tapers to be made. The upper part is secured to the tailstock base by large bolts which are independent of the base clamping bolts, and therefore the top part may be adjusted crosswise without danger of slipping, though work may be held between the centers. The tailstock has a power traverse along the bed which is obtained through a reversible motor that drives gears engaging the feed rack in the bed.

The tool carriage extends entirely across the bed and has a central depression in which is fitted a removable track. This is the removable section previously referred to. Mounted on the carriage is a long cross-slide which carries a swiveling compound guide for the tool-slide. This permits of turning tapers of considerable length without the use of a separate taper attachment. Lateral, cross and angular feeds by both power and hand are furnished for the tool-slide. An independent motor and controller mounted on the carriage is used for rapidly traversing the carriage in either direction.

The five-jaw steadyrest shown is usually furnished; however, roller steadyrests and C- or back-rests and tool-slide extensions for crankshaft work, can also be supplied. Platforms and ladders are provided on the headstock, carriage, and tailstock for the convenience of the operator in running the machine. The motor-control handwheel on the carriage is mounted on the top of a telescopic shaft which may be lengthened or shortened to permit of revolving it either with the operator standing on the carriage platform or on the floor. The large size of the parts of this machine necessitated four railroad cars for its shipment. The bed is 11 feet wide and the faceplate 12 feet in diameter. The weight of this lathe is about 250,000 pounds.

NIAGARA SPECIAL FORGING PRESS

An interesting development in power presses has been made by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., in equipping its No. 512 straight-sided single-crank press for producing special forgings in large quantities from hot blanks. The machine runs continuously, and produces a finished forging at each stroke of the slide. It is equipped with an automatic dial feed of the ratchet type, as illustrated in Fig. 2; this mechanism consists principally of a circular disk to which intermittent motion is imparted through connections from the crankshaft. There are holes in the circular disk in which are placed interchangeable bushings shaped to receive the hot blanks.

The blanks are placed in the openings of the dial at the rate of eighteen per minute, as the openings approach the front of the press. Each blank is then automatically fed to the die and pressed to shape. It adheres to the punch as this member rises, and the next step is to strip it automatically. As the forging drops, a sweeping member swings out and directs its fall to the rear of the press. The dial has an unusually long period of rest to make possible a deep forming operation and to let the blank remain the necessary amount of time under the pressure of the dies. However, between these working periods, the dial moves rapidly. This intermittent motion is derived from the end of the crankshaft through a crankplate and a slotted lever.

As the operation is performed on hot work, it is necessary to provide a relief to function in case of an overload. A hydraulic release is provided by having the bolster which carries the dial feed and the die mounted on a steel plunger supported by water pressure. Water from ordinary city lines has sufficient pressure to raise the plunger to its maximum height. A check valve is placed in the feed-pipe to prevent a back flow in the feed-line, and a relief valve in the outlet from the cylinder is set to open when the rated

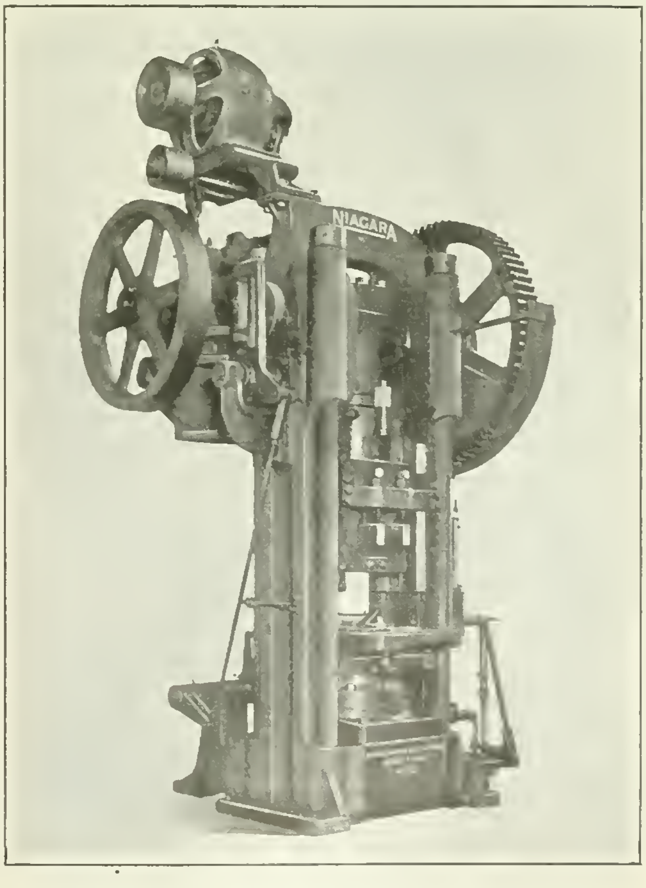


Fig. 1. Niagara Straight-sided Single-crank Press equipped for Hot Forging

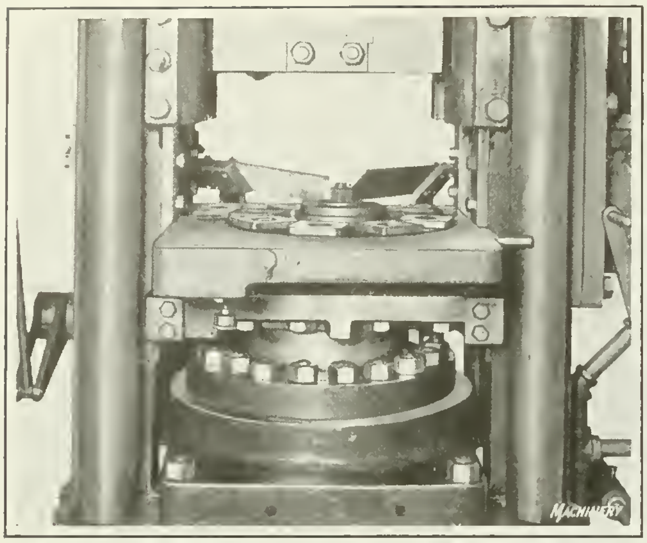


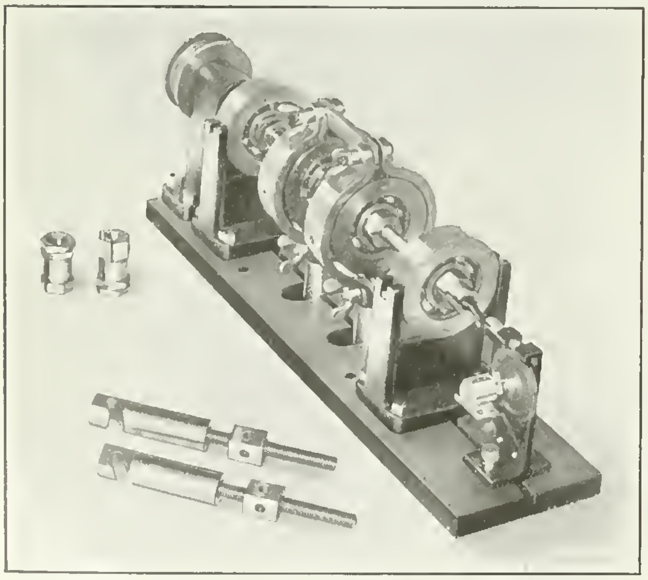
Fig. 2. Automatic Dial Feed provided on Niagara Press

capacity of the press is exceeded. Consequently, should a cold or over-size blank, which would produce an overload, be fed to the die, the bolster, upon opening of the hydraulic relief valve, would be depressed under the pressure of the ram, and protect the machine from overstrain. When this pressure was relieved, the bolster would rise to the correct working height in time for the next stroke of the press.

Three outstanding claims are made as to the suitability of this equipment for use in hot forging work: First, that it gives an output that cannot be equalled by non-automatic devices; second, that its operation is quiet, continuous, and requires a minimum amount of operating skill and attention; and third, that by reason of the protection afforded by the hydraulic release attachment, the press can be limited in size to suit ordinary loads, and need not be made over-size to withstand overloads. The press is double back-geared, and provided with a double-disk friction clutch.

BULTMAN FATIGUE TESTING MACHINE

A machine designed to record the number of alternations of stress that may be applied to a steel specimen before destruction is accomplished, is made by the F. H. Bultman Co., 10271 Berea Road, Cleveland, Ohio. This machine is known as the "Farmer Type" fatigue testing machine. It consists of a baseplate provided with a housing in which are mounted ball bearings that carry the specimen in a horizontal plane, and another housing with ball bearings and a shaft on which a pulley is mounted to drive the equipment from a motor. There are also two ball bearings which are put on the specimen to carry the weights that apply the load or stress. Hook-bars are attached to the weight bearing housings.

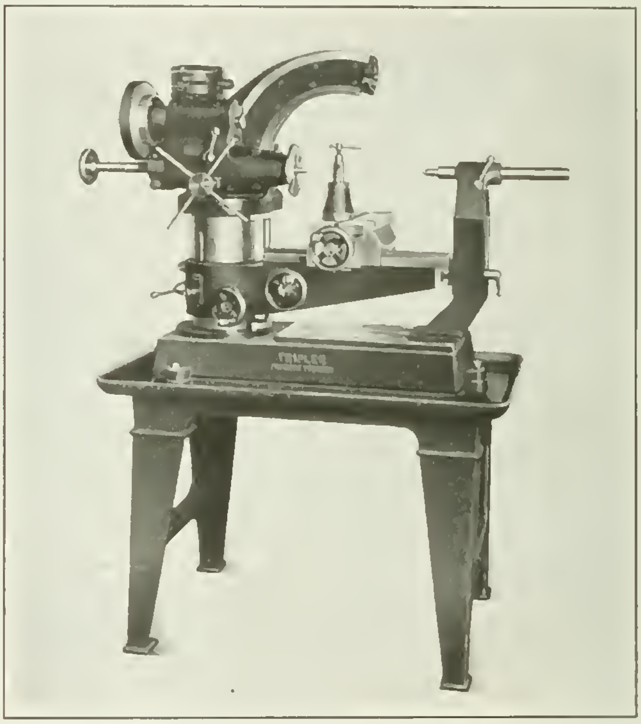


"Farmer Type" Fatigue Testing Machine made by the F. H. Bultman Co.

All the ball bearings are provided with easily adjustable compensating chucks to fit the specimen, so it is a simple matter to mount the specimen in the machine. A bracket at one end of the machine carries a revolution counter which records the number of revolutions made by the specimen under test up to the time of failure. The specimen is connected to this counter by means of a flat notched bar which falls out of position when failure occurs and causes the counter to stop. At the same time the broken specimen swings out of contact with the driving shaft.

TRIPLEX COMBINATION MACHINE

The combination lathe, milling and drilling bench machine developed by the Triplex Machine Tool Corporation, 50 Church St., New York City, which was described in December, 1921, Machinery, may now be furnished with a combined floor stand and chip pan as shown. The design is similar to the original model, but the swing over the carriage has been increased from 8 inches to 10 inches. The maximum distance between centers is 14 inches. An important change in the head design is the substitution of S. K. F. radial ball bearings on the change-gear shafts for the bronze bearings formerly used.



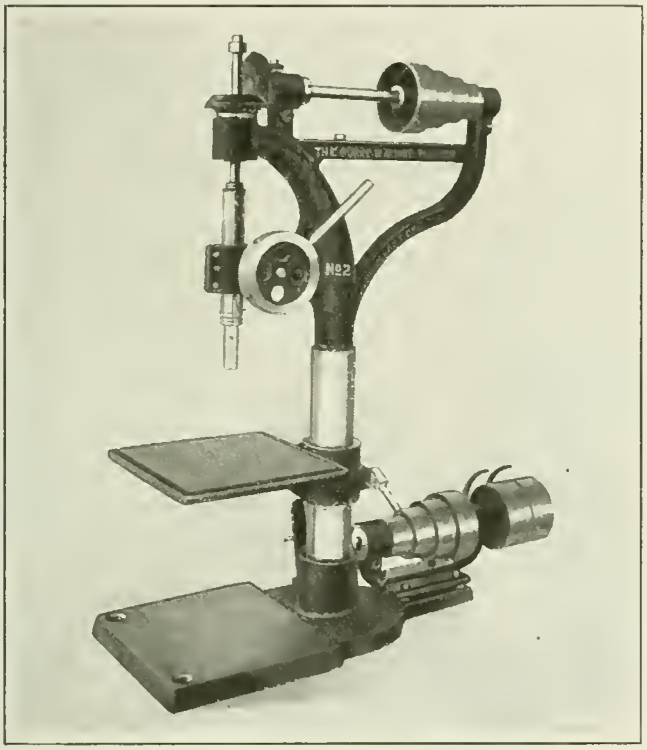
Triplex Combination Machine with Floor Stand and Chip Pan

The maximum spindle speed has been reduced to 1050 revolutions per minute, but the minimum speed of 90 revolutions per minute has been retained. It will be observed that the starting switch is now mounted on the head in a convenient location. A key on the column engages a keyway in the bearing of the bed on the column when the axis of the bed is swung into alignment with the spindle axis, and this insures accurate alignment. The bed is graduated in degrees around its bearing on the column, so that in swiveling the bed for machining bevel surfaces its setting may be determined by referring to the graduations and a scribed line on the column. The opposite end of the bed is graduated to facilitate setting it for turning tapers.

BURKE HEAVY-DUTY BENCH DRILLING MACHINE

A bench drilling machine, with a capacity for drilling holes up to 9/16 inch in diameter, is being built by the Burke Machine Tool Co., 516 Sandusky St., Conneaut, Ohio. The base of this machine is planed so that it may be used as a table when the regular table is turned to one side. All bearings of the machine are made of phosphor-bronze and are provided with deep oil-cellars and wick-feeders. The cone pulleys have four steps of 5, 4¼, 3½, and 2¾ inches diameter, respectively. The countershaft pulleys are 5 inches in diameter, the countershaft being ordinarily driven at a speed of about 800 revolutions per minute.

The driving gears are made of the spiral bevel type, with a view to producing a quiet, smooth-running and powerful machine. Fiber thrust gears are placed under each gear to take the wear. The spindle is ¾ inch in diameter, counterbalanced, and supplied with ball thrust bearings. A fiber collar is also placed under the adjusting nuts of the spindle. A No. 1 Morse taper hole is usually furnished in the spindle nose, but a No. 2 Morse taper can also be provided. The bearing for the spindle sleeve is split so as to provide for taking up wear. A stop is attached to the top of the spindle.

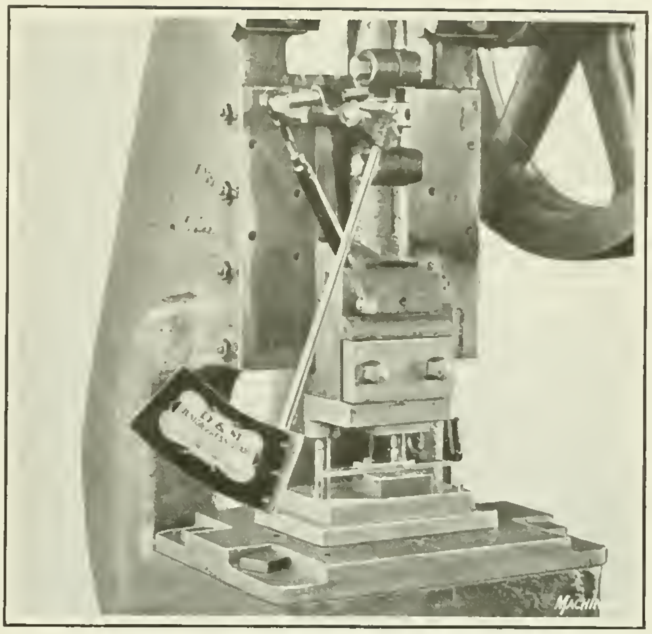


Burke No. 2 Heavy-duty Bench Drilling Machine

A few of the principal dimensions of the machine are as follows: Distance from center of spindle to column, 6¼ inches; dimensions of table exclusive of oil channel, 10 inches square; maximum distance from spindle to base, 18½ inches; maximum distance from spindle to table, 10¾ inches; vertical travel of spindle, 4 inches; and vertical travel of table, 10¾ inches. The machine weighs approximately 170 pounds.

"D. AND M. JUNIOR" PUNCH-PRESS GUARD

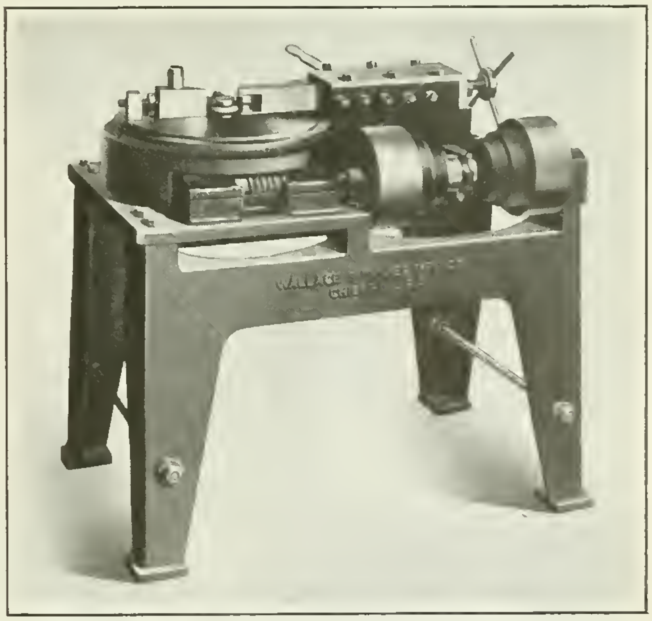
A simple punch-press guard consisting of only nine parts is made by the Taylor-Shantz Co., 478-486 St. Paul St., Rochester, N. Y., and sold under the trade name of "D. & M. Junior." As will be seen from the illustration, the guard arm is automatically driven by the ram of the press. It sweeps across the bolster as the ram descends and passes the dies before they are closed. A rubber cushion prevents injury to the operator's hand from the guard striking it. The appliance is provided with all the adjustments necessary to adapt it to changes in the die space, in the distance that the guard arm travels, and in the speed at which the arm travels; such adjustments can be made quickly. The only preparation necessary for installing this guard on a press is to drill and tap two holes, no changes being required in the press construction.



Punch-press Guard made by the Taylor-Shantz Co.

WALLACE BENDING MACHINE

For bending round, square, and flat bars, and tee, angle, and channel irons, either hot or cold, the Wallace Supplies Mfg. Co., 412-420 Orleans St., Chicago, Ill., is now making the No. 15 bending machine here illustrated. An adjustable mechanism on the under side of this machine provides for automatically stopping the rotating table at any predetermined point, so that parts can be bent in quantity identically alike as to the number of degrees in the bend. The machine is started by manipulating a hand-lever located on the front side, which is the side opposite that on which the tight and loose pulleys are mounted.



Wallace Bending Machine with Capacity for making Bends of 4 Inches Radius to the Outside of the Work

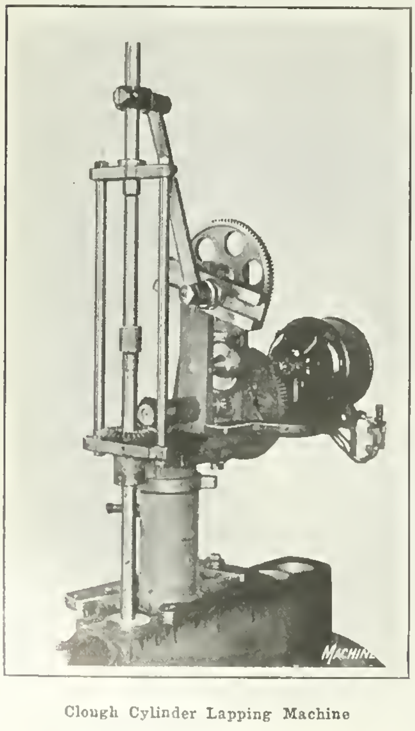
The capacity of this machine in bending cold material is for 1-inch square and round bars, 3/8- by 2-inch flat bars, and 2- by 2- by 1/4-inch angle-irons. In hot bending, the machine has a capacity for 1 1/2-inch square and round bars, 3/4- by 2-inch flat bars, and 2 1/2- by 2 1/2- by 5/16-inch angle-irons. The maximum radius of bend is 4 inches from the center of the circle to the outside edge of the material.

The production varies according to the number of degrees to which the material is bent, and the length, cross-section, and kind of stock. However, a fair average production estimate for ordinary cold-bending of round, square, or flat bars, sidewise, to 180 degrees, is said to be 150 pieces per hour; while in cold-bending flat stock on the edge, the average output is about 100 pieces per hour. The latter estimate would also apply to angle-irons. Bending flat stock on the edge and angle-irons to more than 180 degrees necessitates the use of a split form. The upper part of this form can be lifted after each bend has been completed to permit the removal of the finished part from the machine. For this class of work the average production is about sixty pieces per hour. A three-horsepower motor is recommended for driving the machine. The weight of the machine is about 950 pounds.

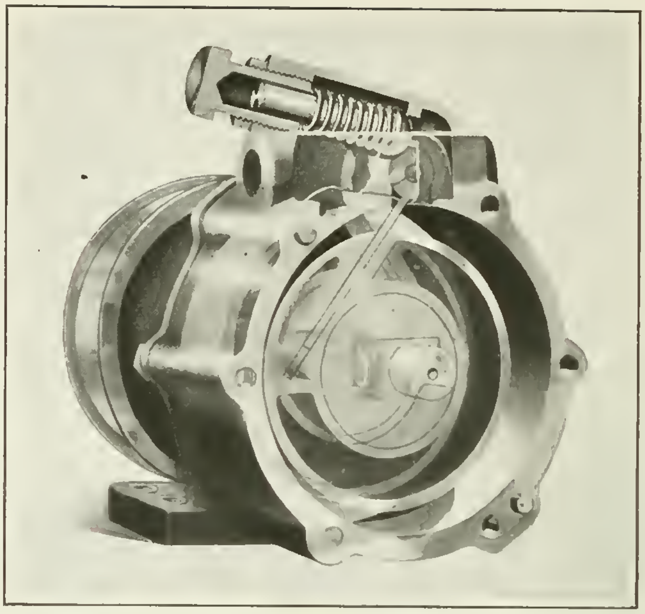
CYLINDER REFINISHING MACHINE

Worn or out-of-round cylinders can be refinished by the honing or lapping process without removing the cylinder block from the automobile, by a new machine developed by Raymond M. Clough, 327 Colony St., Meriden, Conn. For performing the operation, it is only necessary to remove the cylinder head, oil-pan, pistons, and connecting-rods. The machine is then bolted to the top of the cylinder block and readily adjusted centrally with any of the bores, by means of a compound movement derived in the upper section of the machine. The machine has a maximum vertical spindle movement of 12 inches.

The equipment is driven by a 1/2-horsepower alternating-current motor, running at a speed of 1750 revolutions per minute. This speed is reduced to a speed of 112 revolutions per minute by gearing that connects the motor to the spindle. A crank is employed to reciprocate the spindle as it rotates, the crank revolving 49 revolutions per minute or slightly less than once to two revolutions of the spindle. The spindle can also be driven independently of the crank motion by throwing an intermediate gear out of mesh. The hone or lap is attached to the lower end of the spindle by means of a single bolt, and can be easily removed. For convenience in checking the progress of the operation, the upper portion of the machine can be swung out of the way after a clamping screw has been loosened. When the walls of a cylinder have been honed or lapped to the desired dimension, the piston and rings can be run in before removing the machine to the next bore. The weight of this equipment is less than 100 pounds.



Clough Cylinder Lapping Machine



Self-priming Relief-valve Pump manufactured by the Michigan Machine Co.

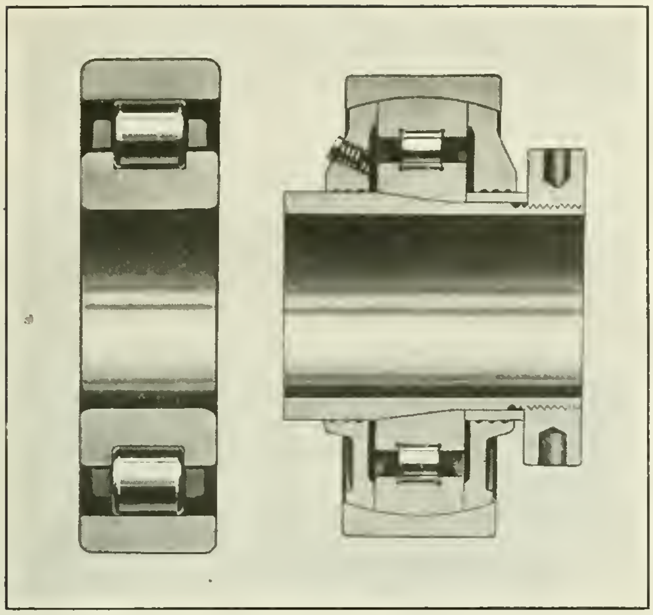
"ROLLWAY" RELIEF-VALVE PUMP

An automatic relief valve has been embodied in the "Rollway" lubricating pump manufactured by the Michigan Machine Co., 85 Porter St., Detroit, Mich., which was described in August, 1919, MACHINERY. The valve can be adjusted to relieve at a given pressure, and transfers all surplus fluid from the discharge line back to the suction line without returning the fluid to the supply tank. This feature saves the expense of independent relief valves and extra piping, and eliminates the stirring up of fine sediment in the supply tank, which may occur with independent relief valves. This pump, known as type R, can be assembled to operate in either clockwise or counter-clockwise direction. It will not pump fluid when revolving in the direction opposite to that for which it is assembled; however it can be run in the reverse direction without damaging the pump, and will start pumping again as soon as the normal direction of rotation is resumed.

The principal pumping mechanism consists of two rollers, which rotate eccentrically in the pump chamber. The entire motion is that of rolling, and so there is practically no wear, such as might occur in another construction due to the movement of the working parts against the pump chamber. The pump is self-priming and will not clog. It is manufactured in various sizes, ranging in capacity from 5 to 160 quarts per minute.

HOFFMAN ROLLER BEARINGS

Rigidly mounted and self-aligning types of roller bearings which in the past have been made by the Hoffman Mfg. Co., Ltd., Chelmsford, England, and sold in European markets, are now being introduced in this country by the Norma Co. of America, Anable Ave., Long Island City, N. Y., which has acquired all the American rights for the bearings. It will be seen from the sectional view at the left in the illustration that in fundamental design, the rigidly mounted type is no radical departure from other standard bearings. The outer race or ring is of plain cylindrical form with a rectangular cross-section. It has a "flat-line" raceway on which the rollers run. The inner race or ring has a channel cross-section, narrow rims being placed on each side of the "flat-line" raceway so as to retain the rollers endwise. The rollers are cylindrical, with a length equal to the diameter. They are held in parallelism with the shaft and with one another by the rims or shoulders of the inner race, which



Hoffman Rigidly Mounted and Self-aligning Roller Bearings

are a distance apart that allows only a slight clearance for the rollers. The roller gage or retainer is of simple construction.

It is obvious that this bearing has no end thrust capacity, and so when end thrust is encountered it is necessary to hold the inner race and the rollers in the correct relation to the outer race by means of a locating device. When the end thrust is small, it may be taken care of by thrust buttons at each end of the shaft, and when the end thrust is large, it may be carried either by auxiliary thrust bearings or by "location bearings" of standard ball type and slightly reduced outside diameter, mounted between two roller bearings.

The same general construction is followed in the Hoffman self-aligning bearing shown at the right in the illustration. The periphery of the outer race of this bearing and of the two dust-and-dirt excluding covers is ground to form a continuous spherical surface which fits a similarly shaped inner surface on the shell or housing. The bearing is thus free to align itself with its opposite members, the dust covers following every movement. This feature permits of boring the covers with but a small running clearance on the clamping sleeve. As a consequence, the lubricant cannot work out, and dust cannot work into the highly finished bearing surfaces. In the example illustrated, the clamping sleeve extends entirely through the dust covers and so the bearing may be mounted without exposing its working parts.

"THOR" PORTABLE ELECTRIC DRILL

A new drill of 3/16-inch capacity has been added to the line of portable electric equipment manufactured by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. The armature and commutator in this drill are of the same outside diameter as in the No. 000 drill made by the same company, but the armature core and winding are shorter. The brushes and brush-holders are the same as the ones used in that drill, and so is the stator, except that the latter is made in proportion to the armature. The gear and field cases and the center plate are made from aluminum, the gear-case being so constructed that it can be screwed on the center plate in four positions, so as to give the same number of close-corner spindle positions in drilling.

The upper end of the spindle is supported by a thrust ball bearing, and the armature is pivoted on self-aligning ball bearings. This drill is made in two different styles which are the same except for the handle. Type U. K. B. has an aluminum cover independent of the switch, with the trigger coming through a slot in the cover, while type U. K. C. is equipped with a small grip handle having a push-button switch. A Jacobs chuck is furnished with the standard equipment. The weight of the type U. K. B. is about 3 pounds, 10 ounces, and that of type U. K. C. 4 pounds, 3 ounces.

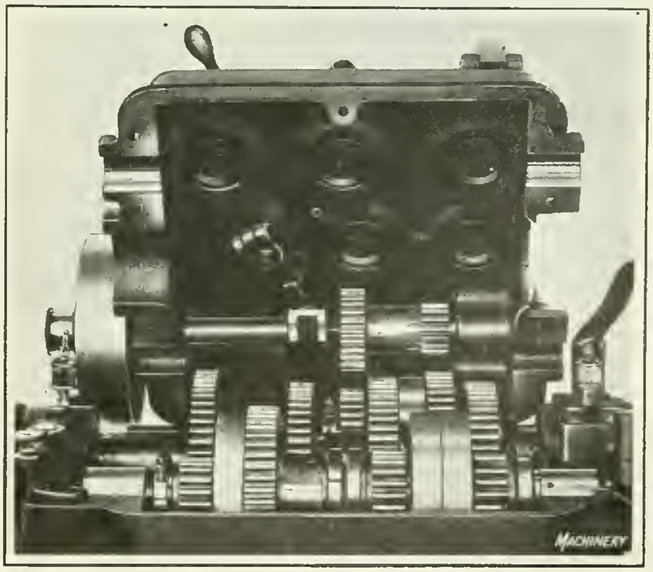
FOSTER ALL-GEARED-HEAD SCREW MACHINES

The Nos. 3, 5 and 7 screw machines made by the Foster Machine Co., Elkhart, Ind., are now equipped with the all-geared head shown in the accompanying illustration. The capacity of the automatic chucks on these machines is for round bar stock up to 1 5/16, 1 13/16, and 2 1/2 inches in diameter, respectively. Except for the geared head, the design of these machines is similar to the friction-head type described in December, 1919, MACHINERY. The machines of the friction-head type are driven through a friction clutch which is mounted on the spindle between a three-step cone pulley and a friction gear in such a way that the spindle can be brought into driving connection either directly with the cone pulley on one side or with back-gears on the other.

Equipped with the all-geared head the No. 3 machine has eight spindle speeds of 29, 43, 64, 98, 147, 225, 337, and 500 revolutions per minute, with the driving pulley running at a speed of 920 revolutions per minute. The pulley is 10 inches in diameter and is driven through a 2-inch belt by a 2-horsepower motor running at 1800 revolutions per minute. The swing over the bed is 14½ inches; over the carriage guides, 13 inches; and over the cut-off slide, 6⅛ inches. The hole through the spindle is 1⅝ inches in diameter, and the thread on the spindle nose is 4 inches in diameter with six threads per inch.

The spindle speeds on the No. 5 machine are 24, 36, 54, 80, 121, 187, 273, and 414 revolutions per minute with a driving pulley speed of 760 revolutions per minute. The driving pulley on this machine is 11 inches in diameter and carries a belt 2½ inches in width. A 3-horsepower motor also running at 1800 revolutions per minute supplies the drive. The swing over the bed is 17½ inches; over the carriage guides, 16 inches; and over the cut-off slide, 8 inches. The hole through the spindle is 2⅛ inches in diameter, and the thread on the spindle nose is 4⅞ inches in diameter with six threads per inch.

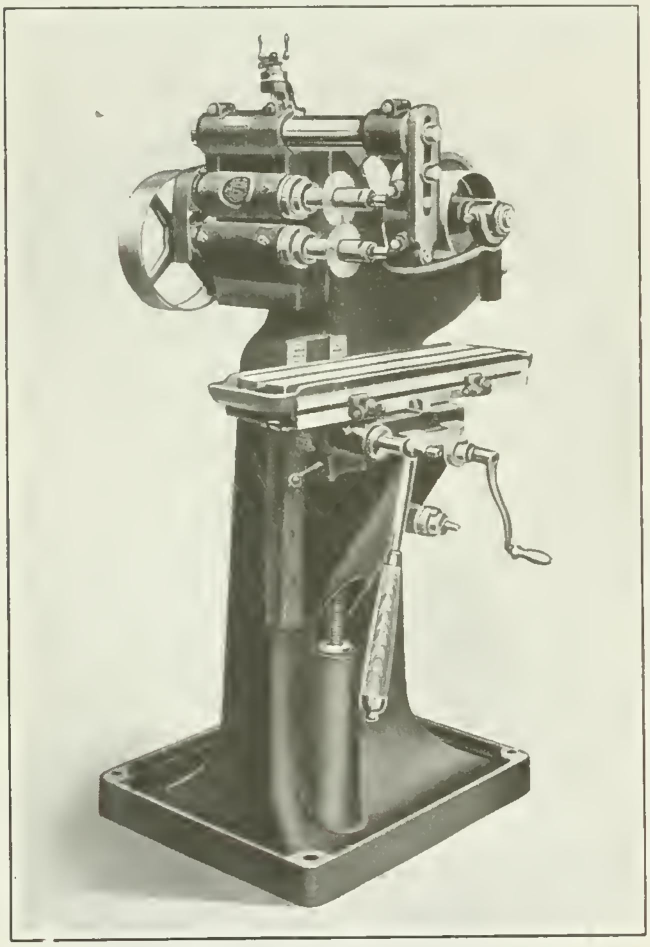
The spindle speeds on the No. 7 machine are 20, 30, 45, 67, 102, 150, 227, and 337 revolutions per minute, with a driving pulley speed of 780 revolutions per minute. The driving pulley is 12 inches in diameter and takes a 3-inch



All-geared Head now furnished on Foster Screw Machines belt. A 5-horsepower motor having a speed of 1800 revolutions per minute is used. The swing over the bed is 20 inches; over the carriage guides, 18½ inches; and over the cut-off slide, 10 inches. The hole through the spindle is 3 inches in diameter, and the thread on the spindle nose is 6⅛ inches in diameter, with six threads per inch.

U. S. DOUBLE-SPINDLE HAND MILLING MACHINE

A double-spindle milling machine of the hand-operated type has been brought out by the United States Machine Tool Co., Richmond St. and McLean Ave., Cincinnati, Ohio. This machine was designed primarily for milling the step slot in automobile piston-rings; however, it can also be used to advantage on other operations, such as milling opposite keyways in small shafts. All feeds are by hand, the same as on the single-spindle milling machine which has been built for years by this firm. There are two arbors on the new machine, one of these running in the right-hand direction and the other in the left-hand direction. Two or more cutters may be mounted on them at one time. The upper spindle is adjustable away from the lower one a distance of 1¼ inches to allow for wear of the cutters. The spindles are special drop-forgings and run in bronze bearings.

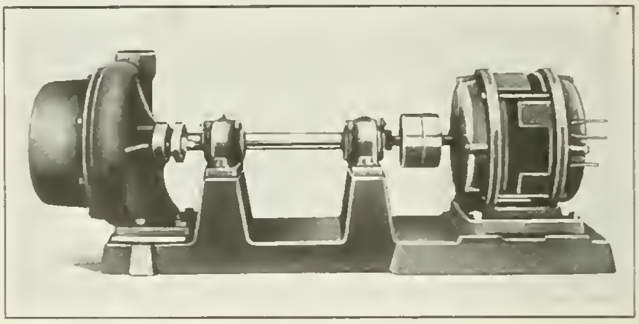


Double-spindle Hand Milling Machine built by the United States Machine Tool Co.

The table measures 7 by 23 inches, and has a longitudinal movement of 6 inches when operated by the hand-lever, and 16 inches when operated by the crank. The cross-feed is 5 inches, and the vertical feed 15¾ inches. Micrometer dials are provided on all feeds to permit of making close adjustments. The machine can be furnished with either a three- or a two-step cone pulley and a countershaft of the friction-pulley type, or with a direct motor drive. About two horsepower is required to run the machine. It is claimed that 300 or more piston-rings can be milled per hour on this double-spindle machine, the production depending to some extent on the design of the fixture provided for holding the work.

"FULFLO" MOTOR-DRIVEN PUMP

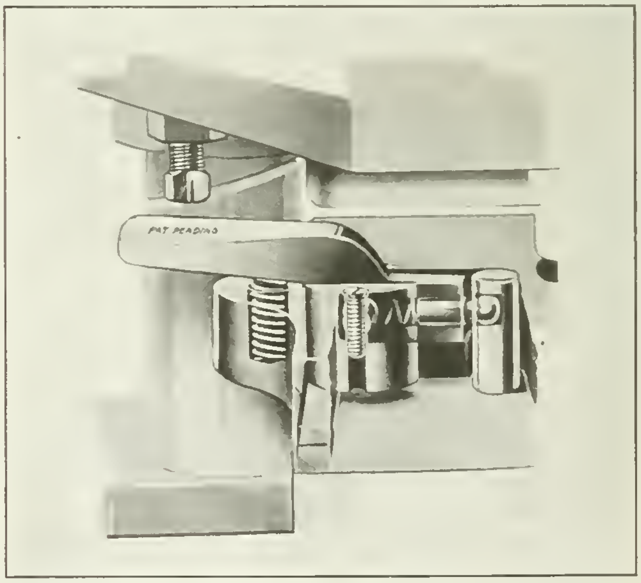
A seventy-five gallon motor-driven pump has been added to the line of pumps made by the Fulflo Specialties Co., Blanchester, Ohio. This pump is equipped with ball bearings throughout, and is adapted for pumping such liquids as cooling compounds, oils, brines, and enamel. The self-priming and anti-clog features embodied in "Fulflo" pumps of past designs, and their free floating impellers, have been incorporated in the new product. It is claimed that with either a central supply-tank system or with individual machine pumps, a constant flow of liquid through the pump is assured, whether delivering only a few drops or a copious flow.



"Fulflo" Motor-driven Self-priming Pump

DANLY BLANKING DIE STOP

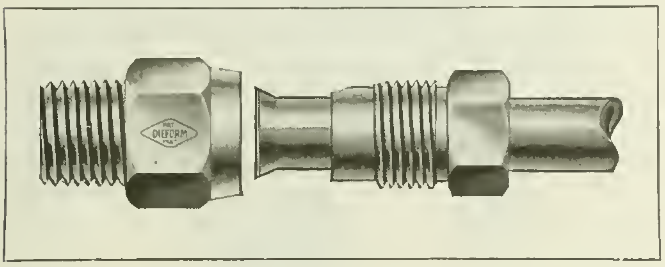
A gage or stop intended for application to blanking dies of almost any construction, whether of the simple, progressive, or compound type, is being introduced to the trade by the Danly Machine Specialties, Inc., 1613 N. Lincoln St., Chicago, Ill. This stop is of simple and compact design. A set-screw on the upper die member strikes a lever to actuate the stop members on the stripper plate. To attach the stop to the die, it is merely necessary to drill three holes and plane or mill a groove, ¼ by 5/16 inch long, to connect two of the holes. The assembly of the stop members to the stripper plate is made after drilling two small holes to receive grooves.



Danly Stop for Application to Simple, Progressive, and Compound Blanking Dies

PARKER TUBING COUPLING

For use with fuel-oil burners and in machinery and other equipment requiring replaceable solderless couplings for soft metal tubing, such as brass and copper, the Parker Appliance Co., Superior Viaduct and Vermont Ave., Cleveland, Ohio, has brought out the "Dieform" coupling here illustrated. This coupling has two nuts, which flange the ends of the tubing being connected, as the nuts are assembled. The tubing is supported in the same manner as in S. A. E. couplings. The couplings are made in different sizes to suit ⅛-, 3/16-, ¼-, 5/16-, and ⅜-inch tubing. The different sizes have standard pipe threads, and are interchangeable with other couplings.

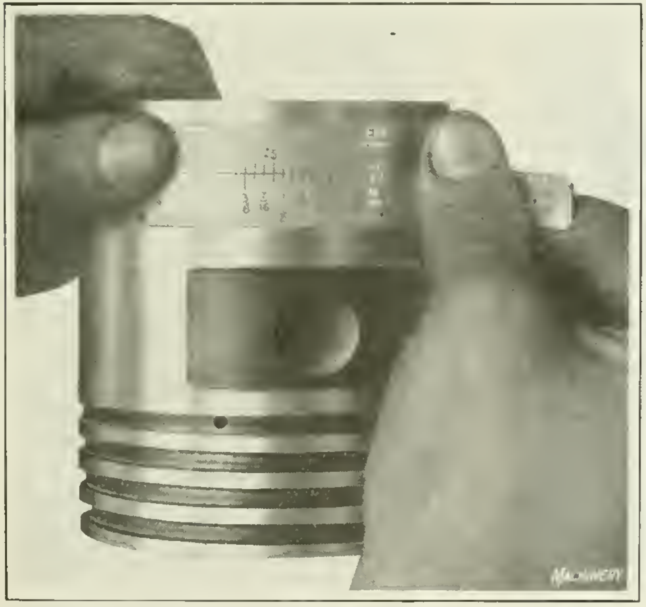


"Dieform" Coupling for Brass and Copper Tubing

SCHAAP "OUTSLIDEMIKE"

A handy instrument or tape intended for measuring the diameter of circular parts, such as automobile pistons, from 2⅝ to 5 1/16 inches, within an accuracy of 0.001 inch, has been brought out by the Schaap Co., 344 Cumberland St., Brooklyn, N. Y. This device is intended to cover the work of the outside micrometer caliper, but instead of giving readings in decimals, it gives direct readings in fractions of an inch to sixteenths, and in thousandths of an inch more or less than a given fraction. For instance, if a piston measured 4.3175 inches by means of the micrometer caliper, the "Outslidemike" would give a reading of 4 5/16 inches plus 0.005 inch. It is particularly intended for use by mechanics who are not familiar with the decimal system. The graduations are spaced about three times farther apart than on micrometers, and so can be easily read.

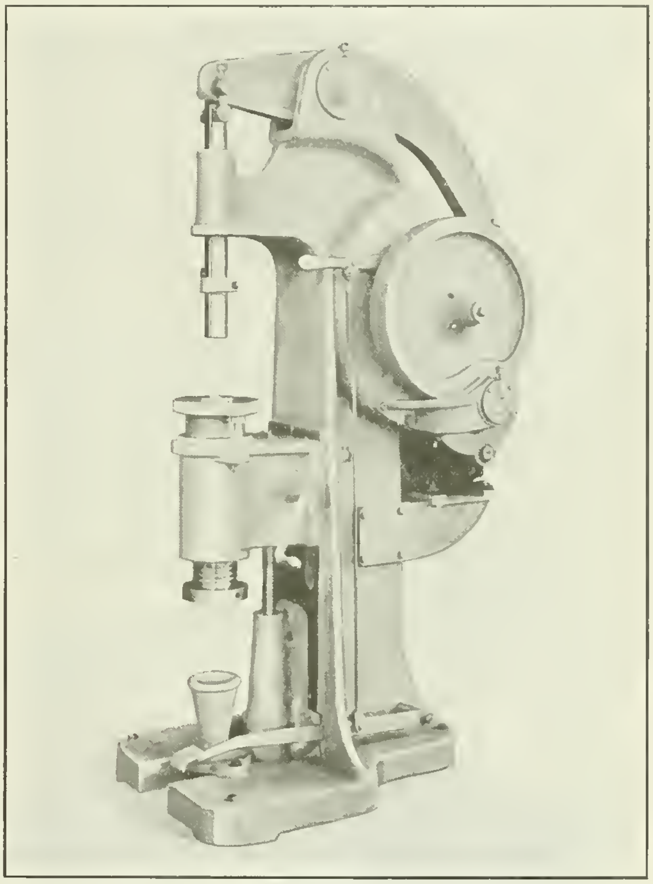
In use, the device is wrapped around the part, as illustrated, with the end held by the right hand beneath the end pressed down with the left-hand thumb. The diameter is found on the lower band by reading the fractional graduation approximately opposite the zero line of the upper band. If the zero mark does not coincide exactly with a graduation, the graduations in the upper band are read in the same manner as a vernier to determine the number of thousandths of an inch that the work is larger or smaller than the fractional dimension nearest to the zero mark. In the illustration the device shows the diameter of the piston to be 4 5/16 inches plus 0.004 inch.



Measuring the Diameter of a Piston with the Schaap "Outslidemike"

GREENERD CAM-OPERATED MOTOR-DRIVEN ARBOR PRESS

A cam-operated motor-driven No. 24 arbor press intended especially for use in shops where a large number of pieces are held on arbors or mandrels for machining, and where parts are assembled in large quantities by employing arbor presses, has been placed on the market by Edwin E. Bartlett, Nashua, N. H. The end of the ram is bored and threaded to receive special tools. It has a maximum movement of 5 inches obtained by means of a cam and rocker arm. This movement may be reduced by means of a clamping collar on the ram that may be set to prevent the complete return of the ram and thus reduce the effective throw of the cam. The cam is operated from an instantaneous Horton clutch, and may be engaged either by hand or foot. A ½-horsepower motor running at 1140 revolutions per minute is used to drive the machine, the gear reduction from the motor to the camshaft being such that the cam revolves at the rate of about 20 revolutions per minute and makes a complete cycle in three seconds. A quick return is provided for the ram.



Greenerd Arbor Press, built by Edwin E. Bartlett

The knee contains a yielding work surface and is adjustable for height. The yielding abutment is held under tension caused by compressing a coil spring, this tension being adjustable by means of a screw. There is a 2½-inch diameter hole through the abutment. A receiving pocket attached to the base catches arbors, etc., dropping through the knee. The over-all height of this press is 73 inches, and the distance from the center of the ram to the frame is 9 inches. The weight of the machine complete is approximately 1575 pounds.

LEBLOND HEAVY-DUTY ENGINE LATHES

Thirteen- and fifteen-inch heavy-duty engine lathes of both geared- and cone-head types are being brought out by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Except for the headstock and taper attachment, these lathes are quite similar in design to lathes of other sizes built by the same company. Two types of motor-driven lathes are furnished—a belt-driven machine equipped with either an alternating- or direct-current constant-speed motor, and a gear-driven machine with a direct-current variable-speed motor.

The variable-speed geared motor drive is supplied with automatic controllers which embody a dynamic brake. The motor is mounted on top of the headstock, as illustrated in Fig. 1, the drive being transmitted through a pinion and an intermediate gear to a wide-face gear that replaces the driving pulley. In this construction the first series of gear changes, ordinarily in the headstock, are omitted, the speeds being obtained electrically; and on lathes with beds 6 feet or shorter, the clutch-operating lever is also eliminated, the spindle being controlled by means of the lever on the electric starting box. This lever controls both the forward and reverse rotation of the spindle, and when brought to the "off" position, applies the dynamic brake to bring the spindle to an instant stop. On lathes with beds longer than 6 feet, an apron motor control is supplied instead of an apron mechanical control.

In the belted motor drive, the motor is mounted on an adjustable plate attached to the head leg of the lathe at the rear, and power is transmitted through a belt to the driving pulley. On lathes equipped with this drive, having beds 8 feet and longer, the spindle is started and stopped mechanically from the apron, while with shorter beds, the spindle is started and stopped by means of the lever on the headstock. A 2-horsepower motor running at 1750 revolutions per minute is recommended for the constant-speed drive, and a 2-horsepower motor running at from 740 to 2200 revolutions per minute for the variable-speed drive.

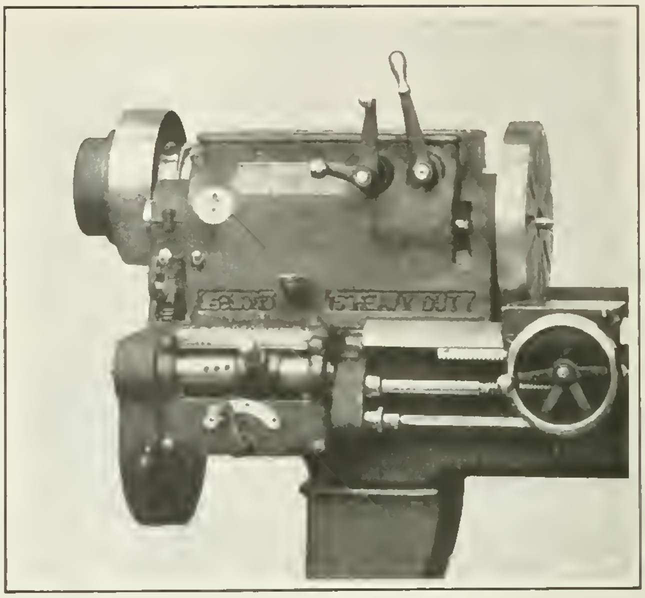


Fig. 2. Single-pulley Drive Geared Headstock which gives Nine Spindle Speeds

The single-pulley geared headstock developed for these lathes is shown in Fig. 2. It provides nine spindle speed changes ranging from 20 to 350 revolutions per minute, by the manipulation of two levers. The speeds may be readily determined from the direct-reading index-plate on the front of the headstock. All gears are made of steel, the sliding gears being made of a nickel-alloy steel, heat-treated and hardened. The gear teeth are of the stub form, and are rounded to insure easy engagement. The driving pulley is connected to the shaft through a multiple-disk clutch which is operated by a lever on the front of the head. This lever applies a brake when the clutch is released, so as to bring the spindle to an instant stop.

Oil is carried by the rotation of the gears to a simple conveyor trough, which may be seen in Fig. 3, and distributed in an abundant stream to the gears and bearings. The spindle bearings and the multiple-disk clutch are also continuously flooded with oil from the same source. The spindle is a 0.50-point hammered crucible-steel forging, and its bearings are made of bronze and lined with babbitt. The front spindle bearing is tapered, and can be adjusted for wear by means of adjusting screws at the front of the headstock.

On the double-friction back-geared lathe (not illustrated), the back-gear mechanism consists of two cone pinions, two back-gears fitted with friction clutches and mounted on the quill shaft, a face gear and pinion, and a lever used in engaging and disengaging the friction clutches. The friction clutch consists of but three parts, an expanding ring, a taper wedge, and a double taper key. The wedge and key are hardened and ground.

The taper attachment shown in Fig. 4, consists of a bracket bolted and doweled to the back of the carriage for carrying a stationary taper bar on which a swivel guide bar is mounted. The taper bar is dovetailed to the bracket, and is free to slide in it. The attachment can be put into use at any position along the bed by simply clamping a bracket to the shears of the bed. The taper guide bar can be set for turning any desired taper by means of a set-over knob and rack, and two binder studs provide for clamping the guide bar for turning the desired taper. This bar is graduated in sixteenths of an inch per foot, and in degrees. The cross-feed screw is mounted in a sleeve which, in turn, has a bearing in the carriage and in the outboard supporting bracket. In turning tapers, the steel draw-bar seen in the illustration is clamped to the taper shoe

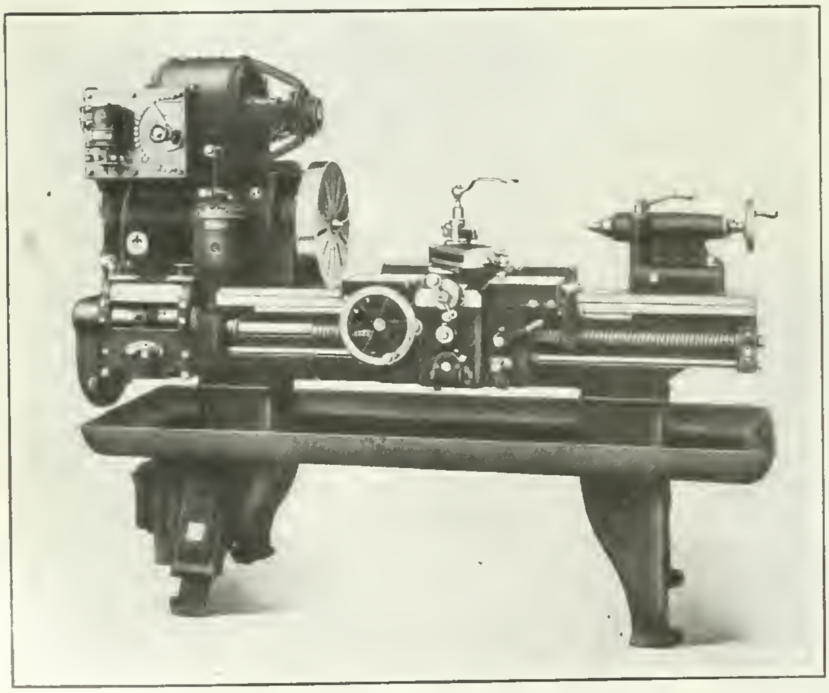


Fig. 1. LeBlond 15-inch Heavy-duty Engine Lathe equipped with Variable-speed Geared Motor Drive

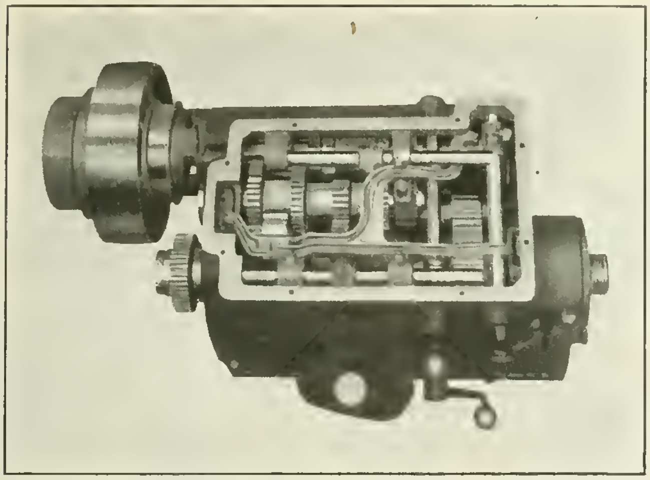


Fig. 3. View showing the Arrangement of the Mechanism in Geared Headstock

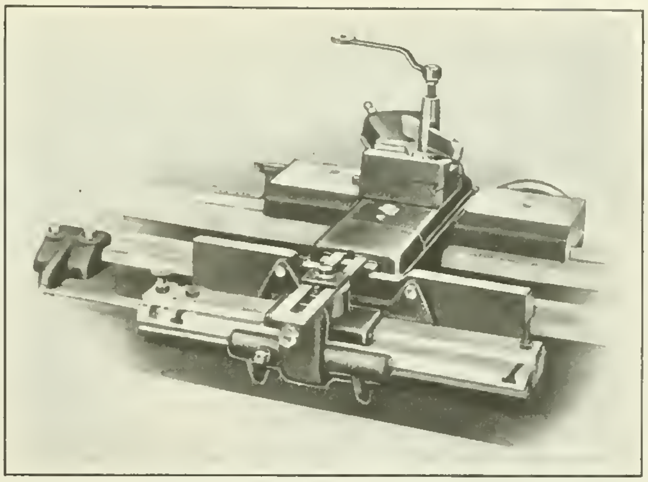


Fig. 4. Construction of the Improved Taper Attachment for LeBlond Lathes

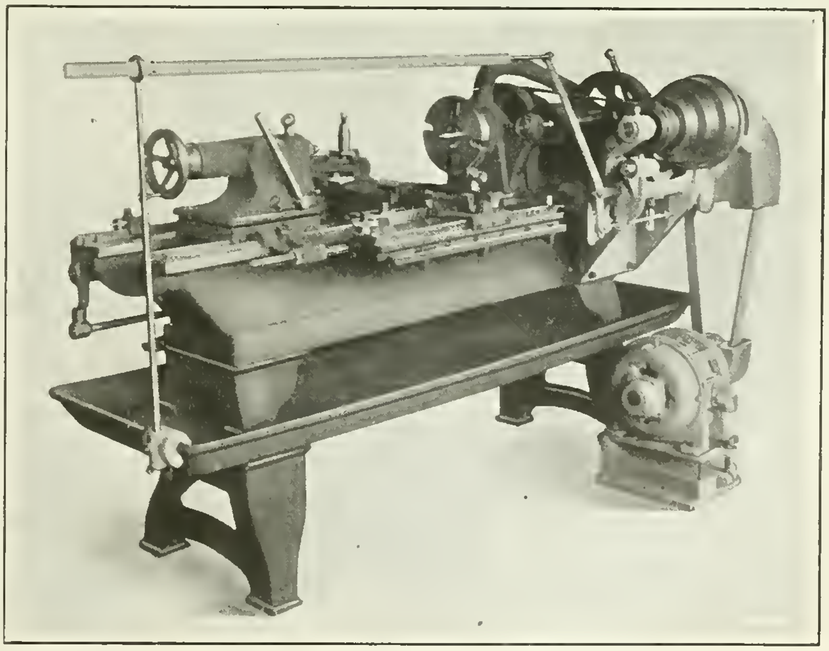
by means of a single bolt, so as to relieve the cross-feed screw and nut of all strain by having the pull taken by the draw-bar and not by the screw. This attachment can be used for turning tapers up to 3 inches included per foot and up to 15 inches in length at one setting.

The apron is equipped with a single positive-jaw clutch for controlling both the longitudinal and transverse feeds. The change from longitudinal to cross feed, or vice versa, is accomplished by means of a sliding gear transmission which is controlled by a knob immediately above the feed clutch. This device is set in a neutral position for threading operations. The bed is provided with the LeBlond improved "compensating vee," which automatically compensates for wear of the carriage and the bed. The range of threads and feeds obtained through the quick-change gear-box covers the usual requirements. A metric quick-change gear-box may be supplied. The compound rest body is set at an angle of 60 degrees with the toolpost T-slot and so there is no interference with the cross-feed screw handle when turning large-diameter work.

Some of the principal specifications of both sizes of lathes are as follows: Distance between centers with a 6-foot bed, 2 feet 7 inches; size of spindle hole, 1 11/32 inches; number of feeds, 32; and range of threads which can be cut, from 3 to 46 per inch. The swing over the carriage on the 13-inch lathe is 9⅞ inches, and on the 15-inch lathe 11¼ inches; and the swing over the shears on the 13-inch lathe is 15 inches, and on the 15-inch lathe 16¼ inches.

HENDEY MOTOR DRIVE FOR CONE-HEAD LATHES

A compact individual motor drive has been developed by the Hendey Machine Co., Torrington, Conn., for application to the 12-, 14-, 16-, 18-, and 20-inch lathes of both past and present designs built by this company. As will be seen from the illustration, the countershaft unit is mounted on a bracket base clamped to the rear vee of the bed at the headstock end, and is further secured by cap-screws which enter tapped holes near the bottom of the bed. A bracket hinged to the main casting carries the tight and loose pulleys, completely enclosed reduction gearing, countershaft, and cone pulley. The loose pulley runs on ball bearings, and both tight and loose pulleys, as well as the motor pulley, are enclosed by cast-iron guards.

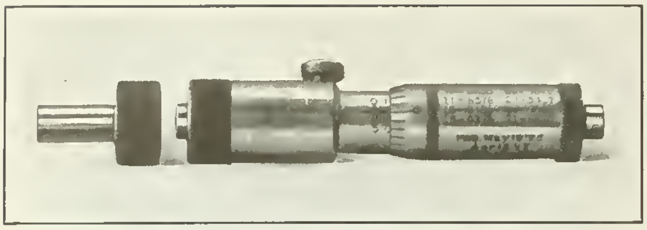


Hendey Cone-head Lathe equipped with Motor Drive

Loosening or tightening of the belt on the cone pulleys may be accomplished by means of quick-operating toggles and a hand-lever, which are employed to move the countershaft toward or away from the lathe spindle. Screw adjustments are also provided for regulating the tension of the belt to compensate for stretch incident to its use. The motor base and its platform are furnished to suit the motor selected, the platform being secured to the base proper by means of a hinged pin at one end and adjustment screws at the other. These furnish a means of keeping the motor belt at the desired tension. The main motor base is bolted to the floor within the area allotted to the lathe. A constant-speed motor of either alternating or direct current, running at about 1200 revolutions per minute is recommended; however, a lower-speed motor or one running up to 1800 revolutions per minute may also be used. Installation of this drive is quickly accomplished, as the preliminary work consists only of drilling and tapping two holes in the bed and, in some cases, slightly dressing a portion of the rear side of the bed to receive the countershaft bracket.

SLOCOMB INSIDE MICROMETER

The particular advantage claimed for a new inside micrometer now being placed on the market by the J. T. Slocomb Co., Providence, R. I., is that it is impossible for this instrument to get out of order unless it is completely disassembled and the adjusting means moved. This means that the instrument would continue to function accurately, even though



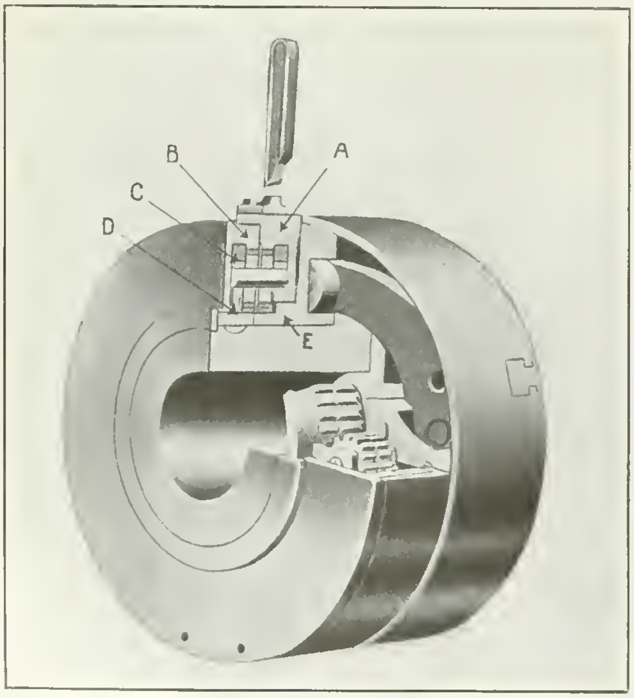
Slocomb Inside Micrometer

a workman were to play with it and perhaps turn the adjustable measuring end. The micrometer is provided with the regular Slocomb adjustment and a tool-steel spindle. It is made in various sizes.

FOSTER-BARKER WRENCHLESS CHUCK

Improvements have recently been made in the mechanism embodied in the Foster-Barker wrenchless chuck manufactured by the Foster Machine Co., Elkhart, Ind., which was described in October, 1920, MACHINERY. This mechanism transmits either an accelerating or a retarding motion to a revolving cam from a hand-lever which does not revolve. Referring to the illustration, internal gears *A* and *B* do not revolve with the chuck, one being fixed to the casing and the other fastened to the hand-lever. Center gear *D* and cam *E* revolve with the chuck, a connection being always maintained with the internal gears through pinions in spider *C*. This member revolves in the same direction as the chuck, but it makes only about one-third the number of revolutions per minute.

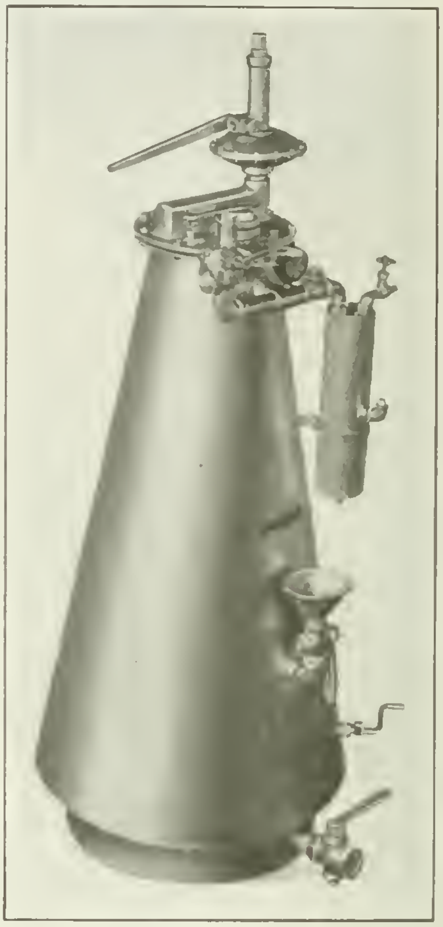
It is evident that if internal gear *A* is advanced relative to gear *B*, cam *E* will be retarded with relation to center gear *D*, and this relationship exists whether the chuck is revolving or stationary. Against the cam surface of part *E* is registered the roller of the arm shown. Consequently, the cam operates the arm, the opposite end of the arm being attached to the jaws and thus opening or closing them as it is moved. The cam of a three-jaw chuck is divided into three equal divisions, and that of a two-jaw chuck into two divisions, both styles having a quick initial rise and the remaining distance slow and powerful. The jaws are thus quickly moved into contact with the work and then forced together with an increased pressure by the slow continued movement of the lever. The movement of the hand-lever for operating the chuck jaws is imparted through the inside set of pinions to the cam. It will be apparent that the jaws may be opened and closed whether the chuck is in motion or at rest.



Improved Foster-Barker Wrenchless Chuck

MILBURN ACETYLENE GENERATOR

A portable acetylene generator for use in oxy-acetylene welding, which is designed to obviate the use of high-pressure cylinders, is made by the Alexander Milburn Co., 1416-1428 W. Baltimore St., Baltimore, Md. This generator has a carbide capacity of thirty pounds, which is equivalent to 150 cubic feet of cylinder gas. The feed is of the double plunger type, operated by means of a diaphragm control through a lever having a movement in a six to one ratio. A cast head forms the housing for the lever, and this is made accessible by removing a plug from each side of the housing. A vertical rod on the hopper connects with the lever of the diaphragm control at the top and with two plunger valves at the bottom. One of these plunger valves shuts off the carbide when the pressure is at zero, and the other when high pressure is reached. The generator has a standard blow-off valve with a self-releasing lever. The body of this equipment is made of steel and welded throughout, and the weight of the generator is about 200 pounds.

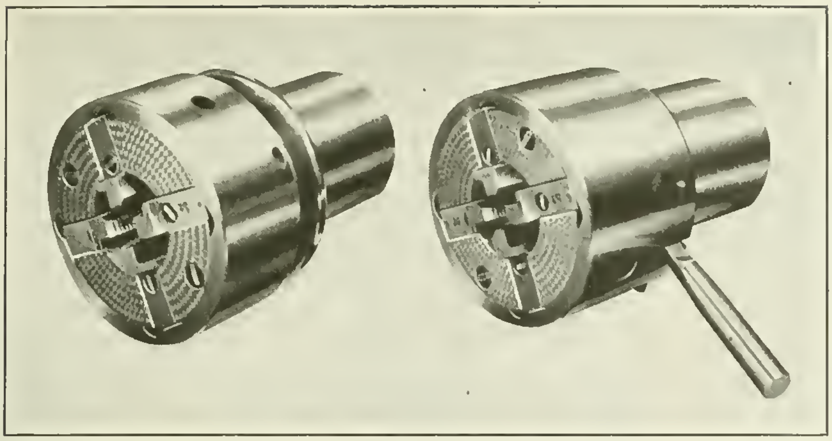


Milburn Acetylene Generator

"NAMCO" HARDENED DIE-HEADS

A line of hardened die-heads made in both the revolving type (as shown at the left in the illustration), and the non-revolving type (as shown at the right), is being placed on the market by the National Acme Co., Cleveland, Ohio. The non-revolving type is intended for use on hand-operated machines. Each type is made in four sizes, to cover a thread range of from 3/16 to 1½ inches. The body and shank of these die-heads are made in one piece, as are also the cam and cup, so as to obtain a simple construction. The bearing of the chasers is directly against the solid cup-cam, and thus eliminates a number of small parts. The cup wall is said to be unusually heavy. Altogether, with the exception of the chasers, only ten parts enter into the construction of these die-heads.

Special alloy steel is used for every working part, including the cup, and all parts are hardened and ground. The chasers are hobbed and lapped, and are ground on the bottom. They fit hardened and ground plates, and are fully supported



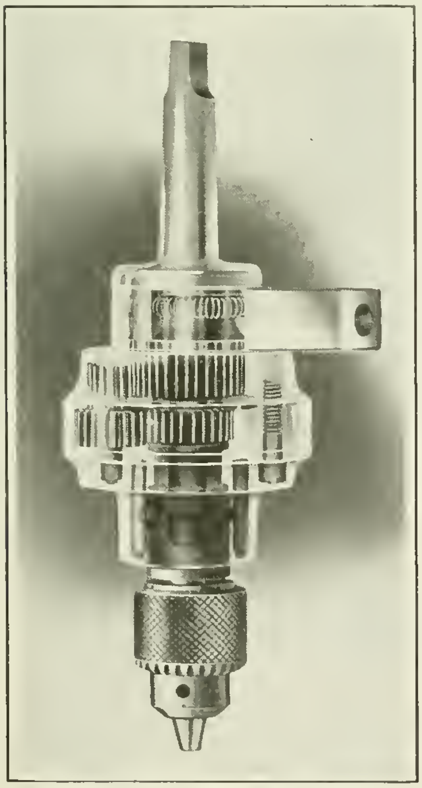
"Namco" Revolving and Non-revolving Types of Die-heads

to insure rigidity while cutting. The chasers project beyond the body of the die-head, so as to permit of threading close to shoulders and to provide freedom from chips. A running test is given each set of chasers. The shank is made either soft or hard, as desired, a hardened plate being supplied for the screw when a soft shank is used. An inside trip can also be furnished.

JARVIS SENSITIVE HIGH-SPEED TAPPING DEVICES

Two sensitive high-speed tapping devices are now being placed on the market by the Geometric Tool Co., New Haven, Conn. These differ from the Jarvis style FD friction type tapping device illustrated in November, 1921, MACHINERY, in that they are equipped with a shock absorber, are particularly sensitive, and their bodies are made of aluminum. Also, the new devices are intended for tapping only up to 3/16-inch holes, whereas the previous style covered a range from 0 to ¼ inch. The chuck spindle is made of tool steel, hardened and ground.

Style OA has a positive ball drive, while style OAN has a cone friction drive. However, both styles are equipped with the shock absorber, which acts on reverse gears. This feature is of great advantage, especially when the spindle is running, for example, at 2000 revolutions per minute, and the chuck runs at 4000 revolutions per minute in reverse. The shock at the instant of the impact would ordinarily be great, and by practically eliminating it, the average life of the taps has been increased. Style OA is intended for work tapped through the piece and style OAN is recommended for tapping blind holes and for tough work. These devices weigh slightly less than two pounds.

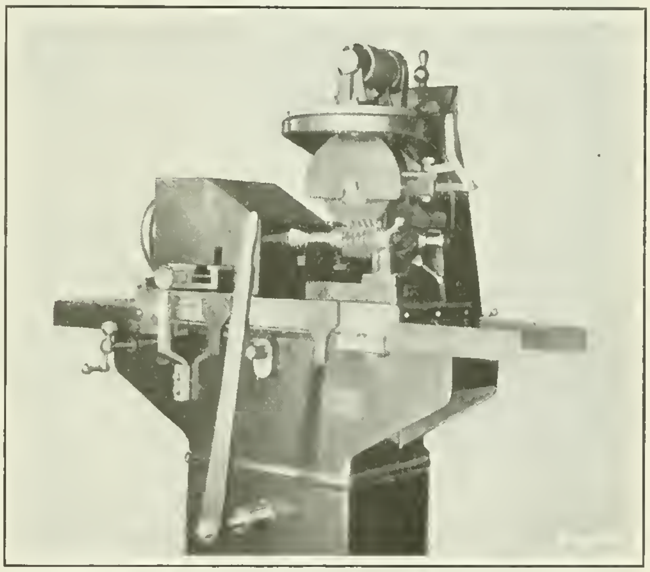


Jarvis High-speed Tapping Device

HARRIS SEMI-AUTOMATIC HOB-GRINDER

A semi-automatic machine intended for grinding gear hobs that have either straight, right- or left-hand helical flutes and that are not over 4 inches in diameter by 5 inches in length, is being placed on the market by the Harris Engineering Co., Bridgeport, Conn. This No. 5 semi-automatic hob-grinding machine, except for the size of work handled, is similar to the larger No. 10 machine described in October MACHINERY. An important improvement has been made in the method of transmitting rotary motion to the work during the travel of the table in order to permit of grinding hobs having right- or left-hand helical flutes. A lever pivoted at the center and having ball bearings at each end is connected to the work-spindle through a steel tape which is wound on a drum. By changing the angle at which this ball-bearing lever operates, a positive helical motion is generated for the work during the travel of the table. The table is carried on ball-bearing rollers.

The index-plates are made of heat-treated chrome-nickel steel; they are accurately cut from a master plate and are double, one plate being used for indexing and the other for escapement. The escapement pawl is provided with an adjustment to take up wear, and because of this design all wear comes on the escapement plate and none on the set employed for indexing. By this arrangement the original accuracy is maintained. The indexing mechanism is semi-automatic, and is operative only at the end of the return stroke, thus preventing any damage which might occur to the grinding wheel or the hob by an accidental indexing in the middle of a stroke. The index-plates are quickly changed.



Harris Semi-automatic Machine for grinding Hobs up to 4 Inches in Diameter and 5 Inches in Length

The wheel-head and column are so designed as to make the center of the wheel swivel on the center line of the table and to obtain a minimum overhang. The wheel-spindle is carried in large bronze bearings of an oil-well construction, is dustproof, and has a device for taking up thrust and wear. It is driven by an open belt, and receives grinding wheels up to 7 inches in diameter. The diamond truing device is built in the head where it is always in position for use, and may be used when the machine is in operation, without disturbing the work.

This machine may be set to grind under-cut hobs or cutters and to give them top rake, as well as to grind them in the ordinary way with radial faces. The feed of the hob is obtained by rotating it against the wheel by means of a small handwheel, which is turned by the operator's left hand after each complete revolution of the hob. The machine may be furnished with either a countershaft or an individual motor drive. When motor-driven, the motor is mounted on top of the machine on a pedestal supplied with means for taking up belt slack. The machine is usually equipped for dry grinding, but it can also be provided with pumping equipment for wet grinding. All working parts are protected from emery dust.

* * *

NEW MACHINERY AND TOOLS NOTES

Saw Filing Machine: American Saw Filing Machine Co., Boston, Mass. A machine brought out primarily for filing band saws used in cutting soft metals. The machine operates automatically, the saw being fed forward in such a manner that the file advances from tooth to tooth, the same as in filing by hand. The feed is accomplished entirely independently of the teeth, so there is no interruption of the operation in the event that a broken tooth is encountered. The machine is adjustable to receive saws from 1/8 to 2 inches in width, and for filing teeth as fine as 15-point.

Forming Press or Brake: J. M. Robinson Mfg. Co., 3282 Spring Grove Ave., Cincinnati, Ohio. A gap forming press or brake which may also be readily converted into a gang punch. The housings have a gap of 12½ inches from the center of the slide which is a particularly convenient feature in cases where the sheets to be formed are wider than the distance between the housings, and when the metal is formed over dies to such a shape that it can only be removed by sliding from the end. The machine is built in three sizes, having 4½, 5½, and 6½ feet, respectively, between the housings.

Rotary Quenching Tank: W. S. Rockwell Co., 50 Church St., New York City. An automatic rotary quenching tank, designed according to the principle embodied in the Rockwell rotary furnace. It is intended for heat-treating small parts in large quantities, and may be operated directly from a rotary furnace. The parts to be quenched are slid quickly into the submerged end of the quenching tank where they are automatically picked up in small batches by an internal screw, conveyed through the quenching fluid and raised to a cone-shaped discharging spout. The continuous movement of the parts in the circulating fluid are said to insure uniform cooling.

Drop-hammer: Boston Hammer Co., Boston, Mass. A pneumatic gravity drop-hammer, which drops with all its force when the air has been released by operating a lever, and returns to the raised position ready for the next blow. The length of drop is adjustable, and the blow can be regulated from full to very slight, by opening or closing a release air valve. If the air should give out suddenly, an automatic check valve would function to hold up the hammer for several minutes, and then permit it to descend slowly. A safety lever necessitates that the operator use both hands in tripping the hammer. The weight of this machine is about 3600 pounds.

* * *

An ordinary vertical file is recommended by the Business Consultation Bureau of the La Salle Extension University as the simplest means for conveniently filing clippings from magazines. By filing the clippings in folders containing only material of like nature, and arranging the folders alphabetically, it is possible to so arrange the clipping file that any subject can be instantly referred to. If the clippings are small, it is desirable to paste them on standard letter-size sheets, so that they will not be lost among the larger sheets and clippings. When there is a great amount of material filed in this way, the file can be supplemented by a card index which will give cross-references.

TERMS OF PAYMENT FOR FOREIGN SALES

By H. A. NAU, American Machinery Corporation, Madrid, Spain

On page 435 of February MACHINERY, an article appeared entitled "Terms of Payment for Foreign Sales." This article does not seem to agree with the understanding of European and especially Spanish markets that the writer has acquired from many years' experience. Referring especially to Spain, it might be pointed out that every reliable concern in Spain considers it an insult if asked to pay for its purchases when the goods are ready for shipment in New York, and would prefer to buy their machines where the manufacturers or their Spanish representatives will grant them such terms as they may ask.

Referring to that part of the article that deals with credits obtained from banks in the customers' own country, it may be stated that Spanish banks, for example, will not extend any credit whatsoever upon stocks of machines or even real estate, without actually mortgaging them and thereby taking over the title of the owner. The only conditions under which credit can be obtained from the banks is through the personal guarantees of well-known people. The banks require a high percentage of interest for credits secured in this way, and extend credit for ninety days only.

As a result of the war, most of the European countries are entirely impoverished, but Spain is one of the exceptions, and may be considered financially one of the most reliable of the European countries, along with Switzerland, England, Holland, and the Scandinavian countries. For this reason, instead of trying to reduce credits to Spanish customers, American manufacturers ought to do everything in their power to extend greater credit facilities, inasmuch as Spanish currency is sound. A reliable agent should be given the benefit of the utmost that the American machine tool builder can do in this respect.

* * *

INDUSTRIAL RECOVERY ABROAD

It has been the common impression, according to one of the monthy reviews of the Federal Reserve Bank of New York, that this country has been almost the only one that has recovered any business activity since the depression of 1921, and it appears to be commonly believed that there has been little, if any, recovery in the European countries. Figures are not available to make possible any accurate measurement of European conditions, such as are possible in this country, but as pig iron and coal production are basic in the activities of practically all other industries, they reflect closely the status of any country's industrial activity, and the tonnage of ships cleared is a good measure of the movement of foreign trade.

The pig iron production in France, including Alsace-Lorraine, is now within 5 per cent of the pig iron production in France in 1913, and is 40 per cent in excess of the 1921 production. The coal production in France is within 6 per cent of the production in 1913, and is 10 per cent in excess of the 1921 production. The shipping of France is in excess of the pre-war shipping, and has increased by over 20 per cent in the last year. In England, the total measure of activity is less in proportion to pre-war business than in France, but the increase relative to the business in 1921 is greater. For example, in 1922 the pig iron production was nearly double that of 1921. The coal production increased by 50 per cent, and the tonnage of ships cleared, by over 60 per cent, so that, as far as the two leading European countries are concerned, business is improving, even if not at as rapid a rate as in the United States.

* * *

The General Electric Co. has announced the formation of an Employes Securities Corporation which will issue $5,000,000 worth of bonds to be sold to employes. Interest at the rate of 8 per cent will be paid to the purchasers of these bonds as long as they remain in the employ of the company.

PERSONALS

Fred K. Cordes, formerly connected with J. H. Williams & Co., Brooklyn, N. Y., is now associated with the Western Drop Forge Co. of Marion, Ind.

F. W. Davis, for several years connected with the Buffalo plant of J. H. Williams & Co., has become associated with the Western Drop Forge Co. of Marion, Ind., and will have charge of cost accounting.

Harold Prigoff, for the last four years sales manager of the Syracuse Supply Co., Buffalo, N. Y., has resigned to become eastern sales manager for the Gardner Machine Co., with headquarters in New York City.

Carl F. Berger, for ten years assistant manager of the Monarch Machine Tool Co., 209 Oak St., Sidney, Ohio, has been appointed secretary and general manager of the Whipp Machine Tool Co. of the same city.

Harry T. Scott, formerly sales manager of the Detroit Twist Drill Co., has become New England representative of the Whitman & Barnes Mfg. Co., Akron, Ohio, manufacturer of twist drills and reamers. Mr. Scott's headquarters will be in Hartford, Conn.

William W. Schwebs has been appointed general sales manager for William L. Procunier, Chicago, Ill., manufacturer of tapping chucks and attachments. Mr. Schwebs was formerly connected with the Western Electric Co., and the Keller Pneumatic Tool Co.

Henry F. Russell, formerly with the Lumen Bearing Co., and for the last five years sales manager of the iron foundry department of Farrar & Trefts, Inc., Buffalo, has been appointed treasurer and general manager of the Buffalo Smelting Co., Inc., Buffalo, N. Y.

Malcolm Grant, formerly with Black & Decker Mfg. Co., Baltimore, Md., has been appointed eastern district manager for the Rainey Tool Co., Cleveland, Ohio, manufacturer of machine tools, pneumatic drilling and chipping tools, mechanics' hand tools, and special tools.

Charles J. Schmid has been placed in charge of sales in Greater New York and Long Island of the carbon dioxide recorders and other power plant gages made by the Uehling Instrument Co., Paterson, N. J. Mr. Schmid was formerly in charge of the Boston office. His headquarters will be in Paterson temporarily.

S. S. MacIntosh, formerly associated with Cyril J. Bath, machinery dealer of Cleveland, Ohio, has recently become connected with the Maxwell Tool & Supply Co., 4500 Euclid Ave., Cleveland, Ohio, dealer in machinery, cutters, and belting. Mr. MacIntosh has had many years of experience in selling new and used machinery.

Paul A. Collins, formerly Washington representative of the Automatic Electric Co., has been appointed assistant manager of the P. A. X. Department of the North Electric Mfg. Co., Galion, Ohio, manufacturer of private automatic exchanges for inter-office communication and machine switching systems for city telephone exchanges.

Huber L. Morrison has joined the organization of the Greenfield Tap & Die Corporation, Greenfield, Mass., and will represent that company in Connecticut and Rhode Island. Mr. Morrison has been associated with the small tool industry for quite a number of years, and is well posted on all aspects of small tool manufacturing and selling.

Edward C. Waldvogel, general manager of the Yale & Towne Mfg. Co., Stamford, Conn., was elected a vice-president, at a recent meeting of the board of directors. His title will be vice-president in charge of sales. Mr. Waldvogel has been associated with this organization for the last eighteen years, starting as a traveling salesman in 1905.

M. D. Galbreath, formerly manager of sales of the McCoy-Brandt Machinery Co., has become associated with J. C. Marr of the J. C. Marr Machinery Co., and after April 1 will conduct business under the firm name of Marr-Galbreath Machinery Co., with office and warehouse at 127-129 Water St., Pittsburg, Pa. The company will deal in new and used machinery.

Richards & Geier, 277 Broadway, New York City, patent and trademark attorneys, have made the following additions to their staff: Joseph Farley, formerly an assistant examiner in the United States Patent Office and a member of the D. C. Supreme Court and Court of Appeals Bar; Henry Ruhl, trademark specialist; and Fritz Ziegler, Jr., registered patent attorney specializing in patent and unfair competition litigation.

C. J. Mundo has been placed in charge of the Pittsburg office of the Monitor Controller Co., Baltimore, Md., manufacturer of automatic motor controls for all kinds of motor-driven machinery. The Pittsburg office is located in the Union Arcade Bldg. G. H. Armstrong, formerly in charge of the Pittsburg office, is now located in Cincinnati at 307 First National Bank Bldg. Mr. Armstrong's territory will comprise southwestern Ohio, southern Indiana, and Kentucky.

B. Olney Hough, for many years editor of the "American Exporter," has established a business of his own as export counsellor, consultant, and adviser to banks, exporters, and manufacturers. The firm will be known as B. Olney Hough, Inc., and will be located at 17 Battery Place, New York City. Mr. Hough will continue to serve the "American Exporter" as export and technical adviser and writer, with the title of contributing editor. He has had a wide experience in the export field, and is the author of several books on exporting, one of which is entitled "Practical Exporting."

OBITUARIES

COLUMBUS K. LASSITER

Columbus K. Lassiter, president of the Consolidated Machine Tool Corporation of America, was stricken with heart failure, on the evening of March 3, as he was driving his automobile on Broadway, near 72nd St., New York City. He died shortly after, while being taken to the Roosevelt Hospital.

Mr. Lassiter was born in 1866 in Roanoke, Va. He reached a high position in the mechanical field by sheer perseverance and constant application to work. He did not have the foundation of a college education to build upon, because the death of his father, when he was thirteen years old, necessitated his leaving school to earn a livelihood. He was then apprenticed to a blacksmith and during his apprenticeship studied evenings. At that time he already evinced a keen interest in mechanical appliances. Upon completion of his apprenticeship, he obtained a position with a flour milling concern, and at the age of nineteen was managing the business. When twenty years old, he bought out a bakery and confectionery establishment. This enterprise was successful, but on account of his greater interest in machinery, he sold the business and in 1892 entered the employ of the American Locomotive Works at Richmond, Va., as a timekeeper. In ten years he had advanced to the position of vice-president in charge of production, and retained this position until 1922, when he resigned to become one of the organizers of the Consolidated Machine Tool Corporation of America.

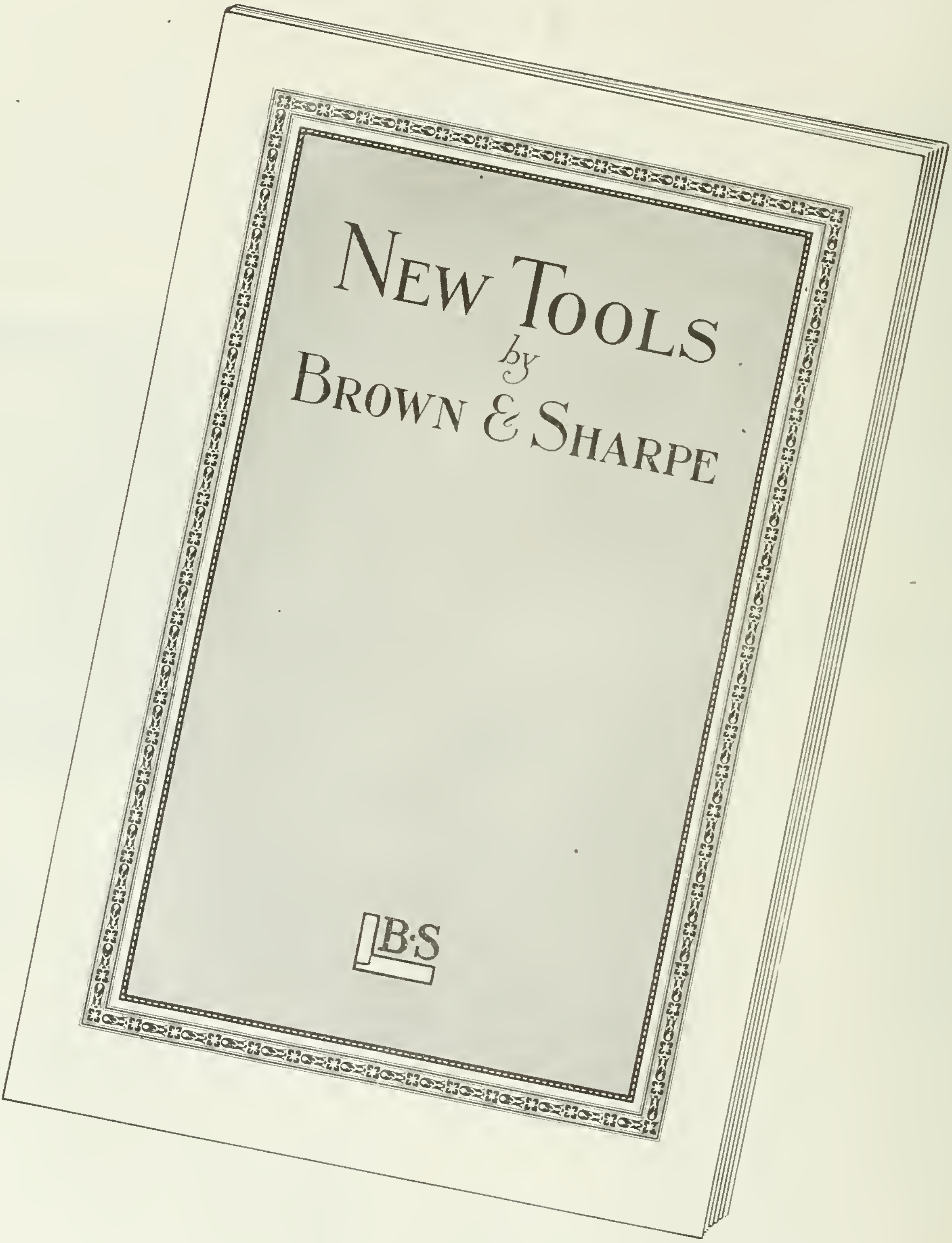
At the time of his death, Mr. Lassiter was interested in several industrial and financial companies in addition to the one of which he was the head. He owned the controlling interest in the Baush Machine Tool Co., Springfield, Mass., at one time. During his connection with the American Locomotive Works he took out a considerable number of patents, principally on staybolt cutting machines of both the horizontal and vertical types. When the war broke out, he successfully undertook the first contract to manufacture shells for the Allies. At one time he had 30,000 employes under his supervision in the American and Canadian plants of the company.

Mr. Lassiter is survived by his wife, two daughters, and a son, Robert R., who is secretary of the Consolidated Machine Tool Corporation of America.

Alton N. Bates, vice-president and general manager of the Erie Foundry Co., Erie, Pa., died February 17.

Howard M. Wilson, president of the Taylor Wilson Mfg. Co., Pittsburg, Pa., died suddenly on February 16, aged sixty-one years.

Send for this booklet—



on NEW TOOLS *by* BROWN & SHARPE

The New Tools described in this booklet are designed with typical Brown & Sharpe skill to meet certain present-day requirements of every mechanic and shop owner.

Such up-to-date tools as a single micrometer measuring from 2" to 6", a complete line of Micrometers covering a range from 0 to 24", and a 6" rule of Stainless Steel are a few of the New Tools this booklet describes.

These New Tools are direct helps toward better workmanship—they will benefit every man or shop which uses them.

Learn about these helpful tools—write for this booklet today.

With the booklet we shall be glad to send our No. 28 Small Tool Catalog if requested.

BROWN & SHARPE MFG. CO.
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B·S
TRADE MARK

TRADE NOTES

F. P. Screw Co., Cleveland, Ohio, has changed its firm name to the Cleveland Cap Screw Co. This change is in name only, the personnel remaining the same.

Hjorth Lathe & Tool Co., manufacturer of precision bench lathes and machine and machinist's tools, announces that it is now located at its permanent address, 10 Tremont St., Boston, Mass.

E. A. Harper Tool & Supply Co. has combined with the Aborn Steel Co., and has incorporated under the name of the Aborn-Harper Steel & Engineering Corporation, with offices at 22-24 Clarke St., New York City. E. A. Harper is president and directing head of the new corporation.

Timken Roller Bearing Co., Canton, Ohio, is making provision for a considerable increase in the production of Timken tapered roller bearings at both the Canton and Columbus plants. Extensive additions to the equipment are being made at both factories, and a large modern factory building is in the process of construction at the Canton plant.

Gibb Instrument Co., Bay City, Mich., manufacturer of electric welding equipment, has increased its capital stock from $75,000 to $175,000. The company announces the opening of a sales office in the General Motors Bldg., Detroit, in charge of F. M. Luchs, formerly chief engineer, and also in Cleveland, Ohio, at 2104 E. Superior Ave., in charge of W. O. Little.

Link-Belt Co. of Philadelphia, Chicago, and Indianapolis, announces that the price of its portable belt conveyor known as the "Cub" has been reduced more than 16 per cent. Owing to the large volume of orders on hand, the "Cub" loader was put on a quantity production basis, resulting in a large saving in the cost of manufacture, and thus making possible a reduction in price.

Stewart Mfg. Corporation, manufacturer of die-molded castings and bronze bearing metal, announces that the office of its Ohio representative, E. P. Grismer, has been removed from 326 Caxton Bldg., Cleveland, Ohio, to 1982 E. 66th St. A complete stock of semi-finished cored and solid bars of Stewart bronze bearing metal will be carried at that office for immediate delivery.

Shields Machine Co., 1729 Doan Ave., Cleveland, Ohio, has been organized to manufacture a line of small tools, as well as screw machine and automotive parts. The president of the concern is Carl Shields, formerly of the Shields Cutter Co. and the Cleveland Milling Machine Co.; vice-president and general manager, L. H. Mesker; and secretary-treasurer and factory manager, S. S. Shields.

Spartan Saw Works, Springfield, Mass., manufacturer of hacksaw blades, reports that its rapidly increasing business has made it necessary to erect a new factory, which is located at Wason and Fisk Aves., in Brightwood, Mass. The new building is a one-story brick and steel structure of modern mill type, conveniently arranged, and providing for expansion as the business increases.

Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill., have purchased the plant, stock, and good will of the Cincinnati Iron & Steel Co., Cincinnati, Ohio. Lewis E. Skinner, who has been connected with Joseph T. Ryerson & Son, Inc., for eighteen years, has charge of the plant. He will be assisted by C. A. Parnell, former assistant to Arthur Allshul at the Ryerson Buffalo plant.

Production Engineering Corporation, Canastota, N. Y., has been incorporated to take over the business of the Marvin & Casler Co. of Canastota. The corporation will continue to manufacture and sell the Casler tools, including offset boring heads, drill chucks, non-floating reamer holders, planer jacks, planer blocks, and T-slot nuts. The new company is particularly equipped for designing and building special machinery and tools.

Charter Gas Engine Co., Sterling, Ill., has purchased the entire Mietz (also known as Mietz & Weiss) oil engine business heretofore carried on at 128 Mott St. and 430 E. 19th St., New York City, by the August Mietz Corporation and the Reliance Oil Engine Corporation. The Charter Gas Engine Co. is now moving from New York City to its plant at Sterling, Ill., all the physical assets comprising the Mietz engines, meanwhile filling repair orders from New York.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio, manufacturer of high-pressure hydraulic presses, pumps, valves, accumulators, and intensifiers, has recently increased its capitalization from $260,000 to $1,200,000, and is contemplating making extensions and changes in its equipment and buildings. The contemplated extensions consist of a new office building; an extension to the erecting shop, wood, and pattern department; and the addition of a number of new machines to the machine shop and pattern department.

Foster Machine Co., Elkhart, Ind., manufacturer of turret lathes, screw machines, and H. & M. thread millers, announces that at a regular meeting of the board of directors held on February 12, Oskar Kylin was elected vice-president of the company. Mr. Kylin, who is primarily responsible for the design of the new line of Foster screw machines and turret lathes brought out and perfected during the last six years, will continue in immediate charge of sales and engineering. The Syracuse Supply Co., Syracuse, N. Y., has been appointed exclusive agent for the products of the company.

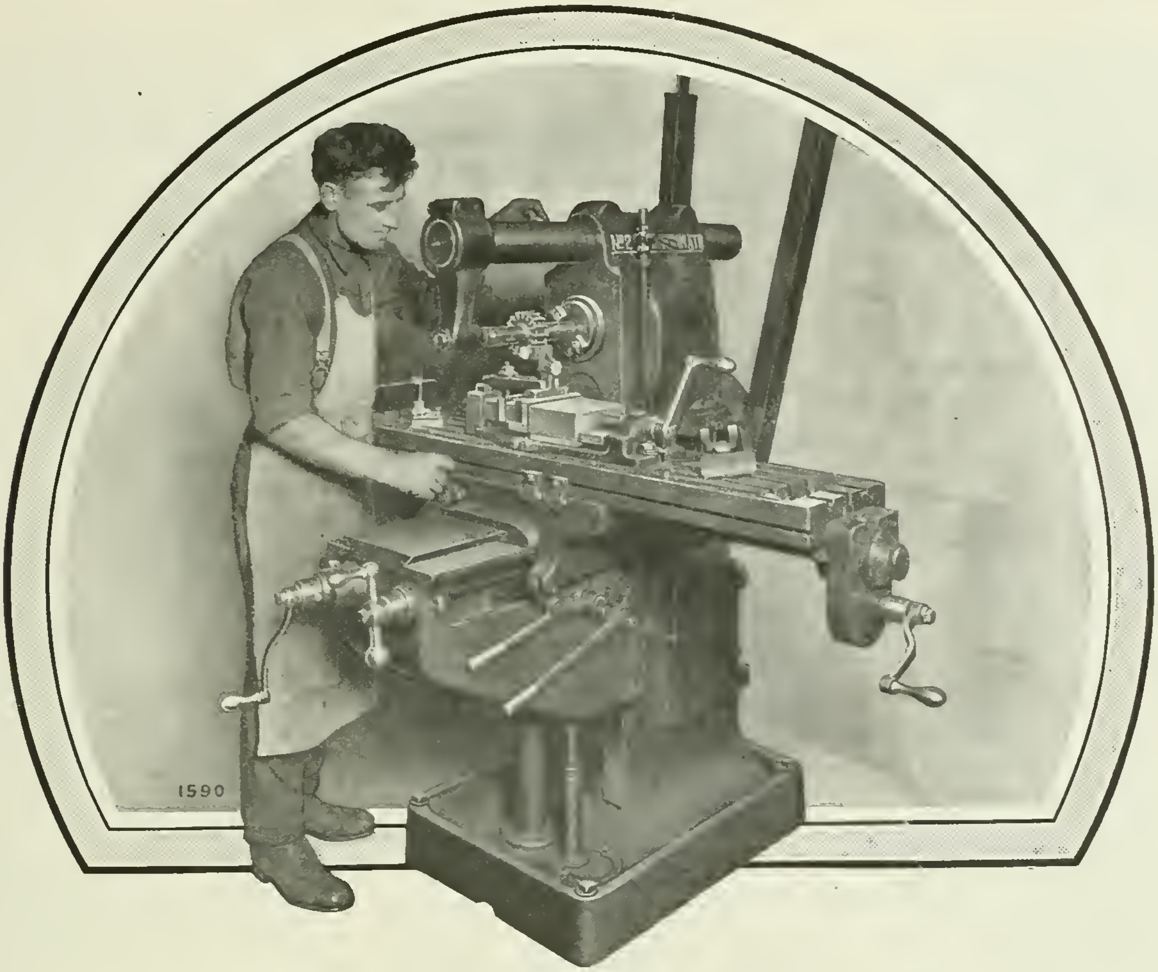
Triplex Machine Tool Corporation, manufacturer of the "Triplex" combination bench lathe, milling and drilling machine, has moved its office from 18 E. 41st St. to 50 Church St., Hudson Terminal Bldg., New York City. At the new address the corporation will also act as dealer in machine tools, small tools and supplies, and has made arrangements for representing several concerns in the New York and New Jersey districts. This company was awarded the Gold Medal at the international exposition of inventions recently held in the Grand Central Palace, for its combination bench lathe, milling and drilling machine, which was there exhibited.

American Tool & Mfg. Works, 652 W. Lake St., Chicago, Ill., is a new concern engaged in the design and manufacture of special machinery, dies, jigs and fixtures, and screw machine and punch press products. A. B. Cochrane, president of the new concern, purchased the plant and equipment of the Screw Machine Products Corporation, the Standard Clutch Control Co., and W. I. Denny. Mr. Cochrane was formerly district sales manager for the Steel & Tube Co. of America and the Mark Mfg. Co. Robert Hofstetter, formerly engineer with the Illinois Tool Works of Chicago and the Nash Motors Co. of Kenosha, Wis., is manager.

Uehling Instrument Co., Paterson, N. J., has appointed Mitsui & Co. its exclusive representatives in Japan and China for the sale of Uehling carbon dioxide recording equipment and other power plant instruments and gages. The main office of Mitsui & Co. is located in Tokio, Japan, and the New York branch office of the company is at 65 Broadway. ·The Uehling Instrument Co. has also appointed two new agents in the West and Middle West. John E. Arnold, 15½ S. Fourth St., Tulsa, Okla., will have the territory covered by the state of Oklahoma, and H. R. N. Johnson, 917-A Marquette Ave., Minneapolis, Minn., will have the territory of Minnesota, North Dakota, and South Dakota.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., manufacturer of multi-graduated precision grinders, precision thread lead variators and gage blocks, and permanent alignment wheel truing heads, announces the following appointments as foreign representatives: Toronto and Vancouver, Canada, The A. R. Williams Machinery Co., Ltd.; Montreal, Canada, Williams & Wilson, Ltd.; France, Belgium, Switzerland, Italy, and Spain, Allied Machinery Co. of America; Norway, Sweden, and Denmark, V. Lowener; Japan, Andrews & George Co.; Petrograd and Moscow, Russia, M. Mett Engineering Co.; Holland and Dutch East Indies, R. S. Stokvis & Sons; Berlin, Germany, Bohm & Bormann; Melbourne, Australia, Bevan & Edwards.

Wells Corporation, Greenfield, Mass., has been formed as a holding company in which are consolidated the Frank O. Wells Co., Inc., Greenfield, Mass., the American Tap & Die Co., Greenfield, Mass., and the Williamsburg Mfg. Co., Williamsburg, Mass. The joint capital in this merger is well in excess of $1,000,000. The Frank O. Wells Co., Inc., manufactures thread cutting tools, reamers, counterbores, broaches, broaching machines, and tap and drill grinding machines. F. O. Wells, president of the company, was one of the original founders of the firm of Wells Bros., tap and die manufacturers, started in 1876. In 1912 Mr. Wells organized the Greenfield Tap & Die Corporation, of which he was president up to the time of his resignation in 1919. Since that time he has been engaged in development work in the tap and die field. Mr. Wells will be president and consulting engineer of the new consolidated company. L. E. Peck, who has been general manager of the Frank O. Wells Co., Inc., will be vice-president and general manager of the new company. A. B. Allen, of the American Tap & Die Co., manufacturer of a line of standard screw cutting tools as well as of butchers' cutlery and supplies, will be secretary and treasurer of the consolidation. Mr. Allen was formerly cashier of the First National Bank of Greenfield. The Williamsburg Mfg. Co. manufactures a line of screwdrivers, iron levels, and hacksaw and butcher saw frames. David B. Miller, of the Frank O. Wells Co., Inc., will continue in his present capacity, as will also Herbert J. Smith, who will continue as the superintendent of the American Tap & Die Division of the corporation. No changes in the several organizations are planned.



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Feed changes are made at the front of the machine—not at the side or rear of the column.

All other control levers are reached by the operator from the same position. Speed changes are made and both the hand and power longitudinal cross and vertical feed control levers are reached.

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Cincinnati flanged spindle end
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COMING EVENTS

April 9-14—Paper Industries Exposition to be held at the Grand Central Palace, New York City. Charles F. Roth and Fred W. Payne, managers, Grand Central Palace.

April 16-19—Twenty-fifth annual convention of the National Metal Trades Association at the Hotel Astor, New York City. Secretary, L. W. Fischer, Peoples Gas Bldg., Chicago, Ill.

April 18-20—Spring convention of the Society of Industrial Engineers, at Hotel Gibson, Cincinnati, Ohio. Further information can be obtained from the business manager of the society, 327 S. La Salle St., Chicago, Ill.

April 19-21—Seventh annual meeting of the American Gear Manufacturers' Association, at the Hotel Cleveland, Cleveland, Ohio. T. W. Owen, 2443 Prospect Ave., Cleveland, Ohio, secretary.

April 26-28—Transportation meeting of the Society of Automotive Engineers in Cleveland, Ohio. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

April 28-May 3—Twenty-seventh annual convention and seventeenth annual foundry machine and equipment exhibit of the American Foundrymen's Association at Cleveland, Ohio. C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill., secretary.

May 2-4—Tenth National Foreign Trade Convention in New Orleans, La. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 3-5—Semi-annual meeting of the American Electro-chemical Society at Hotel Commodore, New York City. Secretary, Colin G. Fink, 327 S. La Salle St., Chicago, Ill.

May 7-10—Eleventh annual meeting of the National Chamber of Commerce in New York City at the Waldorf-Astoria Hotel. Secretary, D. A. Skinner, Mills Bldg., Washington, D. C.

May 15-18—Annual convention of the National Association of Purchasing Agents at Cleveland, Ohio. Secretary, O. H. R. Heydon, 19 Park Place, New York City.

May 17-19—Joint convention of the National Supply & Machinery Dealers' Association, Southern Supply & Machinery Dealers' Association, and American Supply & Machinery Dealers' Association in Cincinnati, Ohio. Secretary, F. D. Mitchell, 1819 Broadway, New York City.

June 11-14—Annual meeting of the Electric Power Club in Hot Springs, Va.; headquarters, Hotel Homestead. Executive secretary, S. N. Clarkson, Kirby Bldg., Cleveland, Ohio.

June 14-15—Eastern sectional meeting of the American Society for Steel Treating in Bethlehem, Pa. National secretary, W. H. Eisenman. Hotel reservations made through George C. Lilly, superintendent of heat-treatment, Bethlehem Steel Co., Bethlehem, Pa.

June 19-23—Summer meeting of the Society of Automotive Engineers at Spring Lake, N. J. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

June 25-29—Annual convention of the American Institute of Electrical Engineers at Swampscott, Mass. For further information, address the secretary's office, 29 W. 39th St., New York City.

June 25-30—Twenty-sixth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa., secretary.

October 8-12—Annual convention of the American Society for Steel Treating to be held in Pittsburg, Pa., in connection with an international steel exposition. W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio, national secretary.

NEW BOOKS AND PAMPHLETS

The International Metric System of Weights and Measures. 16 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 2 of the Bureau of Standards.

Preparation and Properties of Pure Iron Alloys. By Henry S. Rawdon and Frederick Sillers, Jr. 17 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 464 of the Bureau of Standards. Price, 10 cents.

An Investigation of the Properties of Chilled Iron Car Wheels—Part II. By J. M. Snodgrass and F. H. Guldner. 72 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 134 of the Engineering Experiment Station. Price, 40 cents.

Dermatosis Following the Use of Cutting Oils and Lubricating Compounds. By William J. McConnell. 22 pages, 6 by 9 inches. Reprint No. 770 from the Public Health reports. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents.

Trademarks. 46 pages, 6 by 9 inches. Published by Richards & Geier, Patent and Trademark Attorneys, 277 Broadway, New York City.

This is the third edition of a pamphlet on trademarks and trade-names, covering selection, use, registration, validity, unfair competition, and duration of right. The law governing registration of trademarks is stated, and information is given on what may or may not be registered, procedure in making application for registration, procedure in the patent office, renewals, etc. The law and practice governing trademarks in foreign countries is also included. This book is distributed gratuitously to those interested in the subject.

Machine Tools and Their Operation—Part I. By Fred H. Colvin and Frank A. Stanley. 341 pages, 6 by 9 inches; 77 illustrations. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $4.

This is the first of two volumes to be brought out on the construction and operation of machine tools. The first volume contains a discussion of the fundamental principles involved in the operation of lathes, drilling machines, hand and automatic screw machines, screw machine tools, and boring machines. The section on lathes takes up work held between centers; driving and turning work; steadyrests, follow-rests, and faceplate work; chucks, chucking and boring tools; taper turning and boring; thread cutting; and the lathe indicator. The section on drills treats of the shape of the cutting edges, clearance lubrication, and speeds and feeds. The section on hand and automatic screw machines describes the Pratt & Whitney, Brown & Sharpe, Cleveland and Acme machines. The part dealing with boring describes boring machines and their work; the horizontal machine in the railroad shop; unusual work on a boring machine; the vertical boring machine; and methods of holding work to be turned and bored.

Metals and Their Alloys. By Charles Vickers. 800 pages, 6¼ by 9¼ inches; 110 illustrations. Published by Henry Carey Baird & Co., Inc., 2 W. 45th St., New York City. Price, $7.50.

This book treats of the preparation, properties, and uses of alloys of all kinds. The volume is partly based on the book "Metallic Alloys", by W. T. Brannt, but the revision has been so complete that a practically new book has resulted. The aim in preparing this work has been to make it of value to the practical man. The author is a foundryman of many years' experience, and a specialist in the melting, alloying and casting of metals. He has contributed extensively to the technical press. The physical properties of the various alloys have been given, when it was possible to obtain them, and simple formulas have been included. Information is given on magnesium alloys, and the precautions to be observed when melting and alloying the electron group of alloys. The melting and casting of monel metal is also described, and the chapter on die-casting treats of the die-casting of bronze, as well as the low-fusing alloys. The foundry uses of scrap metals is the subject of another chapter. The alloys have been divided into twelve classes, each having a different metal as a base, including iron and steel, as well as alloys having zinc as a base.

Design of Machine Elements. By James Alexander Mease and George Fred Nordenholt. 237 pages, 6 by 9 inches; 101 illustrations. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $2.50.

The text of this book is intended as a course in elementary machine design. Simple stresses and moments only are dealt with, the treatment of combined stresses being avoided. The fundamental relations between simple forces and stresses are first established, and then applied as far as practicable to simple machine elements. All theoretical formulas are developed, and, wherever possible, the theoretical basis for empirical formulas is explained. In almost all cases the method of procedure in making computations is outlined. The text is divided into twenty chapters headed as follows: Definitions and Simple Stresses; Moments and Moment of Inertia; Materials and Fundamental Considerations; Bolts, Nuts, and Screw Fastenings; Determination of Required Bolt Diameters; Cylinders and Riveted Fastenings; Keys for Shaft Fastenings; Shafts; Transmission of Power from One Shaft to Another; Gear Tooth Profiles; Spur Gears; Bevel Gears; Worm and Worm-wheel; Belts and Pulleys; Rotating Pieces; Standard Bearings; Connecting-rods; Flywheels; Helical Springs; and Application of Friction.

NEW CATALOGUES AND CIRCULARS

General Motors Corporation, Detroit, Mich. Sheets for loose-leaf catalogue, containing material specifications and heat-treatments for iron and steel and for non-ferrous metals and alloys.

New Departure Mfg. Co., Bristol, Conn. Sheets Nos. 5, 14, 34, 35, and 119 FE for loose-leaf catalogue, showing installations of ball bearings in centrifugal pumps, driving pulleys of drilling machines, change-speed gearing for machine tools, motor-driven exhausters, and spinning lathes.

Wagner Electric Corporation, St. Louis, Mo. Bulletin 131, containing instructions for ordering and adjusting repair parts of Wagner single-phase motors. The bulletin points out the various causes of a motor failing to start or to operate correctly, and describes methods of correcting the trouble.

Hoosier Universal Machinery Co., Goshen, Ind. Catalogue describing in detail the construction of the Hoosier spring cushion universal joint, which is designed with a torque cushion, by means of which the life of clutch, bearings, gears, and axle shafts is conserved, and the transmission of power is effected without shock.

Golden-Anderson Valve Specialty Co., Fulton Bldg., Pittsburg, Pa. Bulletin illustrating and outlining the features of the Golden-Anderson "Non-return" valves, by means of which a disabled boiler can be instantly isolated from a battery in case of accident, thereby confining the damage to one boiler and eliminating shut-down of the plant.

Hy-Way Service Co., South Bend, Ind. Circular of the Williams vertical cylinder grinder, containing a list of the special advantages of this machine, a detailed description, and general specifications. The machine is equipped with an "Oil-gear" variable hydraulic feed pump, which gives any desired feed instantly to the grinding wheel, with automatic reverse and rapid traverse for raising the wheel out of the work.

Greenfield Tap & Die Corporation, Greenfield, Mass. Bulletin 101, illustrating and describing "Hydroil" Nos. 51 and 52 internal grinding machines, designed for the accurate grinding of internal surfaces on a quantity production basis. The bulletin describes the principal features of these machines, and gives complete specifications and details. Bulletin 2, containing data on G. T. D. drills, taps, and dies for lighting fixture manufacturers.

Farrel Foundry & Machine Co., Inc., 344 Vulcan St., Buffalo, N. Y. Catalogue descriptive of the Sykes patent double helical gear generating machine, the rights for which have been acquired in the United States and Canada by this company. Illustrations of the machine and examples of the continuous double helical gears cut by the Sykes process are shown. The catalogue points out the particular advantages of this process, and gives the capacity, speeds, etc., of the machines.

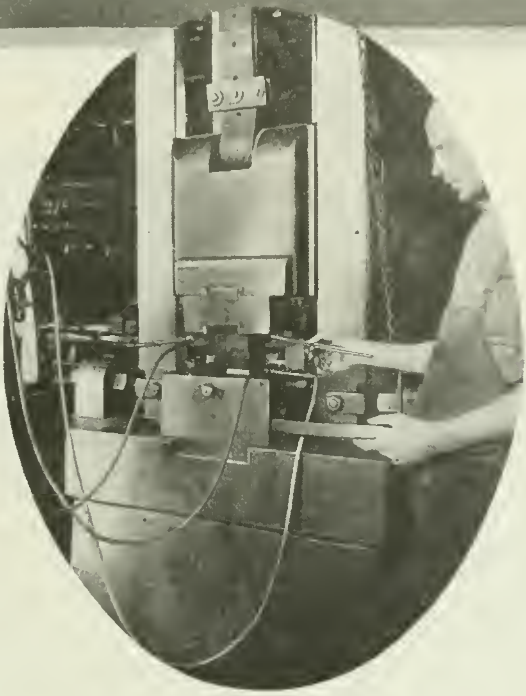
Goodell-Pratt Co., Greenfield, Mass. Catalogue 15, 448 pages, 6 by 9 inches, covering the entire line of Goodell-Pratt tools, including drills, chucks, bit braces, augers, saws, cutters, tool handles, screwdrivers, countersinks, nail sets, punches, chisels, hammers, wrenches, valve lifters, vises, grinders, grinding and polishing heads, squares, levels, steel rules, straightedges, calipers, micrometers, screw pitch gages, etc. The catalogue contains a complete index of the various tools, as well as a separate list of the new tools.

Landis Machine Co., Inc., Waynesboro, Pa. Catalogue 27, containing illustrations and descriptive material covering the Landis line of pipe threading and cutting machines, pipe and nipple threading machines, chaser grinders, and automatic die-heads. The distinctive characteristics of the Landis die are pointed out, and a detailed description of the chasers and chaser-holders is given. Specifications covering the size, range, number of chasers, capacity, etc., are arranged in tabular form. A numbered list of the names of parts of the Landis die-heads and pipe threading and cutting machines is included for convenience in ordering repair parts.

Timken Roller Bearing Co., Canton, Ohio, has published two booklets dealing with methods of steel making and the heat-treatment of steel, which have been prepared by the metallurgist and furnace superintendent of the company. These books describe in detail the processes used in the plant of the Timken Roller Bearing Co. for making special electric steel for Timken bearings. A comprehensive description of the heat-treating methods is also given. The booklets include the results of recent important research work by the metallurgical department of the company, and comprise technical treatises rather than mere catalogues.

Victor Tool Co., Inc., Madison & W. M. R. R., Waynesboro, Pa. Catalogue 10, illustrating and describing the line of tools made by this company, which includes self-opening die-heads, collapsible taps, solid adjustable taps, floating tool-holders, and nut facing machines. The various tools are described in detail and fully illustrated, and tables of specifications are given covering the size and capacity of each. The book is completely illustrated with views of the tools as well as views showing them in operation on specific jobs. The latter illustrations are supplemented with data concerning the nature of the work and the production time.

Prolonging the Life of Forging Dies



A Method of Increasing the Resistance of Steel to Repeated Shocks and Resulting Fatigue and Crystallization

By MORGAN PARKER
President, Bard-Parker Co., Inc., New York

A remarkable discovery has been made regarding a method of prolonging the life of cold-forging dies or other tools that are subject to fatigue and failure as the result of repeated shocks. This discovery, as successfully applied to commercial forging operations, is here described for the first time. Before the introduction of this method in connection with a certain cold-forging operation, the Bard-Parker Co. obtained from a few hundred to about one thousand forgings during the life of an expensive pair of dies. Now by the application of the simple discovery referred to, the production during the life of a set of dies has been increased to fifteen or eighteen thousand forgings. This same method is applicable to other classes of shock-resisting tools.

A SIMPLE but effective method of prolonging the life of shock-resisting tools has been discovered. This method, briefly described, consists in artificially maintaining the dies or tools, while in use, at a temperature above that resulting from normal operation but below the temperature at which they are hardened and drawn.

When forging dies are expensive to replace, as when exceptional accuracy or intricate shapes are required, the total production obtained during the life of a set of dies becomes an important item in the cost, and the heated die method is especially applicable under these conditions. This method was discovered by H. Reinhardt, 80 Rutland Road, Brooklyn, N. Y., and it was first applied in a commercial way by the Bard-Parker Co., 37 E. 28th St., New York City.

Many efforts have been made in the past to increase the total production obtained during the life of drop-forging dies. These attempts have consisted chiefly in experiments with the better grades of alloy steels in place of ordinary straight carbon and heat-treated die-blocks. Such attempts have generally proved unsuccessful, because the alloy steels, either through lack of toughness or because of an unsuitable composition for hot-forging die work, usually failed, and the cost of most of the new steels proved so high as to more than offset any economy gained through a slight extra service. Attempts to solve the problem by inserting special steel sections in ordinary die-blocks have also resulted in failure in nearly every case.

Prior to the time when high-speed steel first made its appearance, around 1900, there was little reason, perhaps, to question the use of dies and tools at atmospheric or shop temperatures, although even then the practice of warming drop-hammer dies and other shock tools on a cold morning "to take the chill out of them" was quite an old one on two continents. It was known that hardened dies and tools are very brittle around and below the freezing point. Owing to the relatively low critical point of the ordinary carbon steels then in use, care had to be taken not to overheat the faces of the dies while in use and thus impair their hardness; hence it is not surprising that the plan of operating dies or tools at artificially high temperatures was not thought of.

While studying the peculiar magnetic properties of various high-speed steels, as compared with other steels, the remarkable tenacity and elasticity of the test pieces at temperatures ranging from 300 to 1100 degrees F. was discovered. Further investigation proved that the samples could, without exception, be made very tough, without affecting their hardness to any marked degree, by heating them. Subsequent shock tests on alloy steel samples known to possess very little resistance to shock, showed plainly that these steels will stand a lot of pounding if sustained at artificial temperatures. Apparently the toughness of hardened steel increases with its temperature up to a certain point. It remains to be ascertained whether or not there is any distinct rule relating to toughness and temperature that would fit all kinds of steel, and it may be that eventually a formula will be found for determining the temperature at which one steel or another will give the best service.

An important fact also brought out by the pounding test is that fatigue, or crystallization, is effectively retarded, if not altogether prevented, by suitable artificial temperatures. Heat evidently gives a certain amount of molecular freedom, which reduces the rigidity of the martensite. In this state of molecular freedom, the compressive strength of hardened tool steel grows to an extraordinary extent. We find that the crystals are kept in a state of elasticity by the steady flow of heat from a burner into a die-block, against the effects of the severe pounding of a drop-hammer, or the combination of shock and pressure in forging machines; in fact, increasing the temperature of the dies by artificial means seems to be the one effective remedy crystallization being prevented as borne out by actual shop experience.

Practical Application of the Method

Before the heating method was utilized by the Bard-Parker Co., much trouble was experienced with cold-forging dies. This company manufactures a surgical operating knife, the principal feature of which is a detachable blade, which may be replaced after use like the safety razor, thus obviating resharpening.

The dies are used for the handles of these knives. This scalpel handle (see Fig. 2) must be forged accurately, the end to which the blade fits having a tolerance of 0.001 inch. To obtain this accuracy, the handles are swaged cold in dies finished accurately and with a high polish. All name and trademark type is raised in the die, thus avoiding machine sizing and stamping operations on the forgings and eliminating the possibility of inaccuracy. The handles are made of a non-ferrous nickel alloy, and require annealing between the successive rough- and finish-swaging operations under the drop-hammer, owing to the density of the material. With this cold drop-forging operation, success depends upon the dies, which soon fail to produce satisfactory work if used at ordinary temperatures. From the beginning, the heating method showed a great increase in the life of the dies.

The company referred to had tried every brand of die steel within reason, and every known method of routing and sinking the dies, both in hot and cold die-blocks. Nevertheless, production never exceeded a few hundred to a thousand forgings per die, so that the burden of die depreciation, coupled with the constantly increasing demand for the article, made it impractical to continue that method of production. Consequently, the Reinhardt heating method was put into operation. This method is covered by a U. S. letters patent, and is also protected in foreign countries.

Dies Used and Method of Heating to Prolong Life

The set of dies used for this forging operation was made up of a non-shrinkable semi-high-speed steel, containing about 2.5 per cent carbon, 14 per cent chromium, 1 per cent nickel, and 0.55 per cent manganese. The dies were hardened glass hard, and slightly drawn to relieve internal stresses. While in use under the drop-hammer, these dies are sustained at an artificial heat of 400 to 450 degrees F., by the use of gas burners. The first set of dies made and operated in this way produced eighteen thousand forgings, in comparison with a few hundred by the old method; the second pair of dies produced fourteen thousand forgings. The dies in both instances finally gave out by splitting in two, lengthwise of the impression. The fractures showed that the molecular structure of the steel had in no way been disturbed; there was no trace of crystallization, the fracture presenting a beautiful dense satin-like surface and being a good example of the forged grain of the die-block.

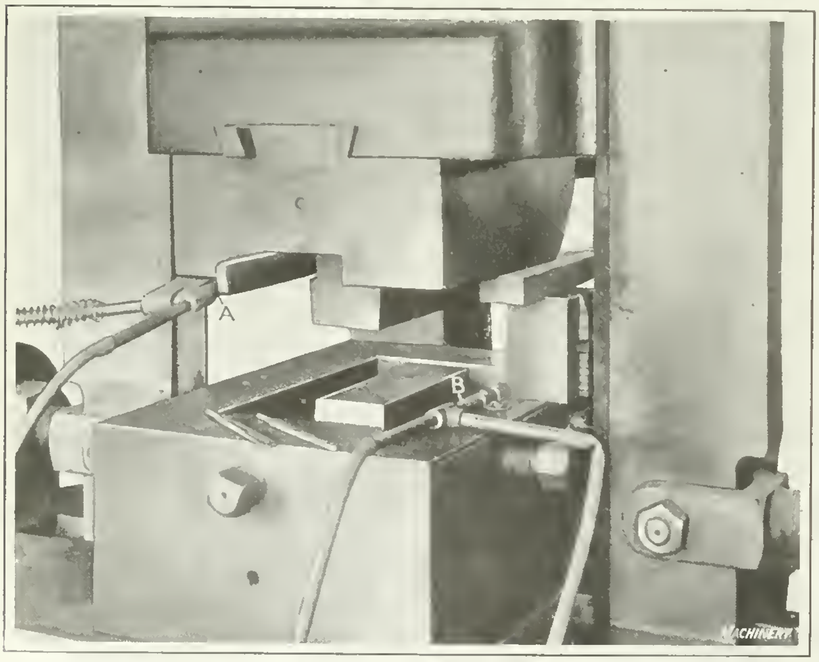


Fig. 1. Hammer equipped with Cold-forging Dies and Gas Burners for heating the Dies to a Temperature of 400 to 450 Degrees F. while in Use

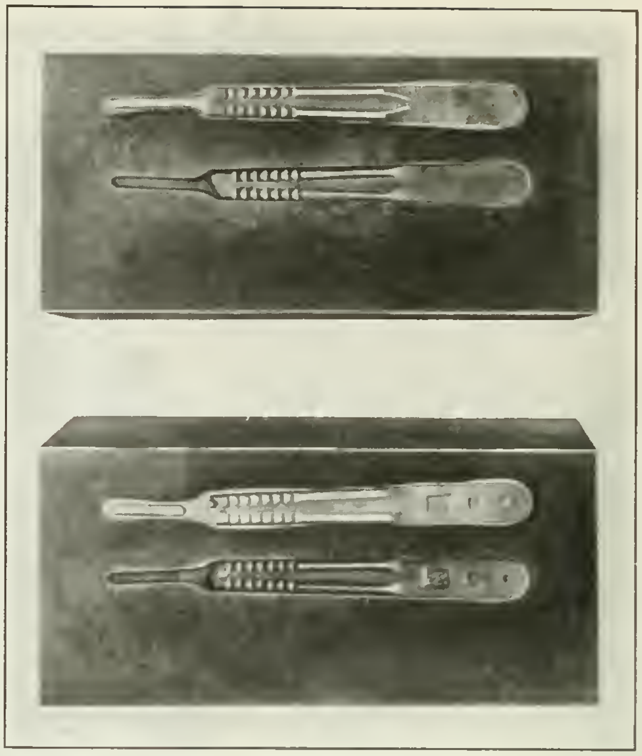


Fig. 2. Upper and Lower Dies and Sample Forgings, showing the Side formed by Each Die

The temperature (400 to 450 degrees F.), although not affecting the hardness of the dies, is sufficiently high to prevent the dies from flying to pieces which would happen instantly with this steel on the first blow if the dies were used cold. The dies are heated by a very simple arrangement, consisting of four small and very light gas burners, two being attached to each die on opposite sides, as shown in the heading illustration. The burners on the upper die were screwed to the hammer and connected by flexible tubes to the gas and air supply pipes.

The burner for the upper die is located at *A*, Fig. 1, and the burner for the lower die at *B*. Each burner is in the form of a perforated pipe, and the flame plays against one side of each die-block. Pilot lights have been installed to relight the burners at the top of the stroke, should they be extinguished by the jar of the blow. When the dies have been brought up to the required heat, which may be checked by bringing soldering wire into contact with them, the burners are turned down sufficiently to maintain the proper heat and offset the loss through radiation.

Many other dies have been made since the first trial and used for protracted periods without showing any sign of crystallization, bearing out the previous experience concerning hardened dies that showed no sign of fatigue under heat operation. A set of old carbon steel dies previously used without artificial heating for this forging operation, is shown in Fig. 3. These dies produced 1100 forgings, but to obtain this number, it was necessary to use additional intermediate breaking-down and annealing operations. The upper die finally chipped out on the left-hand side, as the illustration shows, and there are small but objectionable imperfections on the lower die (not visible in the illustration).

Results of Additional Tests

Horizontal forging machines in which heading and gripper dies are used in manufacturing hot- and cold-forged bolts and rivets, afford an unusually good opportunity to show the benefits derived from the application of heat to the tools in operation, because practically unlimited quantities of bolts and rivets are made, and the tools are used until unfit for additional service. On small cold-forgings, figures have recently been obtained showing that heading dies of a high-carbon chromium steel, under a constant heat of about 400 degrees F., yield four to five times as many rivets as the average tool-steel dies used unheated. The tests have shown that these heading dies made of a very high-grade wear-resisting alloy steel, eventually require replacing on account of wear only, and do not show the defects (sponginess) typical of the unheated carbon tool-steel dies normally used, which make the latter unfit for further use.

This marked difference in the performance of the heated and unheated tools indicates that crystallization caused by fatigue is retarded in the heated dies to such an extent that the tools require replacement on account of wear long before they show any indication of crystallization. This makes it possible to use the tools again after they have been redressed, whereas tools that have been used without artificial heat have to be discarded on account of defects extending an inch or more down into the stock. Unfortunately, owing to the way these tools are confined, difficulties are experienced in applying the heat through Bunsen burners; and there is a lack of suitable electric heating devices having the necessary resistance to shock and vibration.

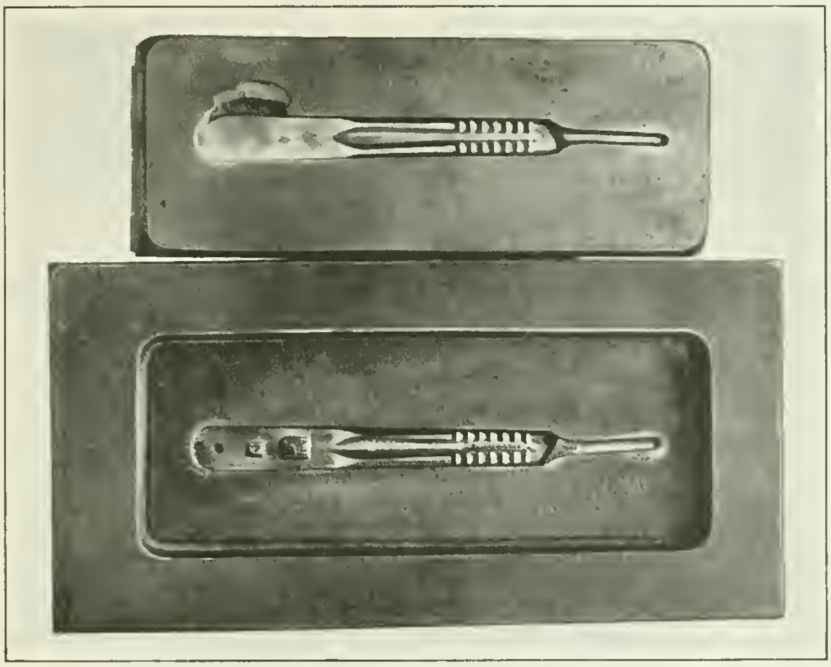


Fig. 3. Set of Carbon Steel Dies previously used without Artificial Heating—note Chipped out Spot at Left on Upper Die

The numerous tests that have been carried out, or still await settlement, have brought good results. Perforated disks and knives for meat choppers are made by two concerns by the hundreds of thousands in steel dies containing 0.40 per cent carbon, 1.80 per cent tungsten, 1 per cent chromium, 0.85 per cent silicon, and 0.35 per cent manganese. These dies are maintained by gas torches at temperatures of about 400 degrees F. during operation. Production figures so far show an average of 15,000 disks per die, as against 3000 disks formerly obtained. The number of knives obtained per die has been increased six times.

Rail spikes, made in circular high-speed steel dies in a friction screw press, are produced at the rate of 30,000 spikes per die. Formerly these spikes were made in carbon steel dies having a total yield of 4000 to 5000. The carbon steel dies were kept cool by a stream of water, while now the high-speed steel dies are maintained at a temperature of 500 to 600 degrees F. when in use, the method having been reversed so far as temperature is concerned.

Another interesting example illustrating the possibilities of heated dies is found in the following record of performances for dies used for forging lock keys which are drop-forged while hot. These keys measure about 3 9/16 inches over-all, and 34,000 were forged in a single lower die artificially heated. After doing this work, the die was put away in excellent condition. This die is made of tungsten steel containing 12 per cent tungsten, 0.50 per cent carbon, and 3.50 per cent chromium.

To match this heated lower die, two unheated upper dies made of high-grade die steel were worn out while producing the 34,000 keys. The following is a record of their performance: Each of these dies first produced 5000 keys. It was then necessary to plane down both dies and re-engrave them. Die No. 1 then produced 3500 pieces after which re-engraving and re-hardening were necessary. Die No. 2 produced 4500 pieces, and then was planed down and re-engraved. Next in order, die No. 1 produced 4500 pieces, and then planing down and re-engraving became necessary. Die No. 2, after producing 5500 pieces, was scrapped. Finally, die No. 1, after producing 6000 pieces, was also scrapped.

Extent to which Process may be Applied

The field of application of this process is very large, and the heating method may be said to be of benefit wherever tools are used that have to stand wear and tear, and are subjected to shock, pressure, or vibration, still being expected to yield large production. Thus the method is of great interest to manufacturers of small drop-forgings used in large quantities, automobile, motorcycle and sewing machine parts, pliers, scissors, spoons and forks, hot- and cold-forged knife blades, parts of surgical and dental instruments, small forged and punched tools in general, hot- and cold-swaged parts and similar work.

Manufacturers of table ware have adopted the heating method for their dies without changing the brand of steel, simply with a view to reducing breakage and the risk of chipping. As one design of spoon is rarely required in large quantities, it is considered unnecessary to use a die of the expensive high-grade alloy steels. Dies of carbon steel are used and maintained at artificial heats of about 300 degrees F.

Perhaps the most interesting use of this method so far is in the drop-forging of high-speed side milling cutters. These forged cutters are practically ready for grinding and hardening after forging. The dies are made of tungsten steel containing 0.50 per cent carbon, 12 per cent tungsten, and 3 to 3.5 per cent chromium. Regular 18 per cent tungsten steel has also been used. Neither test has yet been brought to a conclusion, and since only one hundred and fifty 2½-inch and one hundred and sixty-nine 3-inch cutters have been made up to the time of this writing, the dies are still in perfect condition. Every one of the cutters came out perfect. The cost of producing these cutters was less than that of producing a similar number of machined cutters from solid bar stock, even including the cost of the dies for making the number of cutters mentioned.

From what has preceded, it is evident that heat means life to a shock-resisting tool, as it does to the human body. The vitality imparted by the proper degree of heat to the smallest crystal of a given body of hardened steel finds expression in the almost incredible shock resistance of the combined mass of molecules that cannot be crushed. Thus the benefits of the new method may be likened to those of a steel, or alloy, that is yet to be discovered—one that combines hardness and toughness in the extreme.

Experiment with a Blanking Die

An interesting experiment was conducted to determine the effect of the artificial heating method as applied to a set of blanking dies used for cutting blanks from steel containing 1.28 per cent carbon and 2 per cent chromium. As these blanks are used for making the blades for Bard-Parker surgical knives, the edges of the blanks must be without burrs, and consequently maintaining sharp edges on the dies is of particular importance.

The production obtained ordinarily from a set of dies between grindings is about 35,000 blanks. When a set of dies was operated at a temperature of 350 degrees F., 65,000 blanks were cut and the dies were still sharp, but unfortunately it was necessary to discontinue the experiment at that point owing to a slight warping of the die-shoe. As the punch clearance is only 0.0005 inch, and as the pillars are provided with hardened and lapped close-fitting bushings, the result of this slight warping was to move the pillars out of alignment just enough to cause the bushings to bind to such an extent that there was danger of their "freezing." For this reason the test to determine the possible advantage of artificial heating in this case, could not be continued, and therefore, it is not regarded as conclusive, but has been referred to because it tends to support the theory that the artificial heating method is effective for blanking dies as well as for those used in connection with forging operations.

* * *

NEW PLAN FOR FINANCING INDUSTRIAL STANDARDIZATION

A new plan for financing the industrial standardization work of the United States, which provides for membership dues on the basis of one cent per each $1000 of the gross receipts of industrial corporations, has been approved by the executive committee of the American Engineering Standards Committee. Twenty of the most influential industrial executives of the country have accepted places on an advisory committee to cooperate with the ways and means committee in the financing of the Engineering Standards Committee.

The new class of members, whose dues will be apportioned in the manner mentioned, will be known as sustaining members, and a special service will be provided for them, including information bulletins on developments in standardization work in this country and in all other countries where industrial standardization is in progress. Heretofore the Engineering Standards Committee has been financed entirely by dues from the nine technical societies and seventeen national trade associations which, with seven departments of the federal government, constitute its present membership. Annual deficits were cleared by contributions from individual corporations. It is expected that the new plan of financing will provide an annual budget of $50,000 for the Standards Committee. The plan includes the appointment of an engineer-translator who will provide translations of standards developed in foreign countries for the information service to sustaining members.

* * *

The production of copper in 1922, according to the United States Geological Survey, as compiled from reports of the smelters covering the production for eleven months and the estimated production in December, was about 981,000,000 pounds, an increase of 475,000,000 pounds over 1921. Productive work was resumed at practically all the large mining companies by April, 1922, a year after the general shutdown of the copper mines.

STANDARDIZATION OF MACHINE PARTS

By RAYMOND B. TEMPLE

Designing Engineer, Blanchard Machine Co., Cambridge, Mass.

The difference between operating a plant at a profit and at a loss may depend on the attention given to seemingly unimportant details. This is especially true in times of business depression, when the plant may be forced to cut down its production to a small per cent of its normal capacity. Under such conditions, the problem of eliminating as far as possible the duplication of effort deserves special attention. In the engineering department of the Blanchard Machine Co. a system has been devised to cope with this particular problem, and the results obtained have shown the system to be of material assistance in cutting down production costs.

In designing a new machine, particular care is taken to utilize, as far as practicable, parts that have been designed for previously built machines. This procedure often saves considerable time that would otherwise be required for making new drawings. It also saves the expense and space necessary for carrying an increased variety of parts in stock. Before the new system was put into operation, it was necessary for the designer to spend a good deal of time looking over miscellaneous collections of drawings in order to determine if any previously made part could be adapted to the requirements of the new machine. More time was often spent in a fruitless search through old drawings than would be required to make a new drawing and have an entirely new part made.

System of Standardizing Parts

In order to remedy this condition, blueprints of each group of parts commonly used in all types of machines were made up and bound into book form for use in the drafting-room. The parts grouped together in these bound books included machine collets, special nuts, finished washers, pins, shoulder bolts, and similar parts. By reference to these readily accessible books, the designer could easily locate an old part that could be used without any changes, or perhaps a part would be found that could be used by modifying the design of the new machine slightly. If no part could be found that would suit the new requirements, the designer, with his knowledge of the similar parts already in use, could at least design the new piece as nearly as possible like those already made. This plan resulted in gradually building up a uniform line of parts.

In some instances, a systematic study of a particular group of parts shown in the bound blueprints enabled the designer to standardize the parts or make slight modifications in their design that would greatly reduce the total number of parts needed to meet all requirements. The system outlined can, of course, be extended to cover an unlimited variety of parts. It would eventually include such items as machine handles, name plates, and all kinds of special parts used in the company's products. The possibilities of cutting down production costs by this system of standardization have only begun to be realized in the plant referred to. However, there is ample evidence that the system is one that will increase profits if it is properly carried out.

* * *

PRODUCTION MEETING OF S. A. E.

The Society of Automotive Engineers will hold its annual production meeting this year at Cleveland, October 25 to 26, when papers on new processes, shop methods and production problems will be presented. The subjects dealt with at the production meetings cover all phases of factory economics, wage systems, planning, purchasing, and production methods. Last year the production meeting was held in Detroit. It is planned to change the place for the meeting from year to year, but always to hold it within the region where the major portion of the automobile industry is located.

Types of Polishing Machines

By BRADFORD H. DIVINE, President Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THERE are many different types of polishing machines in use adapted to a great variety of work, ranging all the way from a simple cheap cast-iron bench lathe up to the elaborate automatic machine. Bearings of all kinds are used—cast iron, babbitt, and bronze bearings, plain, roller, and ball bearings. Machines are available in types and styles to meet the requirements of any purchaser. The designs incorporate single-end and double-end types, floor lathes with straight columns, flaring columns, etc., in a very large assortment.

In the early days of polishing when the wheels were made in the factories using them, very little attention was paid to the design of polishing lathes. This was due to the fact that the polishing wheels were generally of small diameter, made out of wooden blocks and faced with leather straps, or out of disks of sail cloth glued together, or of similar types, and the strains set up while operating were small. A wheel larger than 12 inches in diameter was rare, the common sizes being 8 and 10 inches.

The ordinary type of polishing lathe consisted simply of a cast-iron column with a base for support, placed either on a bench or on the floor, with the upper part of the column spreading out into a pair of V- or U-shaped arms fitted with cast-iron or babbitt bearings. The bearing boxes were usually very short, and the spindles long in proportion, so that the wheel was carried at some distance from the frame of the lathe, to provide sufficient clearance for turning the work around the polishing wheel. Even with wheels of light weight, the pressure applied by the polisher on the wheel produced a strain that made the bearings very short-lived. The cost of the repairs was a relatively modest item, but the loose vibrating shaft or wheel prevented the operator from producing a well polished surface, or from doing his work cheaply or rapidly. Often the simplest and cheapest forms of floor and bench grinding lathes were used for polishing, but such lathes were not built to stand the higher polishing speeds, and caused trouble.

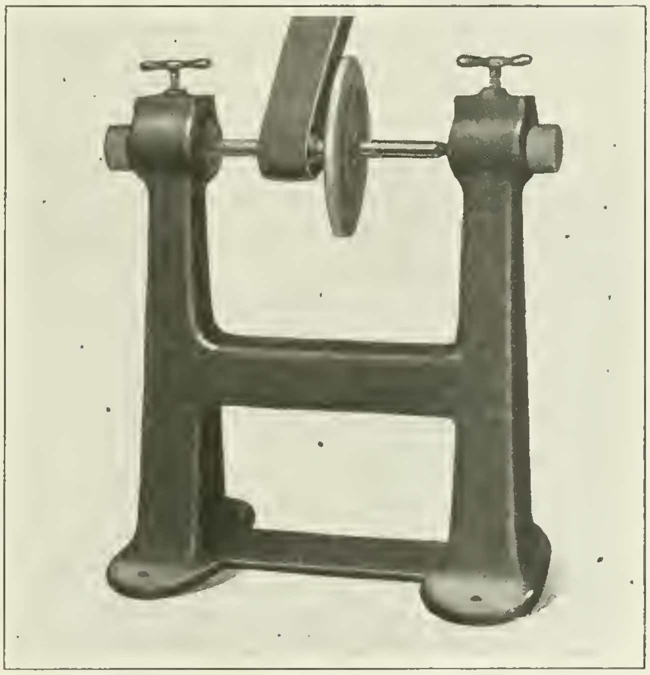


Fig. 1. Cupola Jack Polishing Machine

The Cupola Jack Polishing Machine

Another type of polishing machine is the so-called "cupola jack," shown in Fig. 1, which is still extensively used, especially in the cutlery industry. This machine is quite different in design from the column type with the double-end shaft just described. The cupola jack frame consists of a cast-iron base with two cast-iron upright columns, connected by a brace at the middle. The upper end of each column is arranged to hold a removable hard-wood block in a horizontal position, with the end of the grain against the end of the shaft, and fastened in place by a set-screw. The spindle and arbor hole of the wheel are both tapered, and the polishing wheel is driven on the spindle with a tight fit. The ends of the spindle are tapered down to points, and fitted into countersunk depressions cut into the ends of the hard-wood blocks which constitute the bearings.

The driving pulley is permanently fixed to the tapered shaft. The spindle is removed when a wheel is to be replaced by throwing the belt off the pulley and releasing the set-screw clamp on one of the wooden block bearings, which is moved out sufficiently to enable the spindle to be removed. The blocks are usually of rock maple, and originally were lubricated by simply applying tallow to the countersunk bearings. An improvement upon this was made when the blocks were saturated or boiled in oil.

One of the disadvantages of this type of bearing was that the blocks used to split and tear out, especially when work was caught in the wheel, and many serious accidents happened from this cause. This was eliminated by driving a well seasoned piece of maple into a pipe and then boiling it in oil, so that the swelling of the wood held the block firmly in the pipe, and the set-screws for holding the bearing in place were applied to the pipe instead of to the wood. Reinforced in this way, the wood bearing had less chance of splitting, and as a consequence, accidents were practically eliminated.

Advantages of Large Polishing Wheels

As time went on, the advantages of larger and heavier wheels with higher speeds, and the demand for the increased production possible with such wheels and speeds brought into use more wheels of from 12 to 24 inches in diameter than those of the smaller sizes. This necessitated polishing lathes of heavier and stronger construction, and bearings of a better type. The larger polishing wheel gives smoother action and better contact, and makes possible lower rotative speeds for the same peripheral speeds, thereby causing less wear and insuring longer life of the polishing machine. Furthermore, the number of wheels required is less, and large wheels are no more expensive in upkeep than smaller ones.

The unit cost for removing, cleaning, rebeading and replacing wheels is practically the same for wheels of various diameters. The time required for making the wheel change is the same per unit, regardless of the size of the wheel; but the advantage gained by using a larger wheel will be appreciated when it is realized that a 16-inch wheel running at 1800 revolutions per minute has a peripheral speed of 7538 feet per minute, whereas the corresponding peripheral speed for a 10-inch wheel is only 4712 feet per minute. In other words, a 10-inch wheel, to give the surface speed of a 16-inch wheel running at 1800 revolutions per minute, would

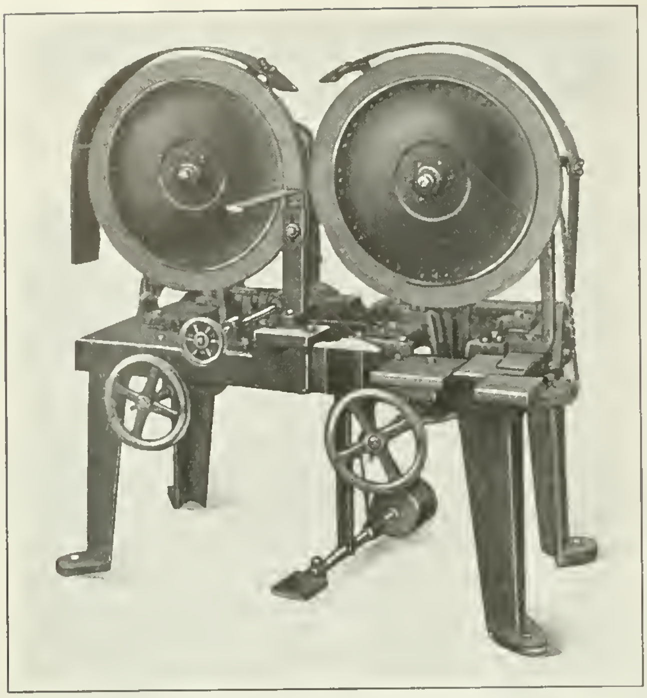


Fig. 2. Semi-automatic Double-head Polishing Machine for Knife Blades

require a speed of 2900 revolutions per minute. Briefly, a larger polishing wheel is more efficient than a smaller one, but this does not mean that small wheels should not sometimes be used; they are, of course, the only means by which surfaces having small radii can be reached.

Drives for Polishing Machines

Before the introduction of the direct-connected electric motor-driven machines, polishing lathes were generally belt-driven either from an overhead lineshaft or from a lineshaft placed against the wall of the room and using horizontal belts. The horizontal belt gave the operator more clearance for his work, while in some cases the vertical belt could not be used at all, because of danger to the operator through interference of the work with the belt. This dangerous condition existed before the present belt-guarding systems were introduced.

Another development was the drop-head type of machine in which the spindle was operated by an under-driven belt connected to a lineshaft usually placed in a pit directly under the line of polishing machines when they were on the ground floor, or from a lineshaft attached to the ceiling below when the machines were on upper floors. In such machines, descriptions of which have formerly appeared in the technical press, the head carrying the boxes and shaft was placed on a hinge, and was raised or lowered by means of a lever. In one position of the lever, the shaft and pulley were brought up against the belt, tightening it; in the other position, this was reversed, the shaft dropping and the pulley making contact with a brake which almost instantly stopped the machine.

Another form of this lever-controlled machine is found in the brake and idler type, in which the movement of the lever to stop the machine releases the idler, which, during the operation of the machine, keeps the belt between the driving and driven pulleys tight. The same motion of the lever applies a brake and stops the machine, and the reverse of these operations starts it. Such machines as these were time-savers, as well as accident preventers, and while more expensive than the simple open-belt type, were much more economical and easier to handle.

Many attempts have been made to design a satisfactory double-end lathe with two independent shafts driven by a single belt and clutches, but few such machines have been successful in everyday use. The advantage obtained with such machines is the ability of each operator to start and stop independently of his mate at the other end of the machine, at a great saving in time and a considerable increase in production. The great disadvantage of a double-end solid-spindle lathe is the stopping of production by both operators when either one must stop to change wheels or shut down for any reason.

The nearest approach to the single-column two-spindle lathe which has been brought out successfully is a single-column lathe with two independent spindles driven by two belts, eliminating the clutches. This machine has recently been described in the technical press. There may be a disadvantage in the two belts, but the advantage in the saving of time of each operator and the conservation of floor space in this type of machine is evident.

Motor-driven Polishing Machines

The development of the direct-connected motor-driven polishing lathe was a real step in advance. In this type of machine, of which several types have been illustrated and described in the technical press from time to time, all belts are done away with, making a self-contained unit, without projections to interfere with the handling of the work. The machine can be set in position without regard to the location of pulleys or lineshaft. It can be placed at any angle, so as to obtain the best light in the room, and has many other advantages. The only disadvantage is found when an alternating-current motor is used, because it runs at one set speed only, determined by the type of the motor; and since polishing wheels under certain conditions have to be of different diameters, it is not always possible, where the work determines the diameter of the polishing wheel, to employ peripheral speeds best adapted to rapid or proper production. When direct-current machines are used, the speed can easily be adjusted to give the proper cutting or peripheral speed for the work.

Motors with open frames are not suitable for polishing machines, because abrasive grains from the polishing wheels will get into the bearings and destroy them. However, in an electrically driven lathe with the motor case tight enough to be dustproof, the possibility of the motor overheating must be reckoned with. This can be guarded against by ventilating the motor case with intake and exhaust tubes connected to the case. The intake, of course, must have its openings outside of the polishing room. The exhaust is commonly connected with the exhaust system of the polishing room. This condition is taken account of in the manufacture of some electrically driven lathes in which openings are left for pipe connections in the castings of the frame.

Solid Floors Required for Polishing Machines

With the high speeds used in modern polishing lathes, proper foundations are imperative. While much has been done by some manufacturers in designing the shapes and weights of the columns of machines to absorb vibration, still, any high speed machine, when placed on an ordinary wooden floor, will produce vibrations that will seriously fatigue the polisher and also influence the quality of the work. Fatigue of the operator is one of the most important elements in the cost of polishing; consequently everything should be done to eliminate this condition as far as possible.

The proper setting of any type of polishing lathe to insure solidity and prevent vibration is extremely important, especially for delicate polishing processes and precision work, or where the character of the polished surface will be affected by a vibrating wheel. In many plants the floors are none too heavy. Where the buildings are put up with the usual 8- by 10-inch or 2- by 10- or 12-inch stringers and joists, and the floors are not thick enough to take the hold-down setscrews of the polishing lathe, the vibration often loosens the nails in the floor and tends to tear it up in places. A remedy that has been adopted in a number of cases, when nothing interferes below the floors, to run a heavy timber, 6- by 8-inch or 8- by 10-inch, lengthwise under the joists and under the row of polishing machines, and bolt right down through it so that any movement of one particular machine will be communicated through a wide area of flooring.

Even in modern factory buildings, with steel girders and wooden floors, where the ends of the flooring are supported on a comparatively small wooden rib or filling on the girder, a vibrating polishing lathe will have a tendency to lift the whole wooden mass, even with the usual 3- to 5-inch thickness of floor. A remedy in such a case is to put a heavy timber or girder underneath the supporting steel girders that carry the floor. With this extra member lengthwise, a row of polishing machines bolted down through the whole mass ties the polishing machines to the frame of the building itself and reduces vibration to a minimum.

Automatic and Semi-automatic Machines and Attachments

Fatigue of the operator, labor troubles, the general character of polishing work, the difficulty of obtaining intelligent operators, and strenuous business competition has brought about the demand for automatic or semi-automatic machines and attachments wherever work is done on a production basis, and where accuracy of finish and other requirements cannot be met by the old-fashioned hand process. Automatic and semi-automatic polishing and buffing machines find general application where large quantities of work are regularly performed. This includes all classes of work from the polishing of small articles such as alarm clock bells and electric light sockets to hot air furnace registers, 4 feet square. The forms of these machines are many: Some handle just flat work with large areas; some handle circular or cylindrical work at any angle; and some handle composite contours and surfaces of any kind, such as tea kettles and hollow-ware bodies.

Automatic machines are so arranged, especially for buffing, that the head of the machine carrying the work can be set in any desired position in relation to the buffing wheels. The movement of the wheel-head is always under the direct control of the operator. Machines of this kind revolve the work either with or against the rotation of the wheel, as desired. The rotation of the work can be stopped by a foot-treadle, which applies the brake and releases the chuck. Such machines are designed to carry roughing and finishing wheels at the same time. The use of automatic and semi-automatic flexible grinding and polishing machines has probably reached greater application in the cutlery and stove trade than in any other one line of polishing work.

For the surface operations of glazing, fining, and finishing on kitchen knives, carving knives, butcher knives, and all steel blades of approximately flat contour that are not to be plated, a double-head machine, such as shown in Fig. 2, is used. This machine has two polishing wheels revolving in opposite directions. One wheel-arbor is fixed and stationary, while the other is movable and provided with a spring tension to regulate the pressure of the wheels against the knife. When the knife is put in place, the space between the wheels is widened. The two wheels are then allowed to come together, both pressing against the knife blade. The knife blade is supported on a steel rest and when the wheels have closed on it the operator draws it forward from between the wheels. The important point in this operation is for the wheels to have the proper amount of cushion or softness to flatten and cover the entire width of the blade at each stroke. Different widths of knife blades require wheels of different densities and covering capacities. Wide-blade knives, such as butcher and carving knives, require larger wheels, with an approximately flatter contour, than blades of pocket knives, for which much smaller wheels are used.

Another form of automatic machine in use for table cutlery and to some extent for other work of the same general shape and size is shown in Fig. 3. This machine produces an effect on the metal similar to damaskeening. This is done by applying the strokes of the polishing operation in such a manner that there is no distinct straight stroke or scratch, as would be the case with a double-head machine or with any other process of applying the work to the wheel. The type of wheel used is one with a cushion which can be made of any required density.

The knife is placed in a holder, which grasps the handle, as shown in Fig. 4, and the blade is reinforced by a back piece. The knife lies in a position parallel to the axis of the polishing wheel, and the motion of the machine brings the blade down along the face of the wheel, at the same time moving the knife back and forth from end to end across the face, so that the wheel travels the complete length of the blade a number of times while the latter is passing along the face of the wheel. In other words, two motions take place at the same time. A blending of the polishing marks results from these motions, and the effect is comparable to the process of damaskeening. The knife blade, when finished ready for plating, presents a dull matter surface with no straight polishing scratches visible.

Machines of this type have become standardized throughout the entire cutlery trade in America and England. Fig. 4 shows the end of a machine of this type with the knife in position at *A*. Both this machine and the double-head machine in Fig. 2 require polishing wheels of a special type made with great accuracy and care as to uniformity of density, flexibility of face, perfection in balance and true-running qualities.

Another form of automatic machine in common use is a surface grinding and polishing machine for flat surfaces, as for example, such work as the tops of stoves, registers for furnaces and any class of work that is approximately flat and of large area. This machine embodies a travel board and conveyor to which the work is attached. Various polishing wheels for the different operations are automatically passed over the entire surface of the work as it progresses, covering all operations from coarse grinding to the final finish. The value of such a machine is shown by the fact that in one particular installation a register, 40 inches square, is ground, polished, and finished every five minutes. The processes involved are solid grinding, flexible grinding, and polishing. The finish required is a perfectly smooth surface to receive enamel or to be plated.

Another form of machine is one often called "homemade," in which a device is arranged on the head of a metal planer to carry three or four polishing wheels, the positions of the wheels corresponding to the spokes of a wheel. Magnetic

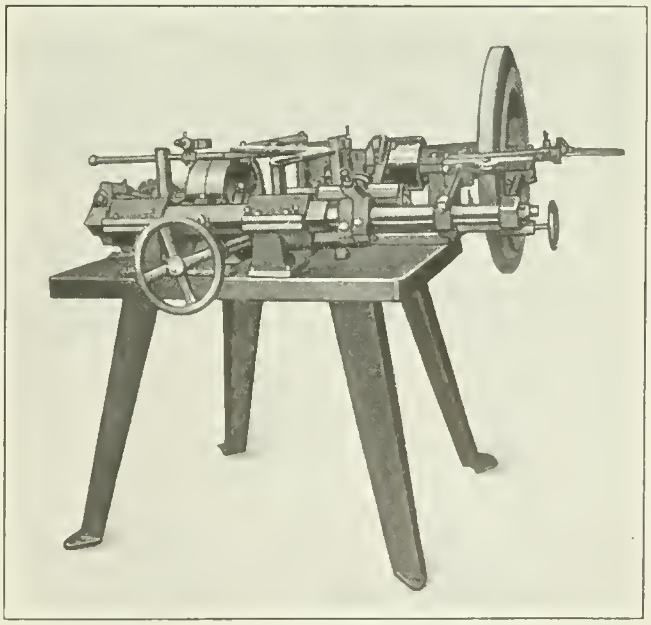


Fig. 3. Automatic Glazing Machine for Table Cutlery

chucks are often used on such machines, especially for thin work that is difficult to hold in position on the bed with clamps, and especially where it is necessary that no devices interfere with the free passage of the polishing wheels over the surface of the work.

Machines of this type are used on skate blades, which, when nested together, will permit about 100 blades to be operated on at one time. This form of machine is also particularly adaptable to long steel shapes, such as parts of textile machinery. The wheels are so arranged that when the work starts, one wheel is brought down on the work through the proper pressure device, and that wheel continues in action as long as the abrasive surface is in good condition, but as soon as it becomes dull, it is relieved and another wheel brought into play in turret fashion, and the operation continues without interruption. On work of this kind, where the pieces are long and the application of the polishing wheel must be continuous, the effect of heat must be guarded against, as it softens the head of glue and emery. The nest of wheels described overcomes this difficulty.

The machines described in the foregoing are those that might be called the standard styles and that are in common use. In addition to these, a great many special machines have been built, usually for the use of the concerns making them, and it is not often that such machines are offered for sale.

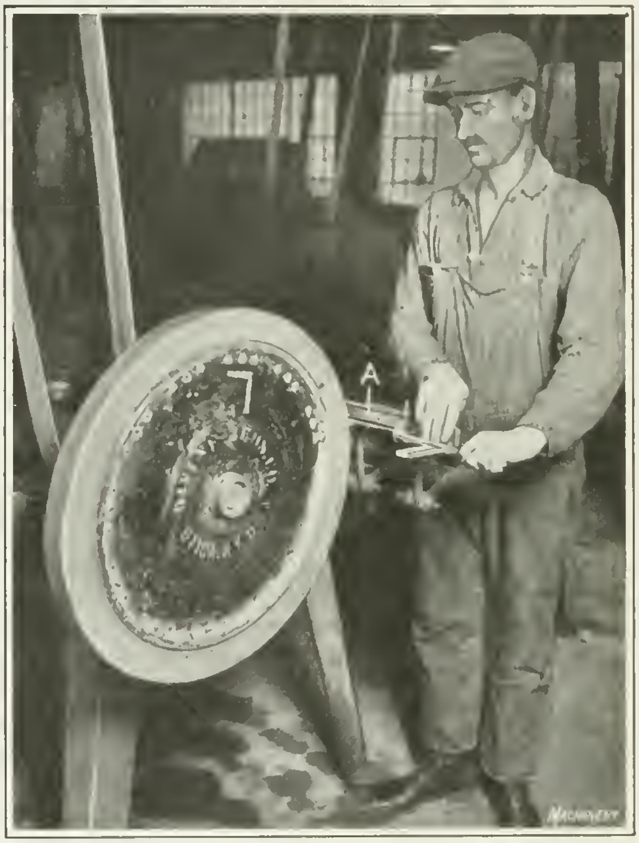


Fig. 4. Automatic Table Knife Glazing Machine, showing Method of holding the Knives

A concern fitting up a new plant is often at a double disadvantage when it comes to the installation of polishing machines. First, it seldom consults competent engineers with sufficiently broad experience in advising and recommending the proper type of machine for the intended work; second, many of the most advantageous types of machines are made as a side line by concerns whose regular business is the manufacture of lines of machines or tools that are foreign to polishing, and the purchaser does not know where to locate the makers and cannot get a good survey of the complete line of machines on the market. In addition to this, unfortunately, such machines often are found only in one size, and the choice is therefore limited.

Illustrative of the limited knowledge that even the best machine designers show at times of conditions attending the use of polishing lathes, is a case of a concern, very well known in its own particular field, that produced a line of polishing machines. This concern called one type a buffing machine and another type a polishing machine. The buffing machine was equipped with ball bearings, and the polishing machine with ring-oiling bearings. The company said that it could not use ball bearings in a polishing machine because *in grinding* it had found that ball bearings would not stand the strain. It was apparent that this concern had little or no knowledge of the fact that polishing practice in regard to machine design varies greatly from grinding practice.

The design and construction of automatic machines was retarded considerably for a similar reason. The designer of the machine usually figured that the wheel could work constantly without interruption, like a grinding wheel, but failed to recognize the fact that continued application of a polishing wheel to metal would cause the glue that holds the abrasive on the wheel to soften, and the abrasive would be stripped from the wheel in a few minutes' use. In other words, no provision was made for the cooling of the wheels, and many an automatic machine correct in other respects failed when put into use for this reason. It is evident that the design and construction of polishing and buffing lathes must be founded on experience taken from within this department of the mechanical arts, and must not be predicated on grinding practice.

* * *

SELLING A PATENT BY MAIL

The first principle of successful selling by mail is a thorough knowledge of the product on the part of the sales correspondent. Therefore, the inventor, or somebody who is equally well informed about the features of the invention, is the best person to set forth the advantages of a new patented device. The Business Consultation Bureau of the La Salle Extension University points out four specific details that should be clearly covered in a letter or statement intending to interest others in the commercial exploitation of a patent.

1. The advantages of the new device over other well-known devices that may already be on the market for the same or similar purposes.
2. The cost of its production, based, if possible, upon personal experience or upon quotations supplied by manufacturers for its production in whatever quantities would be likely to be required.
3. An outline of the market to be supplied, determined in accordance with the nature of the invention.
4. The selling price that may be expected, and the profits that would be necessary in order to interest the manufacturer, wholesaler, and retailer.

After the advantages of the invention have been recorded in this way, the next step is to prepare a list of manufacturers or men interested in the industry to which the invention is applicable, and to send them a letter containing the specific points mentioned—briefly but comprehensively covering each phase of the subject.

* * *

The total tonnage of ships launched in 1922 in all the countries of the world, was 2,467,000, as compared with an average of 2,740,000 tons annually during the five years preceding the world war. The average during the five years 1917 to 1921 was 5,150,000 tons. Of the tonnage launched in 1922, Great Britain was responsible for 40 per cent, Germany coming next in order with about 23 per cent, and France with about 8 per cent. Ocean-going shipping only being considered, Holland, Italy, the United States, and Japan follow in the order mentioned.

Work-holding Surfaces of Machine Tools

Table Design for Different Types of Machines—Second of Three Articles

By FRED HORNER

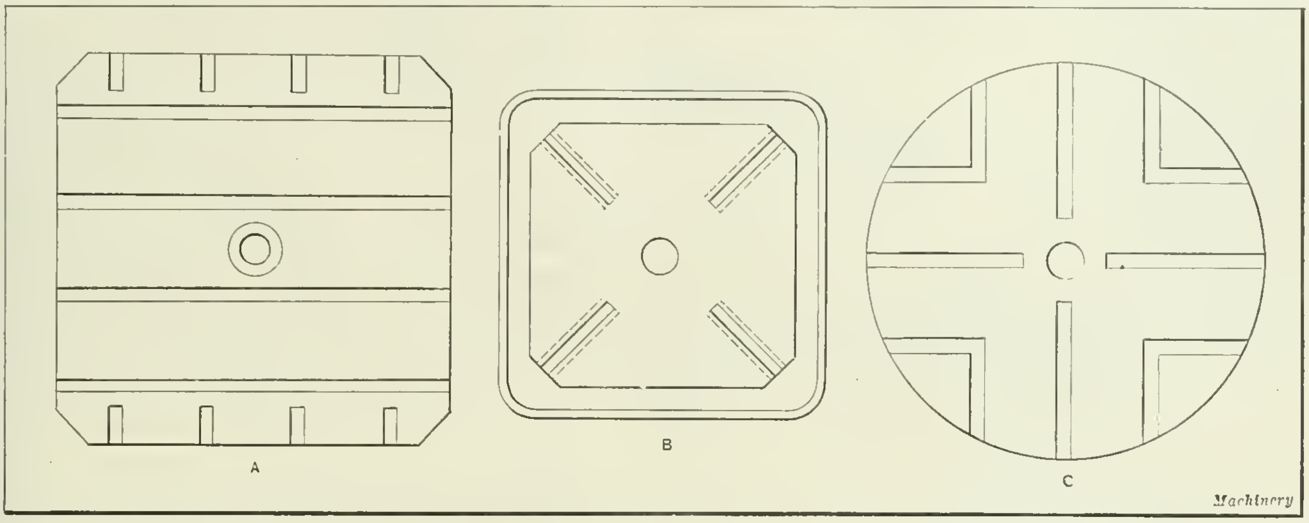


Fig. 8. Various Methods of arranging Slots in Square and Round Tables of Slotters and Drilling Machines

THE first installment of this article, published in April MACHINERY, described certain factors affecting the design of machine tables or work-holding surfaces, and described different designs to meet various conditions. Increase of holding area by the use of supplementary supports, the influence of thrust on table design, plain work-holding surfaces, securing bolts to surfaces by tapped holes, the use of through holes and slots, and arrangement of T-slots were dealt with in the April installment. The present article will treat of the arrangement of slots in square and circular tables, and the influence of drainage on T-slot arrangement.

Arrangement of T-slots in Square and Circular Tables

A long narrow table, such as found on rail-planers, is convenient for placing bolts and using as much of the width as possible for the work, if short side slots are added, as illustrated at *C*, Fig. 5 (See April installment). This practice is also common on large rotary tables for slotters, as shown at *A*, Fig. 8, and for the bases of heavy radial drilling machines. Some varied examples of T-slot arrangements for square and circular tables are shown at *B*, Fig. 8, for a drilling machine, and at *C*, Fig. 8, and *A* and *B*, Fig. 9, for slotters. It will be noted that in each of the slotter tables more than two slots run parallel, with a consequent advantage for many kinds of clamping and for adjustment of angle-plates and other fixtures that require bolting with pairs of bolts in a foot.

As in lathe faceplates, certain tables, notably those for circular milling operations and boring mills, have all the slots placed radially and in sets of three, four, or six of equal lengths, with intermediate slots of other lengths. This arrangement covers, in an effective way, the whole area that can possibly be devoted to slots. The principal departure from the radial arrangement is made when dogs or jaws are to be employed on the table, and then there are two alternatives. One is to cut enlarged grooves, distinct from the T-slots, to accommodate the slides of the jaws, as shown at *A*, Fig. 12. In the other method, the jaws are raised and clamped with duplex parallel slots, as illustrated at *B*. The remainder of the slots for bolts either run radially or are grouped in sets parallel to the jaw slots. Large boring-mill tables may also have duplex jaw slots in combination with a large number of bolting

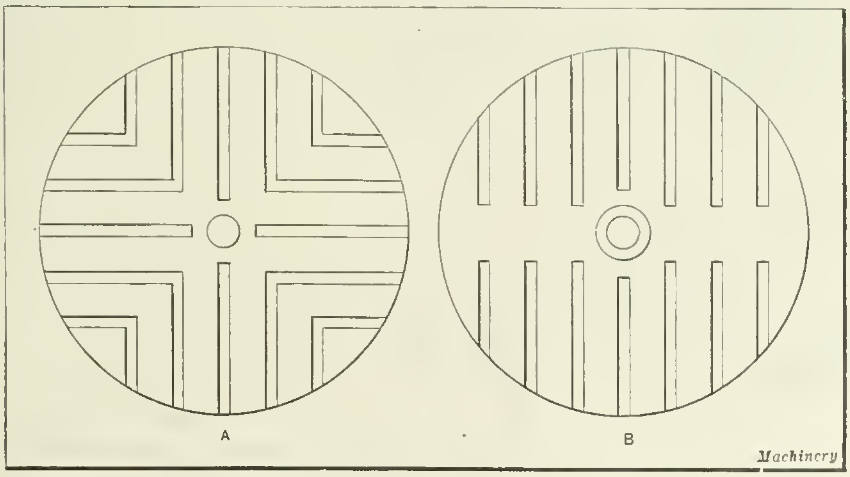


Fig. 9. Slot Lay-out of Two Round Slotter Tables

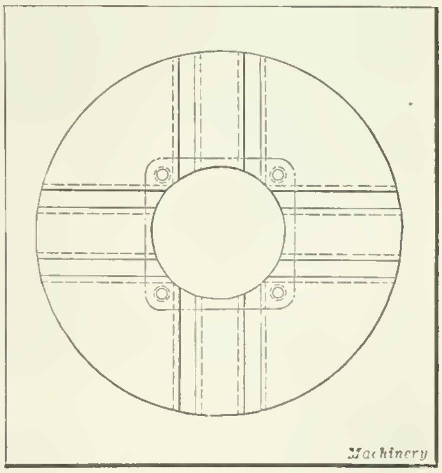


Fig. 10. Gear Hobber Table

slots, which are interspaced and furnished with end pockets, as shown in Fig. 13. The table illustrated is 20 feet in diameter and is cast in halves.

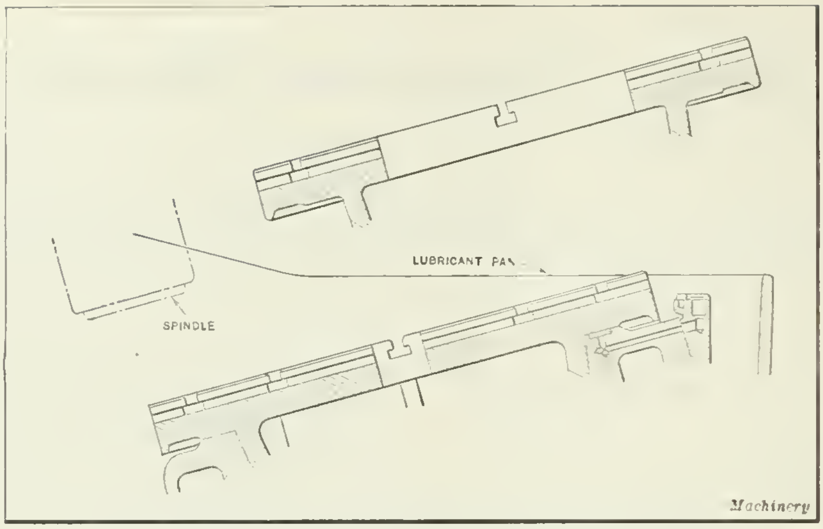


Fig. 11. Two Types of Table supplied on a Milling Machine of the Tilted Rotary Type

The combination of a central arbor with a support for the work affects the design of T-slots; sometimes the slots are utilized to hold a central bracket, or holes for cap-screws may be tapped into the table to fasten the bracket, and the slots reserved for the holding-down bolts. The latter is the case in the gear-hobber table shown in Fig. 10, where the square bracket shown in dot-and-dash outline, carries the arbor, while the slots are used for the rim blockings and any clamping or driving bolts that may be needed for the work.

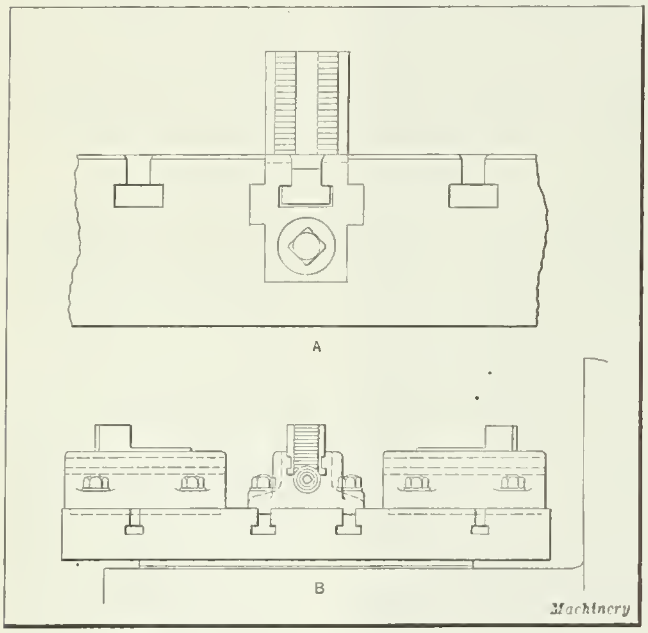


Fig. 12. Two Methods of mounting Radial Sliding Jaws on a Table

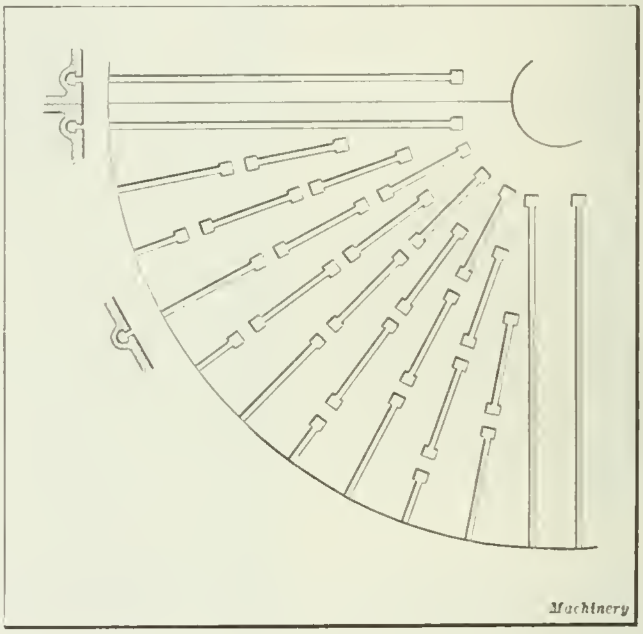


Fig. 13. Boring Mill Table with Jaw Slots and Additional Short Slots

Complete circular slots are usually not of any particular advantage for ordinary clamping purposes, a collection of straight ones being generally more handy. On rotary milling tables, however, they may be an increased convenience when either station or continuous milling is performed, because the work, or the fixtures holding it, may be slid around the table into the required positions, the bolts sliding in the circular slots without hindrance. This special lay-out does not preclude the addition of several radial slots.

A rotary milling machine of the tilted type has a table of the form shown in Fig. 11; the upper view shows a table provided with a large central hole, and the lower, one of ordinary design. Four radial slots are furnished on each table, in addition to one circular slot on the large-hole type, and two on the small-hole type. The reason for inclining the table to an angle of 15 degrees is to enable a large volume of lubricant to be pumped on without splashing, and to be drained readily, so that the chips will be carried off immediately from the table and fixtures.

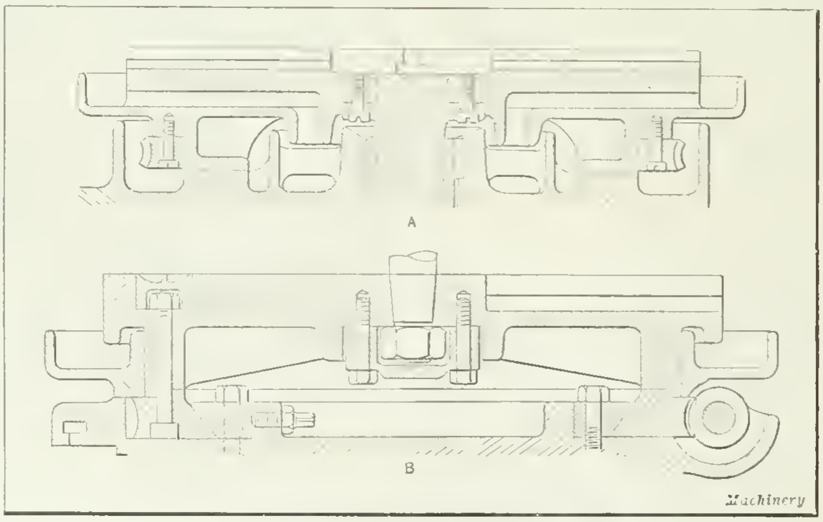


Fig. 14. (A) Circular Table with Integral Coolant Draining Rim; (B) Design in which the Drainage Rim is Separate from the Table

The system of drainage from a circular table may comprise the principle of a fixed catching rim or one cast integral with the table. The second method does not furnish a convenient escape for the coolant, unless there are capacious relief passages leading down into a circular trough having outlets as shown at *A*, Fig. 14. The fixed rim system is less complicated, as the drainage may take place at any suitable point. The rotary table illustrated at *B* moves within the rim and has a turned down lip to drop the coolant well into the rim.

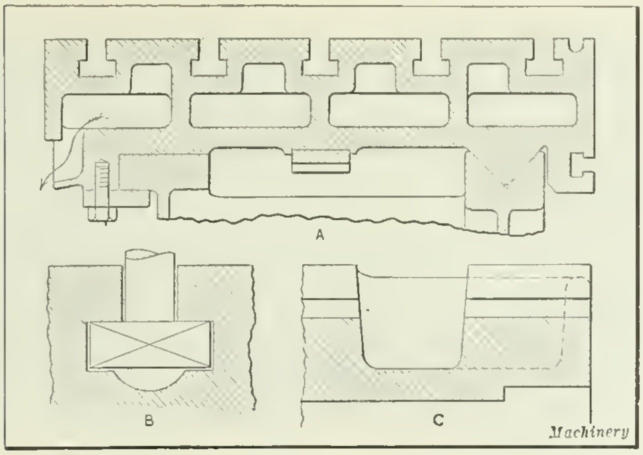


Fig. 15. (A) Table cast Hollow to facilitate Drainage of Coolant; (B) T-slot grooved at Bottom; (C) Proportions of Coolant Pocket for Uncovered Slots

The idea represented at *A* is of value for reciprocating tables, if the quantity of coolant is large, and a considerable amount of dust accumulates on the table, as in grinding machines. For example, the table of a certain type of deep face grinding machine is cast hollow, as illustrated at *A*, Fig. 15, the water falling on the end trays and running through the passages and off the table by way of the side opening, as indicated by the arrow. Draining from the table surface is taken care of by long flaps (not illustrated) below the left-hand side, while on the right-hand side there is a groove. A groove at the bottom of each T-slot is another device for rapidly draining coolant from the table, provided the chips are of such a nature that they wash out freely. The section of a slot so formed resembles that shown at *B*.

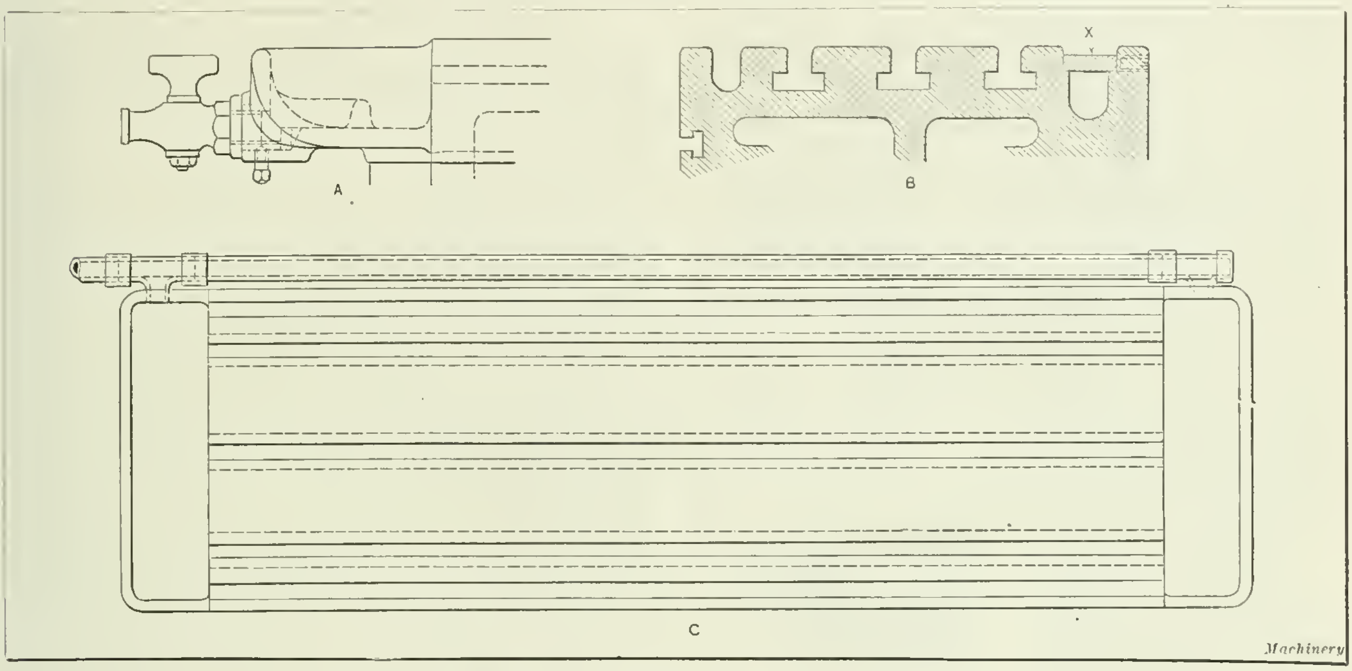


Fig. 16. Various Methods of providing for the Drainage of Coolant from Tables

One of the most troublesome tables to deal with is that of a milling machine when a great quantity of coolant is passed over the work and the chips are fine. The problem is how to take care of all the coolant without delay of operation due to the troughs and outlet pipes becoming choked. The first essential is large capacity for escape of the coolant, and an efficient straining apparatus that will operate without frequent cleaning.

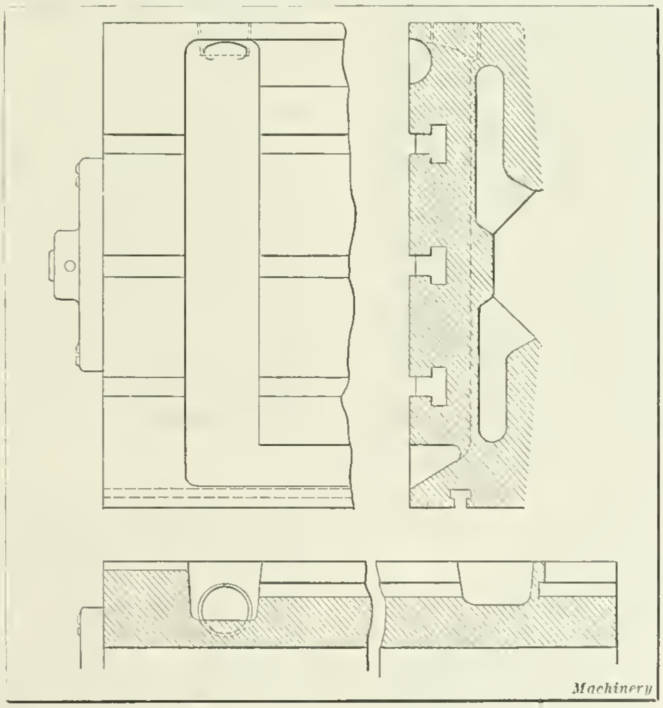


Fig. 17. Table with Grooves in Extreme Left-hand End to receive Tongues of Attachments, and Short T-slots cut in Right-hand End

On small tables using comparatively small quantities of coolant, the provision of draining grooves along the top, leading into end pockets supplied with a wire over which the liquid flows, and out by way of a cock, will suffice. Such a design is shown at *A*, Fig. 16. A can is hung under the cock, or a rubber connection may be made down to a receptacle.

Iron piping joined up to each pocket, as shown at *C*, supplies an alternative of greater drainage capacity, which gives no trouble, provided the outlet mouths are properly covered with strainers. A half-round groove milled close to each side prevents overflow of coolant from the table.

Instead of employing an outside pipe to connect the two pockets, the junction may be effected within the table itself by a method that saves time as regards cleaning. Thus, at *B* in Fig. 16, a steel strip *X* is locked over a groove by means of set-screws to form a passage that can be readily cleaned out. The continuation of the T-slots into the end rims of the table at *C*, as mentioned in the first installment, would increase the effective area of the working surface, and permit bolts to be used right out to the ends as stops and for clamping purposes. In that case, the end rims, of course, would need to be thickened.

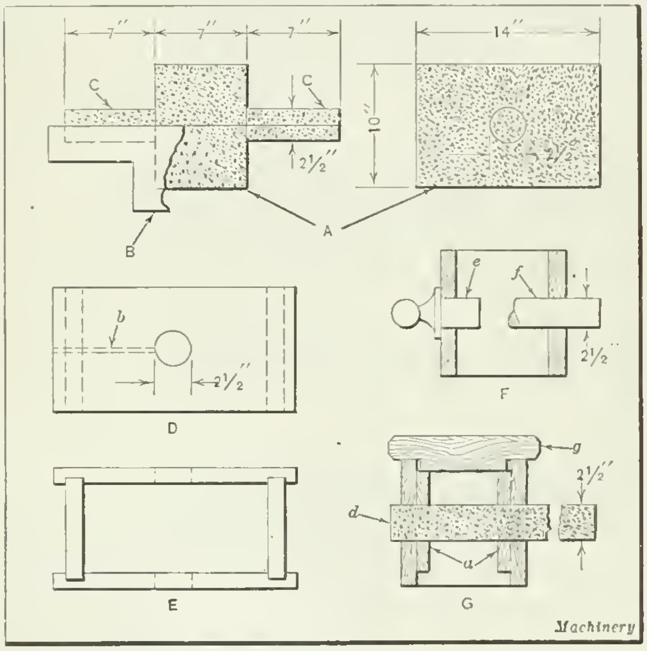
Deepened pockets are essential if the T-slots are not covered up by end plates or castings. At *C*, Fig. 15, are shown the proper proportions of a pocket and slot for uncovered slots. A table is illustrated in Fig. 17, in which grooves are milled at the left end to receive the tongues of attachments, while at the right end short T-slots are cut. A thin wall of metal is left between the slots and the coolant pocket to prevent the escape of coolant. Sieves or strainers laid in the pockets will prevent them from becoming choked up. These should be covered with solid plates when cast iron is being machined.

* * *

EASILY CONSTRUCTED CORE-BOX

By M. E. DUGGAN

During a recent visit to a foundry, the writer's attention was directed to a large pattern that was being molded. Three cores of the general shape shown at *A* in the illustration were required for the mold. The cores were of different sizes, and three half core-boxes were used in their production, the full core being made up by pasting two of the half cores together. A broken section of one of the core-boxes is shown at *B*. This method of making cores is considered good practice, and would probably be used in nine out of ten cases. However, there is no standard to be followed in making patterns or in molding, and for this reason the writer makes it a practice, when in the foundry, to study the construction of patterns and core-boxes sent there by various customers. The apprentice at the patternmaking trade who will do this will learn much about patternmaking practice that could not be learned in one shop.



Quickly Constructed Core-box used for Three Sizes of Cores

The core-box referred to brought to the writer's mind a similar job which was observed in another foundry. In the latter case, three cores were used in making the mold. The dimensions of the largest of the three cores are shown in the two views of core *A*. In the center of the main body of this core were two branch cores *C*.

A casting, the molding of which called for the use of one core of the dimensions shown at *A*, another core slightly smaller, and a third core smaller than either of the other two, was required to fill a rush order. On looking for the patterns in the pattern loft, it was found that the three core-boxes were missing. The time required to make core-boxes like the original ones would delay the production of the casting from twenty-four to forty-eight hours. So a short-cut method, as described in the following, was employed. While this method is rather unusual, it is practical and can be applied to various molding jobs.

A side view of the core-box used in producing the three sizes of cores is shown at *D*, and a bottom view at *E*. The method used to adapt the large size core-box to the production of the smaller sized cores is illustrated at *G*. The box, when used for the smaller cores, was provided with filler pieces *a*, located within the large box, as shown. Small blocks of wood were placed under the bottom edges of the filler pieces to keep the latter in the correct position. The box was adapted for holding the intermediate sized core by cutting strips of wood to the required thickness and placing them on top of the filler pieces.

The two sides that form the large box and the two filler pieces *a* were stacked one on top of the other in their correct relationship, and then nailed together temporarily. The circular opening for the central hole was next laid out and scribed. The hole was then cut out to the scribed lines with a band saw, the saw being fed in to the scribed lines from one end of the box, as indicated by the dotted lines *b*, in the view at *D*. The sides and ends of the box made to form the largest core were then assembled and securely fastened together.

Next, a round core, 2½ inches in diameter by 21 inches long, was taken from the foundry stock cores. This core, as indicated at *d*, view *G*, was passed through the holes in the side of the box. Sand was then filled into the box, and the core finished in the usual way, the round core being withdrawn after the sand had been filled in. The hole left by removing the core was filled with molding sand to prevent the body core from collapsing. The core-box was next lifted away, leaving the core ready for the baking oven. After the body core was baked, the round core *d* was passed through the body core and pasted in place, thus forming a complete core of the shape and size indicated by the views at *A*.

The smaller core was made in the same box by locating the filler pieces *a* on each side of the box, as indicated in the view at *G*. In this case, the surplus sand at the top of the box was cut away or struck off with the strickle board *g*. Black sand was then filled in up to the top of the box, and struck off. The box was next rolled over on the drying plate, and the sand struck off from the upper side with the strickle board. After removing core *d*, the box was lifted away, leaving the core ready for the baking oven. The projecting core was pasted into the baked body core, as in the previous case.

In one hour from the time the order was received in the pattern shop, the core-box, together with its equipment, was on its way to the foundry. The time and labor saved in making the box as described, instead of making three complete half core-boxes, such as shown at *B*, was considerable. Instead of using a stock core *d* in molding the body core, a wood plug ,such as shown at *e*, view *F*, could be inserted in the holes in the sides of the core-box. In this case, cores of the required length would be inserted in the holes left in the body core by the removal of plugs *e*, in order to form the complete core. A wooden mandrel, such as shown at *f*, which can be passed completely through the box, could also be used in place of core *d* when making the mold.

* * *

There are two principal steps in making malleable-iron castings. First, hard "white" pig iron, mixed with a proportion of steel and cast-iron scrap, is melted in a furnace and then run into the molds for the castings. Second, these "white" iron castings are cleaned and trimmed and then "heat-treated" by being packed in a mixture of powdered slag and iron oxide in large covered iron boxes, or "pots," placed in an annealing oven, slowly heated to about 1550 degrees F., held at this temperature and slowly cooled, the heat-treatment requiring seven days.

Care and Use of Small Tools

By HAROLD B. SCHOTT
Brown & Sharpe Mfg. Co
Providence, R. I.

Approved Methods of Using Various Classes of Small Machinists' Tools, and Essential Points Regarding their Adjustment and Protection when not in Use

MACHINISTS' small tools may be divided into three groups according to their degree of sensitiveness and accuracy. The first group comprises those tools not used for actual measurements, and includes V-blocks, clamps, small vises, center-punches, scribers, plumb-bobs, etc. The second group includes tools that are used for comparative purposes or for transferring measurements, such as inside and outside spring calipers, dividers, surface gages, standard external and internal cylindrical gages, squares, spring depth gages, etc. Precision tools, or those used for obtaining actual measurements in inches or parts of inches, constitutes the third class, including rules, micrometers, combination squares, protractors, bevel protractors, and verniers.

Tools of the first group are ordinarily used in conjunction with those of the second and third groups as an aid in obtaining accurate measurements when laying out or machining work. V-blocks are made in pairs and are precision tools in that the sides are ground parallel and the V-grooves are carefully ground central and parallel to the bottom and sides. The fact that each block is made accurately in alignment with the other is a reason why these blocks should receive a certain amount of care in their use. The abuse of one or both blocks, by raising burrs on the surfaces or edges, is a sufficient cause to spoil their relative alignment and accuracy. Clamps, plumb-bobs, etc., are practically fool-proof, and only require protection from rust.

Points on Using Spring Calipers

Tools used for comparative purposes or for transferring measurements require more care and intelligence in their use, and in order to use these tools properly, much is dependent upon the "feel" or degree of sensitiveness employed. The degree of accuracy obtained in using inside or outside calipers depends entirely on the individual. Skillful mechanics can employ these tools with accurate results when working to close tolerances, while less skilled mechanics will have difficulty in maintaining the "roughing sizes." Variation in calipering work depends on the setting of the caliper and the individual's touch or "feel" in applying it.

In setting a caliper from a rule, it is essential that the eye be on a direct line with the caliper toe when taking the scale reading. A mistake sometimes made is that of springing calipers to make them fit. In sizing outside diameters, the calipers should be held at right angles to the axis of work, and the weight of the calipers should be sufficient to permit them to pass over the work, the amount of resistance felt determining the accuracy. Many machinists, when calipering turned work, stop the machine, hold one toe of the caliper against the under side of the work, pass the other toe across the top side, and carefully feel for the contact of the caliper with the work. This is a more common practice in using large calipers.

Inside calipering, in addition to the skill in "feel," is dependent upon keeping the caliper handle on the imaginary center of the hole, and the legs each an equal distance in from the edge. Considerable care must be exercised in making internal measurements, as it is easy to cramp the caliper and obtain an inaccurate measurement. In using standard external and internal gages, the same precautions as outlined for calipers should be observed. These gages are more substantially made than calipers, and consequently there is less tendency to spring, but by forcing or cramping gages, the accuracy of the measurement is impaired.

Machinists' try-squares are made extremely accurate, and although this tool is more or less fool-proof it well repays a machinist to keep his square in a case when not in use. In using a try-square, the face of the blade should be held square with the work being tested. The corners of the blade should never be used for testing for squareness. Abuses similar to those outlined for V-blocks impair the efficiency of a square, and caution should be observed to avoid burrs.

The value of a spring depth gage is dependent on the accuracy of transferring the measurement to a scale, so care in use, as previously outlined with regard to calipers, applies equally to this tool. A spring depth gage is a very handy addition to a machinist's kit for readily determining depths of small holes, recesses, shoulders, counterbores, etc.

Precision tools, although designed and manufactured to withstand reasonably hard usage, deserve considerably more care than they ordinarily receive. A good mechanic appreciates the fact that these precision tools, capable of measuring to 0.001 inch (and in some cases to 0.0001 inch) deserve the same care and consideration as any other sensitive mechanical contrivance. It is surprising the abuse these precision tools receive in the hands of some mechanics, and how quickly the same mechanics complain should their measurements deviate 0.001 or 0.002 inch.

The well-known combination square set is very useful for laying out work, and its adaptability and versatility is such that it is used extensively. In using a combination square set, the mechanic should take care to scribe the line as close to the rule as possible. In a properly constructed combination square set, the center head is made slightly off center (approximately 0.003 inch) to allow for the thickness of a scribed line.

Care and Adjustment of Micrometers

The adjustment of precision tools depends on their particular construction, and to describe the adjustment of each particular style and make of precision tool would require a lengthy article. However, as the micrometer is such a common form of precision tool, it is well to consider its care and use in detail.

A micrometer should be taken apart only when absolutely necessary, for any dirt or grit which might enter is very detrimental to its successful operation and injurious to the threads. In grinding rooms, it is an easy matter for abrasive to find its way into the screw, and rapidly reduce its accuracy. Hence the tool should be protected as much as possible.

In measuring, adjust the micrometer slowly into contact with the work to be calipered. Only a light pressure is required. If adjusted too forcefully, an inaccurate reading will result. Especially is this true of micrometers graduated to read to ten-thousandths of an inch, and the use of this type of tool should be confined to precision measurements as much as possible, as wear which would be of comparatively slight consequence in a micrometer that reads only to thousandths is perceptible and important in a tool of this class. Quite frequently such micrometers are insulated from heat. This is done by clamping wood to the frame or wrapping it with cloth or some other poor conductor of heat. It is well to remember, too, that the heat of the hand, the cutter, or the work will make a momentary difference in the reading. To avoid this, the tool should be kept in a place unaffected by heat. For extremely accurate measurements, the work and micrometer should be allowed to attain the same temperature. This is usually accomplished by letting them remain together on a surface plate or bench.

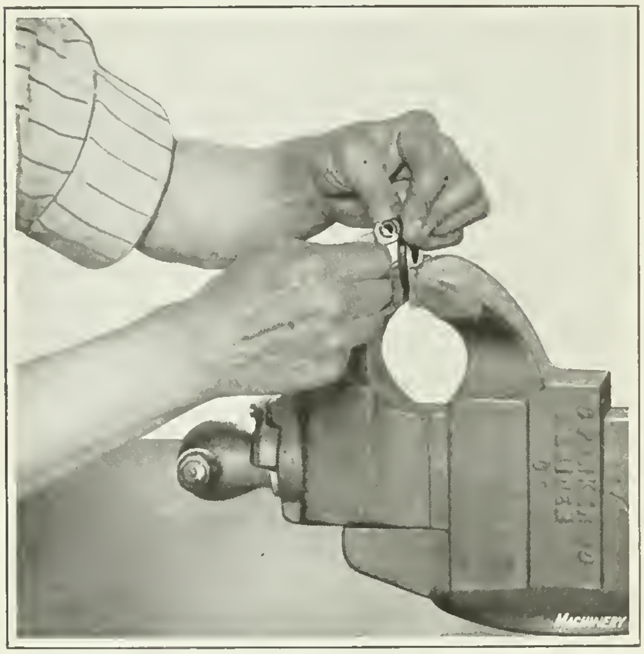


Fig. 1. Adjusting Micrometer to compensate for Wear in Screw

In oiling, only the best quality of a very light oil should be used, and this in a small quantity. A light sewing machine or gun oil is recommended for this purpose. Never use a heavy oil. The spindle should be removed, and the threads thoroughly cleaned with pure naphtha. When the tool is dry and free from any trace of naphtha, the oil should be placed on the threads and the spindle turned back, the oil working into the threads as it returns. A clean toothpick is very convenient for placing oil on the threads. Before oiling, clean the nozzle of the oil-can and shake out a few drops of oil through it to remove any dirt or dust. The oil must be clean.

With ordinary treatment, a micrometer caliper can be used a long time without adjustment. However, in case it should be necessary, means have been incorporated in its design for adjustment to compensate for wear of the screw and also for correcting the reading when the micrometer is set at zero.

Fig. 1 shows how wear or play can be taken out of the screw of a popular style micrometer. The sleeve, with the spindle, is removed and placed where it will be free from dust, preferably on a clean piece of paper. The slots in the tapered nut can then be seen, and this nut is adjusted by using the special wrench furnished with the micrometer. Since that part of the hub containing the tapered threads is split, a very slight turn reduces the diameter of the thread enough to make the screw snug. The illustration shows the sleeve removed and the wrench in hand for making the adjustment. After the adjustment is made, the sleeve should be rolled between the palms of the hands to insure the threads working smoothly.

Fig. 2 shows the means of adjusting the micrometer to obtain the correct zero reading, should the anvil or spindle become worn. It is necessary to have the measuring surfaces of the anvil and spindle clean, and a good way to clean them is to bring these two surfaces together on a clean sheet of paper and then draw out the paper. Screw *A* should be turned to the left just enough to compensate for the backlash in the screw; only a slight adjustment is required usually in resetting the anvil. After making this adjustment, the micrometer should be tested for its zero reading, the measuring surfaces having first been cleaned. If necessary repeat the adjustments until the zero reading is exactly correct; however, care should be taken not to move the anvil too far, for if this is done, the entire operation must be repeated to eliminate backlash. Screw *B* should not be touched unless it is impossible to move screw *A*, and then *B* should be loosened very carefully, for it is likely to turn the anvil when moved. Screw *B* is merely a binding screw. The illustrations Figs. 1 and 2 show the micrometer held in a vise having leather-faced jaws, and although not necessary, a vise so equipped gives a firm support without marring the tool, and reduces the effect of heat from the hand.

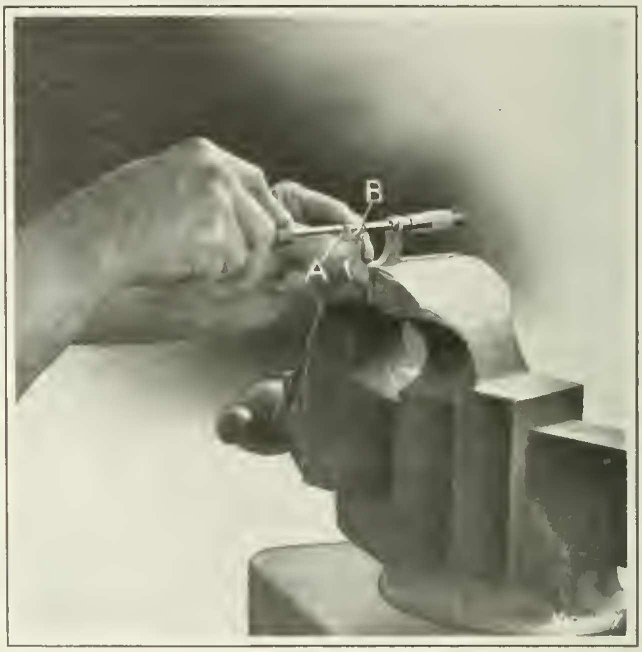


Fig. 2. Adjusting Micrometer to obtain Correct Zero Reading

In using a micrometer depth gage, particular care should be observed to set the micrometer screw so that the leverage exerted by the screw does not raise the base of the depth gage from the work. This is a common fault which can be readily overcome by firmly holding the base of the gage on the work (see Fig. 3) and adjusting the screw slowly and carefully. The flat blade, usually employed in a vernier depth gage, is much easier to set, as it is necessary to hold the base on the work with one hand and push the blade down to the part to be measured with the other, thus overcoming any tendency to lift the base.

Owing to the peculiar nature of the work measured by the thread micrometer, it should not be used in originating or generating standard thread plugs any more than a micrometer caliper should be used in establishing a standard cylindrical plug. Screw thread micrometers should, however, give very close measurements for comparative purposes. A screw thread micrometer graduated to ten-thousandths inch is not recommended. After using a thread micrometer, and before putting it away, the spindle should be separated from the anvil face by withdrawing it a few turns. This is also good practice in using any form of micrometer caliper.

Mechanics should see that all forms of vernier calipers are kept absolutely free from dust or dirt, as grit working under the slide causes scratch marks that will eventually mar the graduations. Verniers should be held as lightly as possible, especially when measuring holes, as in this case the accuracy is dependent on the sense of feel, the same as when using an inside spring caliper.

In using a vernier height gage, as, for example, for laying out jigs or fixtures from a surface plate or machine bed and taking measurements from a plug, the top of the jaw of the height gage should always be passed under the plug, as shown in the right-hand view of the heading illustration. The jaw should never be passed over a plug, as this has a tendency to lift the base of the height gage from the surface plate or machine bed, and thus give an inaccurate reading. Good height gages are made with the under side, or bearing surface of the base, slightly relieved, so that as much friction as possible may be eliminated. Thus when passing the jaw under a plug, a very sensitive "feel" may be obtained.

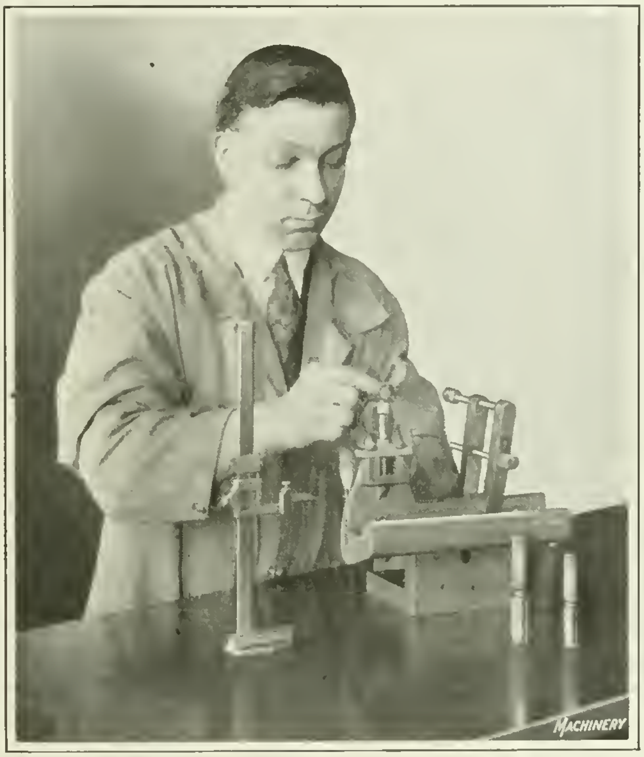


Fig. 3. Proper Method of holding Micrometer Depth Gage when taking a Measurement

A toolmaker's bevel protractor is perhaps one of the most difficult of tools to manufacture, as it is absolutely necessary to have lines that are consistently of the same widths, both on the vernier and on the protractor. It is also a tool that requires much care in setting, as its accuracy is dependent on the lines on the protractor matching exactly with those on the vernier. A good operator takes the precaution of having someone else check up his setting, in order to note any deviations due to differences in eyesight. Setting the tool in a proper light is essential, so that no shadows will be thrown on the graduations. Most mechanics prefer to face the light, having it shine directly down on the reading.

Machinists having a natural bent for mechanical work, usually take considerable pride in their tools, and protect them well when not in use. Such precaution is well repaid, for they find their tools always in first-class shape to use, and accurate in measurements. Furthermore, the life of a tool, when properly cared for, is practically unlimited. In putting tools away for any length of time, they should be thoroughly cleaned (the use of first quality naphtha is recommended for this purpose) and then covered with a coating of oil to prevent rust. If naphtha is used, the tool should be free from all traces of it before the oil is applied. It is a good idea to wrap tools in oil paper also, as this excludes dust, dampness, etc. The boxes in which tools usually come packed will be found convenient for laying them away.

INTERNATIONAL EXPOSITION IN PHILADELPHIA

The plans for the Sesqui-Centennial Exposition in Philadelphia in 1926 have been quite definitely formulated. The purpose of the exhibition is threefold: (1) To mark the 150th anniversary of the signing of the Declaration of Independence; (2) to show the progress of the world, particularly in the fifty years since the Centennial Exposition was held in Philadelphia in 1876; and (3) to create a closer understanding and foster good will between the nations of the world. The exposition will open April 30, 1926, and close November 13.

Among the great exhibition buildings will be a large automobile hall, an airplane building, an electrical palace, and a hall of commerce and industry, in which the progress of the last fifty years will be shown by contrast. For example, the original Corliss engine will be exhibited side by side with the modern steam turbine; a locomotive of 1876 will be shown in contrast with the electrically driven locomotive of 1926, and a hand-plow of 1876 in comparison with the tractor of 1926. This idea of contrast will be carried out throughout the entire exhibit. In the machine tool field some very interesting exhibits can be provided in this connection. A Palace of the Press will also be one of the features; here the growth of the modern newspaper, the periodical press, and engineering and trade journals will indicate the progress made in this field.

In connection with the exhibition, an international engineering congress will be held, to which delegates from all the important engineering organizations of the world will be invited. This engineering congress is organized under the auspices of the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Institute of Electrical Engineers, the Federated American Engineering Societies, and the Engineers' Club of Philadelphia.

* * *

INACCURACY IN MACHINING EARLY STEAM ENGINES

An interesting sidelight was thrown on the development of machine tools in an address by Dexter S. Kimball, dean of the College of Engineering, Cornell University, and past-president of the American Society of Mechanical Engineers, before the Philadelphia Local Section and the Machine Shop Division of the society. It was mentioned that the primitiveness and the inaccuracy of the machine tools in use when Watt began to build his steam engines are almost unbelievable. We find him complaining of one of his steam cylinders that "at the worst place the long diameter exceeds the short by ⅜ inch," and there is much other evidence that indicates similar crudity in all machine processes. The development from these crude beginnings to the modern standards of accuracy and output is something of which every engineer may well feel proud. Wilkinson's boring machine solved Watt's difficulties so that Boulton writes of a 50-inch cylinder that "does not err the thickness of an old shilling in any part."

Position of Thread-cutting Tool and its Effect on Thread Form

By WILLIAM S. ROWELL

As screw threads are dimensioned in a plane that intersects the center line of the work, tools made to these dimensions and set in the same plane will cut a thread of similar dimensions; but if for any reason the position of the tool is shifted from the axial plane, the form of the thread will be altered an amount depending upon several factors. The position of the tool is particularly important when cutting square threads, especially if the lead of the thread is large in proportion to the diameter of the screw.

Position of Tool for External Thread Cutting

As an illustration, assume a 4-inch outside diameter square thread with a groove having a width and depth of 1 inch and a lead of 8 inches. For this thread groove, the angles of inclination to the plane of the center line are approximately 57 degrees 31 minutes at the outside diameter, and 38 degrees 8 minutes at the inside diameter of the groove. Such a thread groove with a section of a relieved tool is shown at *A*, Fig. 1. This tool, however, would not be practical, because the left-hand side has excessive rake and the chips would tend to wedge between the tool and the side of the groove along the right-hand side, owing to the negative rake. To overcome the objectionable features, the rake is usually balanced by using a tool which is set normal to the thread groove as shown at *B*. It will be seen that a much narrower tool must be used in this position than in the plane of the center line in order to cut a groove of the same width.

In balancing the rake the tool is usually set normal or at right angles to the thread groove at half depth, or at the so-called pitch line. It will be understood, of course, that the angle varies from the outside to the inside diameter of the groove, so that the setting of the tool is necessarily a compromise. In this case, the thread groove angle, measured from the plane of the center line, is 49 degrees 41 minutes at half depth.

A section of this thread in the plane *a–b* normal to the groove at half depth is shown at *C*, which indicates that the thread tool must have the shape shown at *C* in order to cut a thread having a square form in the plane of the center line. In other words, the form of tool illustrated by the shape of the groove at *C* is the only one that will cut a square thread when the top of the tool is set in the plane *a–b*.

If a tool of square form were used, the groove produced would have the shape shown at *D*. The normal square section is shown in dot-and-dash lines for comparison. A section of this groove in the plane *a–b* has the form shown at *E*, where the normal thread groove in this section is also shown in dot-and-dash lines. The dot-and-dash lines *f* and *g* show the normal thread groove, and the full lines show the widened groove that a full-width tool would cut if set in plane *a–b*. A tool of normal shape, 1 inch wide, would, if set in plane *a–b*, also cut the bottom of the groove concave, thus removing part of the bolt core, unless the end of the tool were given a concave form to prevent this. Usually, however, this concavity at the bottom of the thread groove would be slight, and therefore would be allowable.

If the thread depth is slight in proportion to the diameter, and the angle of inclination of the thread groove to the plane of the center line is large, the distortion of the groove produced by balancing the rake is negligible. But if the thread is deep and the angle comparatively small, this distortion is an item which should be considered. When the rake is balanced in the usual way, the distortion of the groove form is much greater at the inside diameter than at the outside diameter of the groove. This is because of the rapidly diminishing angle of the groove inclination as the center of the work is approached. Hence, it is evident that the tool should be set normal to the groove at some point below the half depth position, especially in extreme cases, in order to reduce, as far as possible, the distortion of the thread groove in the plane of the centers.

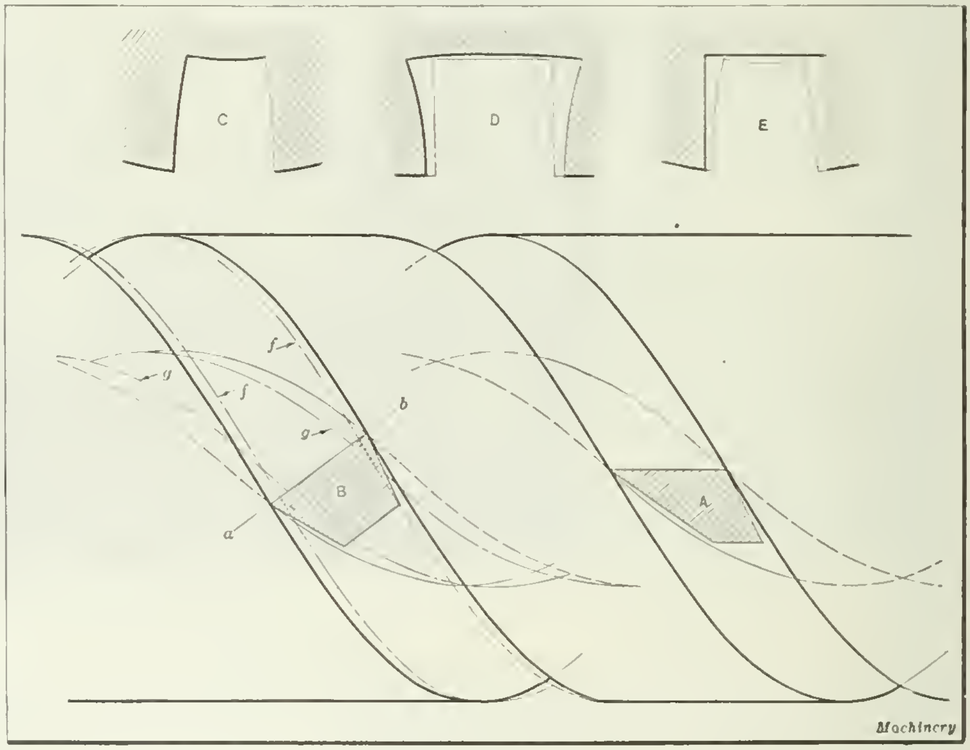


Fig. 1. Diagram illustrating Variations in Thread Form resulting from Changes in the Position of Thread Tool

Distortion Produced in Cutting Internal Threads

As most externally threaded parts are designed to mate with internally threaded parts, the effect of balancing the rake of the tool for cutting internal threads will now be considered. It will readily be seen that a change in position of the cutting edge of the tool will distort an internal thread groove in a nut, the same as in the case of an external thread. Since it would be impracticable to cut a thread of rapid lead in a nut, with the top of the tool set in the plane of the centers, it is essential to balance the rake. If a tool of normal shape and size is set at right angles to the side of the groove at the half depth position, the resulting distortion of form will result in a poor fit between the nut and bolt, even though the latter be perfect, but as these distortions tend toward a loose fit because of widening the groove in both bolt and nut, the inaccuracy is in many cases more readily excused.

As to remedies, if it were a simple case of an increase in the width of grooves, this could be overcome by narrowing the tools a sufficient amount; but as seen by sections *C*, *D* and *E*, the tool should also have convex sides and a concave or convex nose (depending on whether it is an internal or an external threading tool) to produce thread grooves with straight line sides and bottoms in the plane of centers. The amount of narrowing and also the convexity can be calculated, but the resulting curves would be very difficult to follow except by a process of generating.

When this subject was discussed twenty years ago, C. Higgins described a possible method of generating such tools by mounting the stock for the external tool in a lathe toolpost, and forming it by the action of tools set in a bar revolving between the lathe centers while the carriage moved in the direction and at the relative speed proper for the lead to be cut. Similarly, the stock for an internal tool would be mounted as for internal threading, while being acted on by cutting tools extending inward from a bracket fastened to the faceplate of the lathe.

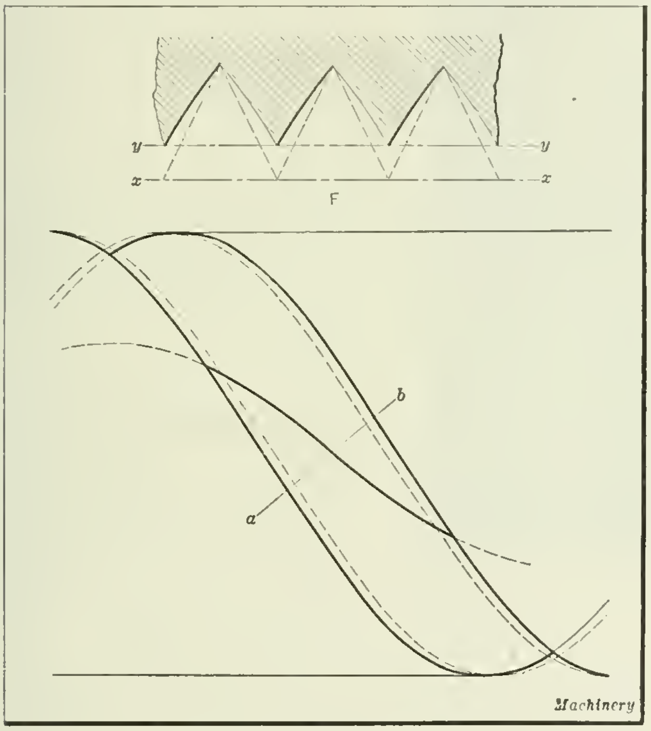


Fig. 2. Diagram showing Thread Groove of V-form and Distortion Possible under Extreme Conditions

It should be understood that the generating tools in both cases are radial elements of the thread to be cut, and are placed the same distance from the center of rotation as the sides of the thread to be cut. The noses of such tools may be similarly generated by cutting tools with edges that are elements of the bottom of the thread grooves—either external or internal: These tools would be mounted on a bar in the lathe for the nose of an external tool, and on a bracket on the faceplate for the nose of an internal tool. In each case the cutting tool is the same distance from the center of rotation as the bottom of the thread to be cut. The flat upper face of the stock from which the tools are generated would in this case be 49 degrees 41 minutes from the horizontal plane of the lathe centers.

Distortion of Thread Grooves having Angular Sides

It is evident that any form of thread will be distorted by balancing the rake of the tool, but that square threads show the most distortion for a given lead, diameter and depth of groove in external work. This is because the thread groove is wide at its inside diameter where distortion is naturally the greatest. The distortion produced in a 60-degree external thread would be comparatively slight, as the narrow width at the inside diameter would tend to eliminate widening of the thread groove where widening is greatest in a square thread. In the case of an internal 60-degree thread the widening is zero at the outside diameter and maximum at the inside diameter because of its width where distortion is naturally greatest.

Fig. 2 shows an external thread groove of the same width, depth, and lead as the square thread we have been considering; but instead of being of square section, it is almost a 55-degree V-form. This form is selected in order to establish a comparison between square thread and a V-thread, since for this angle the thread is as wide as it is deep. With a tool ground to the proper angle, and the cutting edges in the plane of the centers, the normal groove shown by the dotted lines at *F* would result. Shifting the tool to position *a–b* would result in a thread groove about 7/32 inch wider than normal at the outside diameter, with slightly concave sides in the plane of the centers, and this increase of width would reduce the depth of the thread from line *xx* to line *yy*. This reduction amounts to about 9/32 inch, the outside diameter being reduced 9/16 inch.

It is not to be supposed that anyone would by any chance produce such a thread groove as illustrated at *F*, even though the angle of the thread to the plane of the centers was as small as 49 degrees 41 minutes, but it is well known that troubles in thread forms are often encountered and not thoroughly overcome because of a lack of knowledge as to just what causes the trouble.

What has been said about the distortion of the external thread represented by the diagram Fig. 2 applies in principle to internal threads, in connection with which the most difficulty is encountered, especially in the V-form of thread. Thus, if an internal thread groove corresponding to the external thread groove represented in Fig. 2, were cut with a tool of normal shape, set at right angles to the groove at the mid-position, the thread depth would be reduced as shown at *F* for an external thread. The sides of the internal thread, however, would be convex instead of concave. What has been said regarding the difficulties connected with forming a theoretically correct tool for square threads of rapid lead and the way to overcome them applies to V-threads as well.

* * *

SCHOLARSHIPS FOR INDUSTRIAL TEACHERS

The state of New York is offering twenty-five scholarships of $1000 each for men who wish to become industrial teachers, to be awarded to qualified trade and technically trained men. Those awarded these scholarships will spend one year at the Buffalo State Normal School, preparing to teach their subjects in the public vocational schools of the state. At least five years' all-around experience as journeyman is required in the trade or occupation that the applicant expects to teach. In the machine shop field, the following occupations are covered by the terms of the scholarship: Machine shop work; automobile repairing; machine drafting and design; electrical drafting and design; electrical construction, repair and operation; and sheet-metal working. Further information relating to these scholarships may be obtained by applying immediately to the State Department of Education, Albany, N. Y.

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AN OPPORTUNITY FOR THE A. S. M. E.

How can a large and influential engineering society like the American Society of Mechanical Engineers become most useful to the members who are interested principally in the design of machine shop equipment and the management and output of machine shops? In the general mechanical engineering field including steam engines, steam turbines, hydraulic turbines, gas engines and pumping machinery, a great variety of research work has been accomplished that has proved of the highest value to the industries. As a result of this work, the cost of power has been materially reduced and many economies have been made possible.

In the machine shop field, the work of the society, with a few notable exceptions, has been less conspicuous, although the investigations of Fred W. Taylor and Carl Barth on the art of cutting metals were as scientific and far-reaching as any that have been made in other branches of mechanical engineering. In practical machine shop work, there is great need for fundamental research; but unfortunately, all such work involves experiments conducted at considerable cost, as investigations based on well-known theories, such as form part of general mechanical engineering practice, would produce no satisfactory results.

If it is not practicable for the society to serve those who are engaged in the design and economical operation of machine shop equipment by placing on record the results of research work in that branch of engineering, there is another way in which it can become useful to them. An accurate record of good current practice is greatly needed. For example, consider the drawing of sheet metal. No fundamental research work of any importance has been done in connection therewith; but information describing the best practice of firms or engineers who are experienced in that field would be of great value. Some engineers must have collected data relating to the possible reductions in drawing sheet-metal work, the frequency of annealings, and the power required for producing drawn shells, which, recorded in papers read before the society, would be helpful to many members engaged in machine shop work.

Similar information on drilling, tapping, and cutting off metals with rotary saws and power hacksaws, would be equally valuable; and also definite data on the newer cutting metals, stellite, diamond alloy, Chesterfield metal and others of similar qualities. It is not necessary that all these data be based upon exhaustive experiments and research. They are valuable if they merely record what has been found by experience to represent good, everyday shop practice—if they place on record the best practice of the best shops for the benefit of all members.

In the machine shop field, such information made available through papers presented before the society would parallel in value the analytical researches on the properties of steam in the power field. The work in the shop cannot be subjected to such definite laws and rules as the equipment under the direct control of the power plant engineer, because the human element enters into shop work to a much greater extent. But an engineering society can serve the latter field equally well by adapting itself to shop requirements and recognizing that theoretical analyses in the one field are no more important than the records of practical operations in the other. The value of each must be measured according to the conditions prevailing in the industry that is served.

THE DEVELOPMENT OF GEAR GRINDING

Less than ten years ago taps ground in the thread were unknown to the trade; today they are made commercially in considerable quantities. A still later development is that of grinding the teeth of gears to an accurate tooth shape; but this method also is rapidly becoming a commercial process, and several machines are now on the market for grinding gear teeth. Only a few years ago such refinement in gear manufacture was considered unnecessary; today it is general practice for high-grade automobiles.

One interesting development of the gear grinding process is that highly accurate gears can be produced with ground teeth without appreciably increasing the cost over gears whose teeth are merely cut to shape with some form of hob or cutter. When gear teeth are to be ground, they can, of course, be roughed out more cheaply, and the loss of gears in the heat-treating process is smaller, because the distortion in hardening is corrected by the grinding process. A large percentage of gears for high-grade automobiles were thrown into the scrap heap after hardening, when the teeth were not ground. This waste was costly, but formerly there was no known method of avoiding it.

The gear tooth grinding machine saves many gears from being scrapped, and when this item is considered, together with the reduced cost of cutting the teeth, it will be found that the additional grinding operation adds but little to the total cost of the gears. For these reasons the gear grinding machine is destined to occupy a place alongside other important types of machine tools.

* * *

DOES YOUR FUTURE LIE BEHIND YOU?

In a New York savings bank there is a poster headed, "Someone is Banking the Money that you Waste." Changing the wording, but not the fundamental idea, the statement "Someone is Filling the Job You Lost by Wasting Your Time," would apply to thousands of men in the shops who would have better jobs today had they taken the trouble to prepare themselves for more important positions.

Few young shop men today realize how difficult it was for those who started in the machine shop even as recently as twenty years ago, to acquire a mechanical education. At that time there was less than one-tenth of the practical mechanical literature now published. Then there was, for example, not one comprehensive work published on the subject of jigs and fixtures, there was no book dealing with the principles of the design and production of small tools, there was no handbook which specialized on information for the designer and shop man in the machine shop industry. The facility with which knowledge can be acquired today in machine shop practice and machine design makes it possible for any young man of average ability to prepare himself for a better position within a few years.

There is now a library of carefully prepared books, covering almost every subject in the mechanical field, from which all the principles of machine design and shop practice can be learned, supplementing the practical experience obtained in the office, drafting-room or shop. An ambitious student is offered every facility to acquire in a few years a fund of knowledge from technical literature that ten or twenty years ago could have been obtained only from shop instruction given by some of the older mechanics.

American Gear Manufacturers' Convention

THE outstanding feature of the seventh annual meeting of the American Gear Manufacturers' Association, held at the Hotel Cleveland, Cleveland, Ohio, April 19, 20, and 21, was the great amount of data presented in the reports of the society's standardization committees. Apart from the Society of Automotive Engineers, no association in the industrial field has paid as much attention to standardization in its field of activity as the gear manufacturers. The larger part of all the sessions was devoted to reports by the standardization committees. The association now has nearly 100 member companies. At the annual meeting one new company was elected to membership—the Braun Gear Corporation, Brooklyn, with Jacob Braun, executive member.

F. W. Sinram, president of the Van Dorn & Dutton Co., Cleveland, Ohio, and for the last six years president of the association, welcomed the members to Cleveland. He made a brief reference to his pre-convention message that had been sent to the members, in which he called attention to the important part the American Gear Manufacturers' Association plays in the industries, and showed how, through the association's work, gearmaking has been recognized as a separate and independent industry. Attention was also called to the fact that for the first time in the history of the association, which was founded in 1917, we are in a period of normal times, present conditions being more favorable to a healthy progress than at any time since the association was formed.

George L. Markland, Jr., New President of A. G. M. A.

The purposes and aims of the American Gear Manufacturers' Association are twofold—commercial and technical. As stated in the constitution, its objects are to discuss subjects of interest and value to the industry in which the members are engaged; to improve the conditions in the industry; to collect and distribute statistics and information of value to the members; to standardize methods of design, manufacture, and application of gearing; and to promote a spirit of cooperation among the membership that will result in improving production methods and increasing the application of gears.

Probably the most important of the activities so far undertaken is the standardization work. The association is now cooperating with a number of other societies in work of this kind. A definite program for the technical standardization activities has been laid down, and as the times and conditions are now more favorable for the progress of standardization work than ever before, all the members were requested to take an active part in this work. There is evidence on every hand of great interest in the work so far accomplished, and the reports presented at the meeting indicate that within the near future some important standardization may be adopted by the gear manufacturers in conjunction with other leading societies in the industrial field—the American Society of Mechanical Engineers, the Society of Automotive Engineers, and the American Engineering Standards Committee.

Standardization Reports

B. F. Waterman of the Brown & Sharpe Mfg. Co., Providence, R. I., chairman of the general standardization committee and vice-president of the association, presented two reports, one relating to the general standardization work within the association, and the other with regard to the work carried on in cooperation with the American Engineering Standards Committee. The work of the different committees was reviewed, and the extensive scope of the work at present being carried forward was outlined. E. W. Miller of the Fellows Gear Shaper Co., Springfield, Vt., presented a report relating to the cooperation of the Gear Manufacturers' Association with the American Society of Mechanical Engineers in regard to research on the strength of gears.

Separate reports were presented by the committees on spur gears; bevel and spiral bevel gears; herringbone gears; nomenclature; wormgears; sprockets; electric railway, mill, and mine gears and pinions; composition gearing; differential gearing; metallurgical standardization; industrial relations; inspection; commercial standardization; and uniform cost accounting.

Strength of Spur Gears

The spur gear committee, of which F. E. Eberhardt of the Newark Gear Cutting Machine Co., Newark, N. J., is chairman, presented recommendations, the purpose of which is to provide a simpler method of calculating the strength of spur gears. The method is based on the Lewis formula, but provides for simpler factors and introduces a list of constants that facilitate the work. The report states that the horsepower a gear will transmit depends on the quality of the material, accuracy of the tooth spacing, accuracy of the tooth form, quality of the finish, rigidity of the shafts, bearings and housings, and accuracy of the shaft alignment.

A gear that is supported on only one side should be made with a comparatively narrow face. A good rule is to make the face not over the American Gear Manufacturers' Association's recommended standard = 10 ÷ D.P.

Gears should always be made strong enough; that is, they should be good for at least 25 per cent more horsepower than the rated load. If the drive is subject to a known overload, or a probable overload, the gears should be made strong enough for the full overload plus a margin of safety. This means that for such service as heavy rolling-mill work, crushers, reciprocating pumps, and similar duty, the gears should be designed with such an overload factor in mind. The actual overload may equal 250 per cent of the rated load.

When pinions with less than 18 teeth are used, the service may call for stronger teeth than the 14½-degree standard. In such cases, it is advisable to consider the 20-degree standard depth tooth, or a 14½-degree tooth with long addendum. Pinions with low numbers of teeth may be used for slow movements and heavy work, but they are not so desirable for pitch-line velocities above 800 feet per minute.

On motor drives and for ordinary industrial gearing, where ideal conditions do not prevail, it may be necessary, for quietness, to use non-metallic pinions, when the pitch-line velocities exceed 800 feet per minute. If rawhide, cloth, bakelite, or similar non-metallic material is not strong enough for the load, a combination of strength and quietness may be obtained by a laminated construction, using alternate sheets of steel and non-metallic material riveted together.

When gears are mounted rigidly and supported on both sides, well made gears may be run in oil at pitch-line velocities of 2000 feet per minute, both gear and pinion being made of metal.

The spur gear committee also presented a report covering definitions of spur gear terms—a nomenclature for spur gearing for the consideration of the members.

Bevel and Spiral Bevel Gear Standardization

The bevel and spiral bevel gear committee, of which F. E. McMullen, of the Gleason Works, Rochester, N. Y., is chairman, in cooperation with the nomenclature committee, submitted a report on nomenclature for bevel gearing, defining not less than eighty-seven different terms employed in connection with gearing of this type. This work will be carried to its conclusion in conjunction with the American Engineering Standards Committee. The definitions adopted by the committee are made broad enough to apply to gears other than those of the bevel type, when the same terms are used in various kinds of gearing. However, it is difficult to make a definition perfectly clear, when so broad in its application, and for this reason it may be more practicable to have the definitions differ, in some cases, for various types of gearing.

In addition to the nomenclature, the committee submitted as recommended practice for future design that part of the Gleason Works bevel gear system which was presented at the Chicago meeting of the association last fall, and which was published in full in November, 1922, MACHINERY. This recommended practice was adopted by the association.

Worm-gear Standardization

The worm-gear committee, of which J. C. O'Brien of the Pittsburg Gear & Machine Co., Pittsburg, Pa., is chairman, presented a comprehensive progress report for the design of worm-gearing, together with tables and formulas. This report is an attempt to effect a compromise between the commercial, practical, and theoretical requirements in the design and manufacture of worm-gearing. In studying the problem of standardizing worm-gearing, it was found advisable to divide the gearing into groups, and the group covered by the present recommendation is defined as follows: Linear pitches, 1/4 to 2 inches, single to quadruple thread; gear ratios, from 10 to 1 to 100 to 1. This includes worm-gearing required for general commercial uses where the gearing is furnished without bearings or housings, and does not include gearing with the axes at other than 90 degrees. The recommendations incorporated in this report are as given in the following:

(A) That the thread form to be regarded as standard will be the form produced by a straight-sided milling cutter having a diameter not less than the outside diameter of the worm nor greater than 1 1/4 times the outside diameter of the worm, the sides of the cutter having an angle of obliquity of 14 1/2 degrees in the case of single- and double-thread worms, and an angle of obliquity of 20 degrees in the case of triple- and quadruple-thread worms.

(B) That single- and double-thread hobs may be fluted parallel to the axis.

(C) That triple- and quadruple-thread hobs should be fluted normal to the thread angle reckoned from the outside diameter of the hob.

(D) That the following linear pitches be regarded as standard for this group: 1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 1, 1 1/4, 1 1/2, 1 3/4, and 2 inches.

The fact is recognized that in the case of worm-gearing a longer period of transition from present haphazard methods of designing to standard methods may be expected, and in order that the best results may be obtained from existing facilities, the following recommendations are made for the use of existing hobs:

For wheels engaging with single- and double-thread worms, the width of face should not be greater than the chord of the worm outside circle which is tangent to the worm pitch circle, plus one-half the linear pitch.

For wheels engaging with worms having triple or quadruple threads, a face width of 1/4 circular pitch less than the above is recommended.

For the use of existing hobs, it is recommended that the outside diameter of worm-gears be made the following amounts larger than the pitch diameter.

For wheels meshing with single- and double-thread worms:

Outside diam. = pitch diam. + 3.5 × addendum

For wheels meshing with triple- and quadruple-thread worms, where the pressure angle is 20 degrees or greater:

Outside diam. = pitch diam. + 3 × addendum

For wheels meshing with triple- and quadruple-thread worms, where the pressure angle is less than 20 degrees:

Outside diam. = pitch diam. + 2.75 × addendum

In every case a radius at the edge of the wheel rim equivalent to 1/4 circular pitch is recommended.

In connection with this report, complete formulas were presented for the design of worm-gearing. Those interested in the subject can obtain blueprints covering these formulas from the secretary of the association, T. W. Owen, Room 107, 2443 Prospect Ave., Cleveland, Ohio.

Sprocket Wheel Standards

The sprocket committee, of which C. R. Weiss of the Link-Belt Co. is chairman, presented a very complete report, which is also expected to become the standard of the Society of Automotive Engineers and of the American Society of Mechanical Engineers. When finally approved by these two societies, in conjunction with the gear manufacturers, there will be a recognized standard for sprocket wheels that completely covers the various phases of sprocket wheel design.

Other Standardization Reports

The composition gearing committee, of which F. S. Sorensen of the Cincinnati Gear Co., Cincinnati, Ohio, is chairman, presented a report on gears made from rawhide or other non-metallic materials. The report includes tabulated information which will be of value to the designer in aiding him to lay out pinions of proper proportions with the least amount of calculation. The tabulated data submitted in connection with the report is a simplification of the charts that had formerly been accepted by the association, presented in a more convenient form for ready reference.

The differential committee, of which S. O. White of the Warner Gear Co., Muncie, Ind., is chairman, as well as the railway gear and pinion committee, of which W. H. Phillips of the R. D. Nuttall Co., Pittsburg, Pa., is chairman, both presented progress reports accompanied by tabulated data.

Papers Read before the Meeting

A number of papers of unusual interest to both gear manufacturers and gear users were read at the meeting. E. C. Smith, chief metallurgist of the Central Steel Co., Massillon, Ohio, read a paper on "What Does the Microscope Tell Us?" in which he showed a number of screen pictures of photomicrographs, and indicated the significance of the grain structure and the appearance of the fracture.

E. J. Lees of the Lees-Bradner Co., Cleveland, Ohio, read a paper on "Grinding and Measuring Involute Gear Teeth," in which the company's measuring machine was demonstrated and the theory on which it is based, explained. Wilfred Lewis, of Philadelphia, Pa., spoke on gear-testing machines, explaining in considerable detail different types of gear-testing machines designed in the past, and outlining the principles upon which a highly developed form of gear-testing machine should be based.

Col. L. P. Ayres, vice-president of the Cleveland Trust Co., Cleveland, Ohio, spoke on "How Long Will Prosperity Last?" He pointed out that at the present time we are enjoying a degree of industrial activity that has never before been equaled, not even during the war. This high-pressure activity may be expected to last until late in the year, when it is likely that there will be a gradual decline to more normal business.

An address that aroused a great deal of interest among the gear manufacturers was that by K. L. Hermann of the Studebaker Corporation, who spoke on "Tooth Forms of Automobile Gears after Cutting, Hardening and Grinding." In his address, Mr. Hermann showed by charts how the accuracy of tooth forms and tooth spacing may be tested, and which method of gear-cutting is likely to give the most accurate results. Another paper of considerable interest was presented by S. P. Rockwell, consulting metallurgist, 65 Highland St., Hartford, Conn., dealing with the determination of the grade of steel by observing the characteristics of the spark when a sample is pressed against an abrasive wheel. This paper, together with spark pictures indicating the form of spark resulting from different grades of steel, will be presented in a coming number of MACHINERY.

Other papers of interest presented before the convention were an address by O. C. Kiehne of the Van Dorn Electric Tool Co., Cleveland, Ohio, on "Practical Value of Cost Accounting," and one by A. F. Cook of the Fawcus Machine Co., Pittsburg, Pa., on "Hit-and-Miss of Cost Accounting."

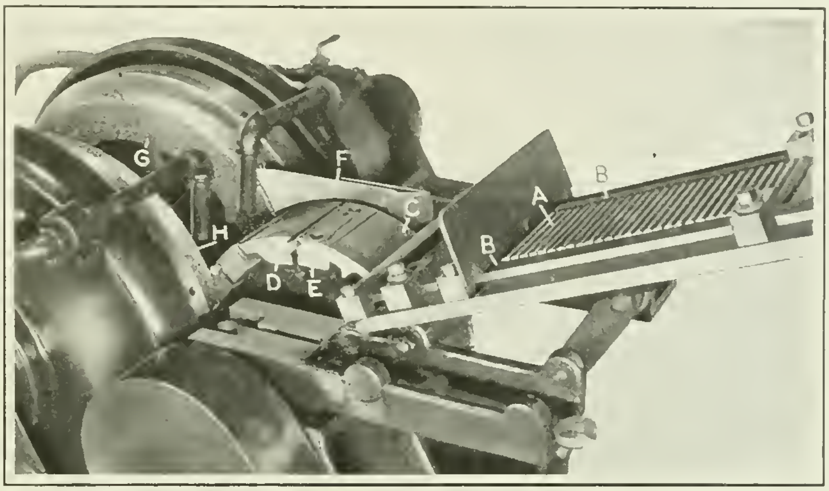
At the meeting, six members were elected to the executive committee, as follows: A. W. Copland, Detroit Gear & Machine Co.; C. B. Hamilton, Jr., Hamilton Gear & Machine Co.; R. P. Johnson, Warner Gear Co.; George L. Markland, Jr., Philadelphia Gear Works; B. F. Waterman, Brown & Sharpe Mfg. Co.; and Arthur E. Parsons, Brown-Lipe Gear Co. George L. Markland, Jr., was elected president to succeed F. W. Sinram, who has held this office ever since the association was formed. A. W. Copland was elected first vice-president; B. F. Waterman, second vice-president; and C. F. Goedke, treasurer. In consideration of the services rendered the association during his presidency, Mr. Sinram was elected honorary president. S. P. Rockwell of Hartford, was appointed consulting metallurgist of the association.

In connection with the meeting, an exhibition was held under the auspices of the metallurgical committee, of which C. B. Hamilton of the Hamilton Gear & Machine Co., Hamilton, Ontario, is chairman. This exhibition included a complete metallurgical laboratory for a machine shop, showing means both for chemical analysis and for the testing of hardness and strength.

VALVE STEM GRINDING ATTACHMENT WITH MAGAZINE FEED

The valves that control the ports through which the gases enter and leave the combustion chamber of an automobile engine may be of one-piece construction, or the head and the stem may be rough-machined or forged separately and then joined together by welding. It is the practice of one manufacturer, in following the latter procedure, to grind the ends of the valve stems preparatory to welding them to the heads. The magazine attachment shown in the accompanying illustration is employed for grinding the ends of the stems on an automatic grinding machine built by the Badger Tool Co., Beloit, Wis., which was described on page 403 of January MACHINERY.

Referring to the accompanying illustration, it will be seen that the machine is set up to grind both ends of the valve stems. It would seem unnecessary to grind more than one end of the valve stem, as the welding operation is performed only on one end, but it has proved cheaper to grind both ends, so that either end may be welded to the head. Thus the welder loses no time in determining which end of the stem is to be joined to the head.



Magazine Grinding Machine Attachment for grinding Ends of Two-piece Valve Stems

The stems to be ground are placed in a feed-chute, as shown at *A*. The guide strips *B* can be adjusted within certain limits to accommodate stems of different lengths. The stems are fed by gravity into the openings between the jaws in the work-carrying head or drum *C*. There are several sets of these jaws in the drum. One set consists of a fixed member, such as shown at *D*, and a pivoted or movable jaw *E*. The movable jaw is opened and closed by means of a cam as the drum revolves in the direction indicated by the arrow. The jaws are, of course, in the open position when opposite the delivery end of the feed-chute.

Let it be assumed that the machine is in operation and that a valve stem has just dropped into the opening between a pair of jaws. As the drum continues to rotate, it carries the valve stem between two sheet-metal guides, one of which is shown at *F*, the other having been removed to give a better view of the drum. The guides serve to locate the stems in the jaws so that the grinding wheels *G* and *H* will remove the same amount of metal from each end of the work. After the work has been thus centered, the cam-actuated jaw *E* closes on the work, and holds it firmly in place while it passes between the grinding wheels.

When the work has been carried around out of contact with the grinding wheels, the pivoted jaw opens and permits the valve stem to drop into a chute, which carries it to a box placed at the front of the machine. The open jaw then picks up another piece of work, as it passes the delivery end of the chute, and the operation is repeated. Each set of jaws operates in the same manner, and production is continuous as long as the chute is kept supplied with work. It will be noted that the chuck jaws are fitted with V-blocks. These blocks are removable, so that work of different lengths and diameters can be accommodated by simply substituting different sets of blocks. The production is thirty pieces per minute.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, April 12

ALTHOUGH most engineering industries are experiencing ups and downs, the tendency as a whole is quite definitely in an upward direction. Competition for new business is very keen, and at present manufacturers are satisfied with meager profits. Prices of most metal-working commodities have stabilized, and any change invariably means an increase.

The Continental demand for blast furnace coke and coking fuels has turned what was a scarcity into a famine, and although some areas report an increased demand for British iron and steel to replace the imports that the Continent has stopped supplying, the scarcity of fuel makes delivery a very uncertain quantity.

The Machine Tool Industry

The machine tool industry shows signs of acceleration, although inquiries are still out of proportion to orders. Buying is fairly general in character, but immediate or very early delivery is a stipulation that has to be met if orders are to be obtained. Buyers are coming to the conclusion that prices are stabilizing and that increases may be expected at any time. As only a few makers now have stocks of any magnitude, there is more building activity in order that inquiries can be met with the promise of quick delivery. Makers of power presses, turret lathes, and brass finishers' lathes, are among those who are feeling the first movements toward a steadier flow of business. The activity of the railway shops is reflected in the purchase of machine tools.

Small tool makers continue to be comparatively active, the healthy conditions of the automobile and motorcycle industries being a salient cause of a steady small tool consumption. At the moment the total output of small tools is estimated to be within measurable distance of the pre-war average capacity.

Overseas Trade in Machine Tools

During February the exports of machine tools continued to show the wide fluctuation that has characterized these returns for many months. February shows a heavy drop as compared with January, the export tonnage for the month falling from 1337 to 1033, the corresponding value being £157,500 and £111,250. Imports rose from 276 to 358 tons, but fell in value from £33,830 to £33,673. While the export value per ton fell quite substantially—from £118 to £108—the import value per ton came down from £123 to £94. Although it would be absurd to base any generalization on one month's returns, there can be little doubt that the number of high-grade machine tools must have fallen.

As in January, exports in February showed a prominence over imports in all classes of machine tools, both in value and in tonnage. The heaviest items of export were lathes, planing and shaping machines, and heavy simple type machines, such as plate-cutting and plate-bending machines, steam hammers, etc. Lathes also figured prominently among imports, but were evidently chiefly lower priced machines, since the average value per ton was only £86 5s.

Railway and General Engineering Fields

Several orders for locomotives have been placed recently. It is evident from quotations submitted that prices do not constitute a hindrance to placing of orders, as, in reply to an inquiry from the Indian railways for eighty-two locomotives, the prices quoted by not less than seven British manufacturers were lower than those received from the Continent. British makers also offered much quicker delivery.

At the same time, railway demands for all classes of products and material are not developing to the extent expected two or three months ago, and it is thought that several projects that would have given a considerable amount of work will now be postponed until the fall.

Now that the regrouping of the railways is an accomplished fact, the question of rates revision is being brought up. Today railway rates are about 75 per cent above the pre-war level—a figure which compares unfavorably with the general level of wholesale prices. A request has been made to the railways by the Federation of British Industries that the rates should be reduced without delay to 33 1/3 per cent above the pre-war level.

In the constructional engineering field the present increased prices of iron and steel prevent the quoting of acceptable prices. In the Manchester district, builders and other constructional yards are slack. Tube makers are very busy on substantial foreign orders. Many steel works and laboratories of technical institutions are increasing or renewing their testing equipment.

The Automobile Industry

The majority of automobile manufacturers have sufficient orders to keep them going, and some of the leading firms are obtaining new business at a rate that exceeds their production rate. Although the small light types of cars are most prominent among the orders received, there continues to be a fair demand for medium class touring cars; but makers of higher quality cars are none of them working at anything like full capacity. The export trade in automobiles is disappointing. Makers of automobile fittings and equipment are mostly working at full capacity, and motorcycle and bicycle makers are increasing their output.

Materials

The demand for iron and steel is good, but it is almost impossible to obtain delivery owing to fuel shortage. Material prices went up suddenly during March in the Sheffield area. Increases are not confined to ferrous metals, aluminum and copper also having risen in price.

The development of stainless ferrous metals is proceeding rapidly. In Sheffield, considerable progress is being made with the production of stainless castings, and the ultimate success of such a process should inevitably open up an enormous field, particularly as it does not promise to be prohibitive in cost. Already some intricate shapes have been successfully cast.

A new form of combined iron and steel was described by Dr. Longmuir before the Birmingham Metallurgical Society. This appears to be much ahead of the steel-faced iron that has been used extensively in the past for anvil faces, press tools, hammer heads, and so on. One feature of the process is that the interpenetration of the two metals is perfect; and another is that steel of very high carbon which will carry the keenest cutting edge is obtainable. Such steel would be difficult to harden in long, thin bars or blades, and the risk from water cracks would be considerable. The greatest advantage is, perhaps, that blades of wood-planing and other machines, made from this material, will be safe to use, as, if the steel should crack, it would not fly, and there would be no danger at the highest speeds.

GERMAN INDUSTRIAL CONDITIONS

From MACHINERY'S Special Correspondent

Berlin, April 12

Of approximately 10,085,000 workmen in Germany, about 2,710,000 are employed in the mining, iron and steel, and metal-working industries, and hence it is apparent that the economic stability of Germany depends to a great extent upon these industries. The serious effect of the French occupation in the Ruhr and other sections on industrial Germany will be understood when it is remembered that 800,000 of the workmen engaged in the industries mentioned live in the occupied districts. Perhaps a better realization of the industrial importance of the occupied territory will be obtained by considering the mining industry alone. Of an estimated 252,000,000,000 tons of coal deposits in Germany, approximately 90 per cent is under French and Belgian control at present, and in 1922 the coal mined in the Ruhr alone represented 92.6 per cent of that mined in the whole country. Germany was formerly a coal-exporting country, but it is now necessary to import coal; approximately 9,538,000 tons having been imported during 1922. The center of iron and steel production is in the occupied territory as well.

Although these losses will be keenly felt in the future, the consequences of the Ruhr invasion are not so seriously felt at present as one might suppose. According to reports from establishments employing 1230 workmen, conditions are about the same as prior to the occupation. The question of selling inside the occupied districts constantly assumes a more serious aspect. However, as stocks had been sold out just before the invasion, and the various establishments are busy on repair and maintenance of equipment in addition to production, employment will probably not drop suddenly during the next few months.

The question naturally arises as to how long industrial Germany can survive without assistance from the occupied regions. Other large industrial centers, such as Saxony, Hanover, and Berlin, are in a position to take over the bulk of the foreign business, and serious scarcity of iron and steel can be avoided for a long period by increasing the production in non-occupied districts. Large quantities of iron scrap are being imported from Russia in exchange for other goods, and large contracts have been made with Swedish and Spanish interests for iron ore. Iron ore can also be imported from Luxemburg, Austria, England, and the United States. As to the shortage of coal, serious difficulties are not expected for a year, because the big industrial plants, on the average, have from four to six weeks' supply, and coal is constantly being imported from England, Upper Silesia, and Czechoslovakia.

The Machine-building Industries

The machine-building industries show a slight decrease in activity, but the condition of the machine tool branch is satisfactory. Machine builders are suffering somewhat from the scarcity of iron and steel.

From a commercial point of view, the results of the Leipzig Fair, which was held March 4 to 10, inclusive, were disappointing. Although there were 166,000 visitors, the majority of potential purchasers expected a reduction in prices. The show-room space of the Association of German Machine Tool Builders had been increased about 22,000 square feet this year. This association is in its twenty-fifth year, and has about 400 members. During 1922 only about 1600 tons of machine tools were imported into Germany, as against 540 tons in 1913, while about 78,200 tons were exported as against 90,300 tons in 1913. Exports of machine tools during January, 1923, were about 20 per cent of the monthly average for 1913, which indicates that Germany is not doing a great export business in this field.

Living Conditions

Wages and living costs rise constantly with the continued depression of the mark. At the beginning of March, the weekly wage of a skilled workman, expressed in marks, was about 1630 times the wage of pre-war times, while the wage of an unskilled workman was about 2050 times the wage of pre-war times. Living costs have risen even more, being about 2650 times the level of 1913-1914. Employment is satisfactory, statistics from labor unions showing that out of a membership of 5,800,000 only about 4.4 per cent are out of employment.

The Exchange Situation

The value of German exports for 1922, expressed in gold marks, dropped to one-third of the value of pre-war years. In consequence of the tremendous drop in the value of the mark during past months the paper mark retains importance only as a means of immediate payment. The dollar has become by far the most important factor in establishing the relation of the paper to the gold mark. The members of the Association of German Machine Tool Builders were the first to use the dollar in their accounts. Business of the last few years is characterized by big paper-mark profits, both in production and commerce, but paper-mark profits have proved to be losses. Profits made in selling goods are usually not sufficient to secure the same quantity of goods again.

The character of all the economic and political factors makes it impossible to draw any conclusions as to the future. Political events have resulted in a closer understanding between Germany and Russia. The principal difficulty in trading with Russia is the question of credit. England is in a position to allow longer credits and, therefore, enjoys a far greater trade with Russia than Germany.

* * *

PREVENT FACTORY FIRES

The annual fire loss in the United States amounts to nearly $500,000,000, the per capita loss in 1921 being $4.24, an unparalleled figure not even approached in any other country. The states with the greatest fire loss in proportion to population were Delaware, New Hampshire, and California. The lowest rate was found in Vermont. Carelessness with matches and smoking was the leading single cause of fires in 1921. At least 65 per cent of the fire loss could have been prevented by the exercise of proper precautionary measures and the realization on the part of everyone of the danger of carelessly handling matches and throwing away lighted cigars and cigarettes. In addition to the property loss, an even greater loss was sustained in the 15,000 lives that were lost in fires during the year. The greatest care should be exercised, especially around shops and factories in regard to matches, because the oil-soaked floors, waste, and other combustibles furnish an additional danger which everyone should guard against.

* * *

MACHINE TOOL SITUATION IN HOLLAND

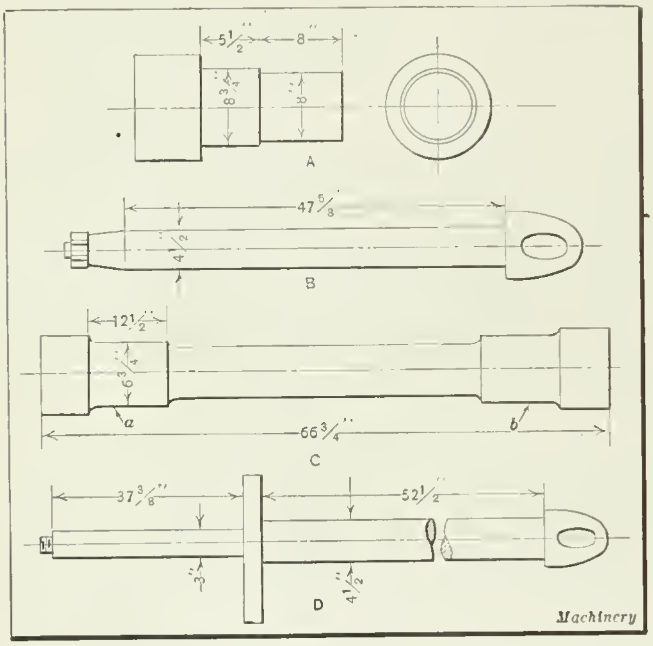
Germany controlled the trade in machine tools, as well as in other types of machinery, in Holland during 1922. American machine tools, which in former years were imported to a considerable extent, constituted but a small part of the 1922 imports. In spite of the fact that during the first half of 1922 the prices of American machine tools were lower than they had been for years, the prices of German machines were still lower, and the difference in price was too great to permit American machines to be sold. On the whole, there was a large decrease in all Dutch imports of machinery on account of the general business depression. The present difference in price between American and German machines is from 20 to 40 per cent.

GRINDING LOCOMOTIVE PARTS

In many railroad shops, grinding has replaced the older method of turning and rolling as a means of machining various parts. A comparison of the results obtained by the two methods in machining three important locomotive parts is given in this article in order to show the saving in production time made possible by grinding. The grinding equipment employed for the work described was made and installed in a railroad shop by the Norton Co., Worcester, Mass.

Grinding Locomotive Crankpins

No record of the production time for the locomotive crankpin shown at *A* in the illustration previous to the adoption of the grinding method is available, so that a comparison of the production rates obtained by the old and new methods in this particular case cannot be made. This pin is made of steel, and must be straight within limits of 0.00025 inch and have a good journal finish. The pin is rough-turned previous to grinding, about 0.035 inch of stock being allowed for the latter operation. A Norton 24- by 4- by 5-inch, grain 24 C grade K grinding wheel, running at a speed of 940 revolutions per minute, is used for this job. The total time required for the rough-turning and grinding operations on the two dimensioned sections of the work is thirty minutes.



Locomotive Parts finished to Size on Grinding Machine

Grinding Piston-rods

Piston-rods of the type shown at *B*, which have been worn in service, are readily refinished by grinding in much less time than is required by the older method of turning and rolling. For this work, a 24- by 4- by 5-inch grinding wheel grain 24 C, grade K, is used. The speed of the grinding wheel in this case is 940 revolutions per minute. The piston rod, when finished, is required to be straight within limits of 0.0005 inch. Approximately 0.030 to 0.060 inch of stock is removed by grinding. The production time for the grinding method is thirty-five minutes as compared with from one to two and one half hours for the turning and rolling method.

Operations on Locomotive Axles

The time required to machine the locomotive axle *C* by the turning and rolling method was from four to five hours. The production time on this part has been reduced to thirty minutes by rough-turning and then finish-grinding to size. The grinding operation is performed only on the two larger bearing surfaces *a* and *b*. About 0.035 inch of stock is removed in the grinding operation, and the finished surfaces are required to be straight within limits of 0.0005 inch. A 24- by 4- and 5-inch grinding wheel, grain 24 C, grade K, is used, which is run at a surface speed of 5900 feet per minute.

Refinishing Worn Piston-rods

Previous to the introduction of the grinding method, it required from four to five hours to turn and finish-roll a worn piston of the type shown at *D*, so that it would again be fit for service. This work is now accomplished in fifty-eight minutes on a grinder equipped with a 24- by 4- by 5-inch grinding wheel, grain 24 C, grade K. The ground sections of the work are required to be parallel within limits of 0.0005 inch. From 0.030 to 0.060 inch of stock is generally required to be removed. For this job, a wheel speed of 940 revolutions per minute is employed.

* * *

CONVENTION OF NATIONAL METAL TRADES ASSOCIATION

The National Metal Trades Association held its twenty-fifth annual convention on April 18 and 19 at the Hotel Astor, New York City. During the first session there were the usual appointments of convention committees, reports of officers, and the opening address by the president, W. W. Coleman. In his address Mr. Coleman dealt in part with the labor situation, industrial education, and the economic importance of immigration.

During the various sessions a number of prominent men addressed the association on topics of particular interest and importance to the metal trades. The question "Shall We Close our Gates to the Immigrant?" was discussed by Magnus W. Alexander, managing director of the National Industrial Conference Board, New York City. "The Old Government and the New Industry" was the subject of an address by the Hon. W. L. Huggins, Justice of the Kansas Supreme Court, Topeka, Kans. Hon. Arthur R. Baxter of Indianapolis spoke on "Business Men and Politics"; and "The Law of Supply and Demand" was discussed by Dr. G. W. Dyer, Professor of Social Science, Vanderbilt University, Nashville, Tenn. Robert S. Binkerd, vice-chairman of the Committee on Public Relations, Eastern Railroads, New York City, spoke on "What is the American Railroad Question?" Dr. J. T. Holdsworth, vice-president of the Bank of Pittsburg, gave an address on "Business and Government." At the convention banquet, Laurence Lyon, former member of Parliament, addressed the convention on "The New Diplomacy."

The following offices were re-elected for the coming year: President, W. W. Coleman, Bucyrus Co., S. Milwaukee, Wis.; first vice-president, J. B. Doan, American Tool Works Co., Cincinnati, Ohio; second vice-president, Paul C. DeWolf, Brown & Sharpe Mfg. Co., Providence, R. I.; treasurer, J. W. O'Leary, Arthur J. O'Leary & Son Co., Chicago, Ill

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TRACTOR MEETING OF S. A. E.

The Society of Automotive Engineers held its annual tractor meeting at the Auditorium Hotel, Chicago, on April 19. The all-purpose type of farm tractor was discussed at one of the sessions, and constructive engineering data based on the Nebraska tractor tests were presented at another. Automotive transportation was dealt with in a meeting held by the society in Cleveland, April 26 to 28, at which papers were read relating to the field of the motor truck in railroad terminal cartage service; the economic control of truck operation; results of tests on motor truck rear axles; and the motor bus for passenger transportation.

Metal Patterns for the Foundry

By J. F. HINES, Hines Pattern & Mfg. Co., Cleveland, Ohio

THE cost of machining castings is influenced greatly by the quality of the castings. To obtain maximum production rates, it is necessary to have castings that can be cut or machined easily. In addition to this, they must be uniform in size and so dimensioned that a minimum amount of metal will need to be removed in the machining operations. In order to obtain accurate castings, it is obviously necessary to provide patterns that will produce accurate molds. The metal patterns described in this article were developed to do this, and they have proved very satisfactory, not only as regards accuracy, but also from the point of view of rapid production.

Aluminum Double-faced Cast Match Plate Patterns

For many classes of work it has been found that there is no better form of pattern than the double-faced match plate. A pattern of this type has all the advantages possessed by the so-called "gate of patterns" in that it allows a number of castings to be poured simultaneously, and in addition it provides a simpler means of making the molds. Double-faced match plates can be used either where the sand is rammed in the flask by hand, where a manually operated squeezer is employed, or where a power-driven jolt squeezer is used in the foundry. This type of pattern will usually be found to give the maximum results obtainable with any of these methods.

The cope and drag, or top and bottom sides, of a double-faced metal match plate are shown in Fig. 1. It will be seen that this consists primarily of what is known in the foundry as a "gate of patterns"; that is to say, there is a series of patterns gated into one or more runners, so that each mold provides for making a number of castings. In this case provision is made for making thirty-two castings at a time. It will be noticed that there is a series of patterns on one side of the match plate corresponding to thirty-two half sections of the pieces to be cast. A second series of patterns, corresponding to the other thirty-two half sections of the pieces is located on the other side of the match plate; thus the half patterns for the thirty-two castings are supported by the match plate. The match plate is provided with eye-holes at each end to receive the guide pins on the flask.

In using a double-faced match plate for molding, the method of procedure is to put the match plate between the two halves of the flask. Sand is then rammed into the drag side of the flask, after which bottom boards are placed over the sand to prevent it from shifting when the mold is turned over. The bottom boards are made small enough to fit inside the drag flask. Sand is next rammed into the cope side of the flask. A cope board provided with a cup or button at the point of sprue is then placed on the sand, and the cope and drag are squeezed together. The cope is next lifted off the match plate after which the match plate is lifted off the drag. After the necessary hand work has been done in finishing the two halves of the mold, the cope side is placed on the drag, and the mold is ready to have the molten metal poured into it.

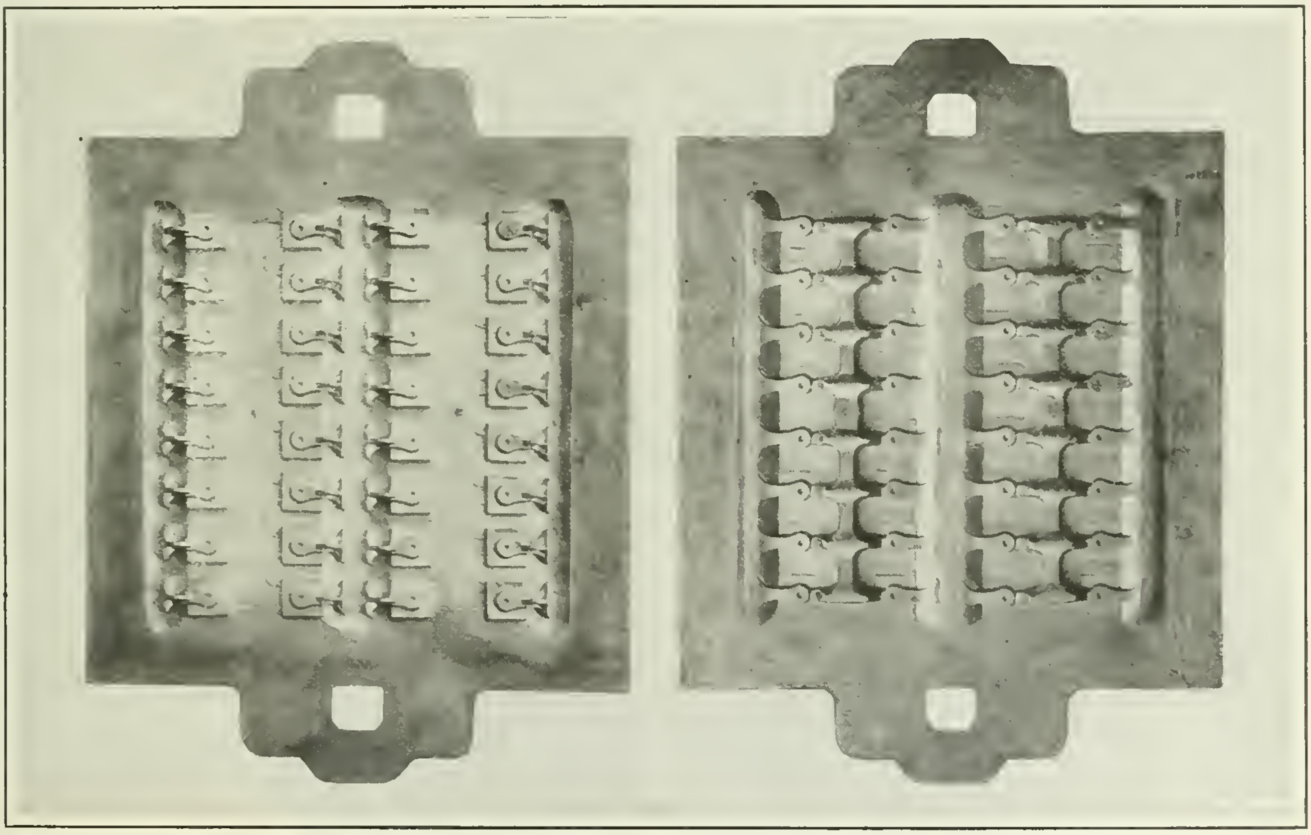


Fig. 1. Double-faced Match Plate Pattern which provides for casting Thirty-two Pieces at a Time

To those who are not familiar with patterns of this kind, it may not immediately be apparent how the two halves of the mold are produced. For the benefit of such readers, attention is first called to the fact that the guide pins that hold the cope and drag in alignment also pass through eye-holes in the match plate. Bearing in mind that the two parts of each pattern unit are split on the parting line of the pattern, with each half at opposite sides of the plate, it will be apparent that the presence of the match plate between the cope and drag exerts no influence in making the mold, beyond constituting a carrier for the two halves of the patterns mounted on it. The cope and drag sides of the mold are made under conditions that assure their registering perfectly when the match plate is removed and the two halves of the mold are put together.

How a Double-faced Match Plate Pattern is Made

The starting point in producing a double-faced match plate pattern will vary according to the nature of the pattern. In this connection, attention should be called to the fact that a pattern of this type may provide for pouring anywhere from one up to a large number of castings in a single mold. Let us first consider a case similar to that shown in Fig. 1, where the match plate carries a number of pattern units. In such a case, the first step is to make a master pattern of one unit with the gate attached to it, as shown at *A*, Fig. 2. If this pattern is of a form comprising flat surfaces and regular shaped curves, it will be made of metal in order to take advantage of the convenience with which the surfaces can be finished on standard machine tools. But if the pattern is of irregular shape, it will be made of wood.

The pattern is then sent to the foundry, where it is used in the regular way to make molds for producing about six white metal castings. At *A* is shown the preliminary pattern, and at *B* a gate of six patterns produced by soldering the white metal castings to a gate. The purpose of this intermediate step is to facilitate the work of molding and casting the thirty-two units required to make the complete gate of patterns shown at *C* and *D*, which is used in casting the finished match plate. By the use of the gate *B*, molds are made to pour the required number of castings, and these are then cut off from their gates so that they can all be assembled into a single unit, as shown at *C* and *D*.

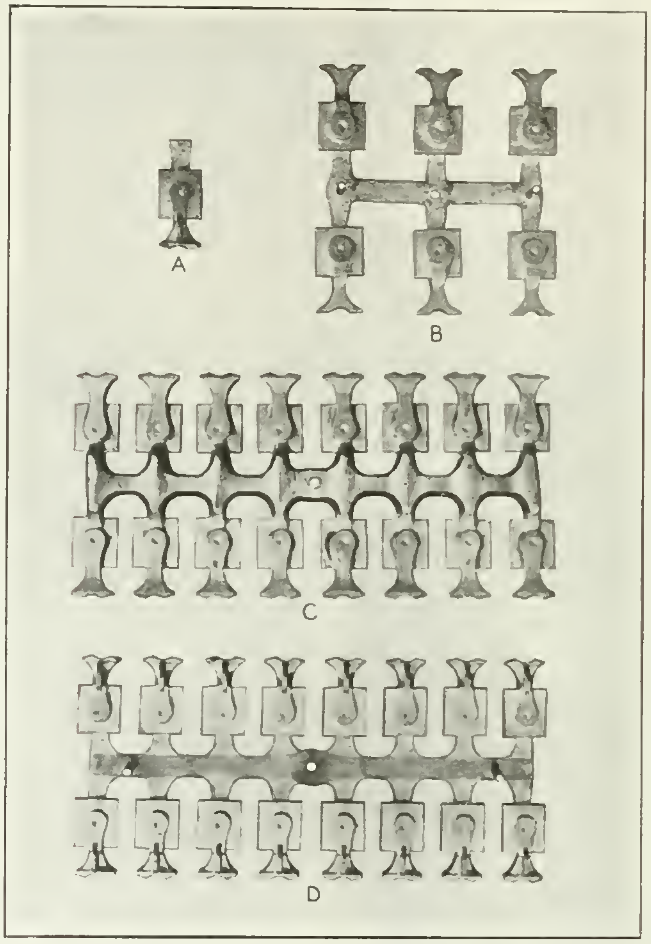


Fig. 2. (A) Master Pattern; (B) Gate of Six White Metal Patterns used in making Pattern Units; (C) and (D) Gate of Patterns used in making Double-faced Match Plate Patterns

Mounting the Pattern Units on the Gate

After the pattern units have been cast from white metal, according to the method just described, the gates are cut off close to the runner. The next step is to mount all the units on a single runner. In doing this work, it is of the utmost importance that each pattern be accurately mounted, because any lack of accuracy in alignment would make it impossible to obtain an accurate mold from this section of the pattern. After the runner has been made, each pattern section and its gate are set up with the runner on an accurate surface plate and carefully blocked in place, so that assurance is obtained that each pattern is in accurate alignment. The pattern units are then soldered to the runner, thus producing the gate of patterns shown at *C* and *D*.

Casting the Match Plate

A gate of patterns of the form described could be used in the foundry for making castings of the required form. As a matter of fact, gates of patterns are used for this purpose in certain foundries, but the degree of efficiency attained through their use in making molds is not as high as with a double-faced match plate. The best practice is to make double-faced match plates out of aluminum, because that metal is hard and rigid enough to give satisfactory service in the foundry; at the same time it has the advantage of being one of the lightest known metals, and as a result the handling of large patterns does not involve an unnecessary expenditure of physical effort by the molders. In making the match plate, the gate of patterns is used in exactly the same way as it would be in the foundry for molding castings that would later be sent to the machine shop for finishing.

The cope and drag sides of the mold are made in the usual way; but after this point has been reached, it is necessary to make provision for casting the match plate between the two sections of the pattern. For this purpose, strips of metal of the thickness desired are laid around the edge of one-half the flask in which the mold is made, and then the mold is built up with sand, a section being left around the cavity of the same size and shape as the match plate to be produced. When this additional work has been done, the cope and drag halves of the mold are put together, and the metal is poured in, with the result that a casting is produced having the two halves of the pattern with a match plate between them. When the work is skillfully done, the match plate comes from the mold in such a condition that very little subsequent hand work is required to prepare it for use in making molds for the production of commercial castings.

Making Simple Double-faced Match Plates

When it is desired to make a double-faced match plate pattern with only one or two pattern units mounted on the plate, the method of procedure in making the pattern is not nearly so complicated. In such instances, the master pattern is made of metal or wood, according to which is the most convenient procedure. The selection of material for making the master pattern is governed by its form, as previously stated. This pattern is used to make a mold, and the cope and drag sides of the mold are then separated by the use of metal strips and the addition of sand in the manner previously described, after which the aluminum is poured into the mold to produce the match plate casting.

For many classes of work, a double-faced match plate is regarded as the best form of pattern for use in the molding

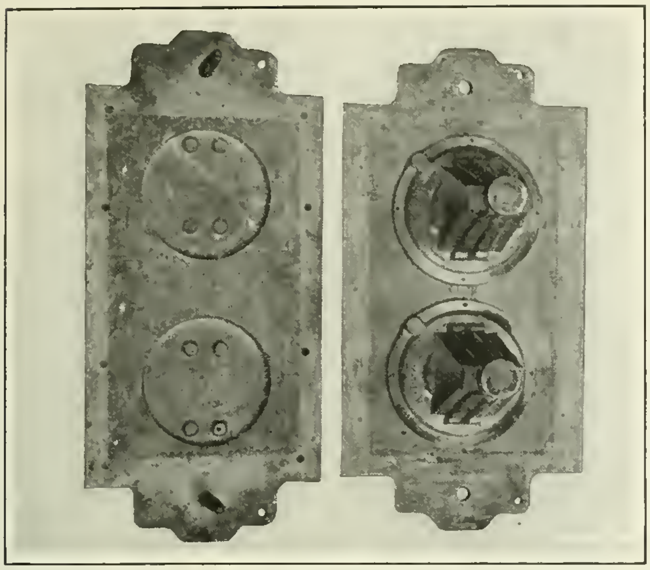


Fig. 3. Cope-plate and Drag-plate Patterns for Water Heater Pedestal

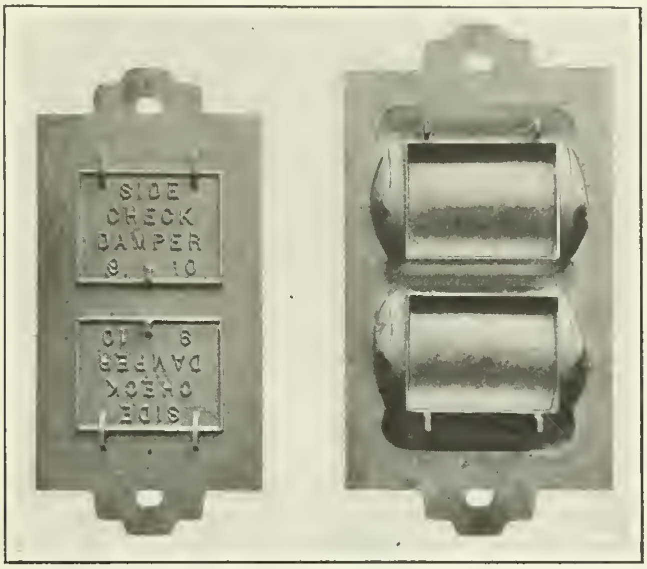


Fig. 4. Patterns for Check Damper Door and Door Frame for a Furnace

shop; but there is one limitation in the use of such patterns, namely, that the making of each mold involves four handlings before it is ready to receive the molten metal. To avoid such lost motion, some foundries make use of what is known as cope-plate and drag-plate patterns. Such patterns are shown in Figs. 3 and 5. It will be apparent that they are of the same general form as the double-faced match plate, except that the cope side and drag side of the gate of patterns are cast on independent plates.

Making Cope-plate and Drag-plate Patterns

The procedure in making these patterns is similar to that followed in making the match plate type. The master pattern is made of wood or of metal, as the case may be; and if a large number of pattern units is to be mounted on a single plate, the necessary number of white metal castings are made from the master pattern and soldered to a gate.

The gate of patterns is then sent to the foundry for use in making molds for the cope plate and the drag plate. These molds are produced in the usual way, but after the regular mold has been finished, both the cope side and the drag side are built up in the manner previously described, and then each half of the mold is provided with a blank mate; that is to say, the cope is fitted with a blank drag, and the drag with a blank cope. Then by pouring metal into either of these half molds, the resulting casting will consist of a plate having a gate of half patterns attached to it.

The advantage of using patterns of this type is that the cope plate and the drag plate are mounted on separate molding machines, arranged to operate in such a way that after the sand has been rammed by power, the pattern is lifted from the mold by the machine or by hand. After the necessary hand finishing, the two sides of the mold are put together. The accurately located guide holes in the cope plate and pins in the drag plate of the pattern assure proper registering of the two halves of the mold when they are assembled. In making molds by this method, there is only one handling of each half of the mold, as compared with four handlings of the complete mold produced with a double-faced match plate pattern. As a result the fatigue factor is cut down to a minimum, and men employed in making the molds are able to maintain a constant rate of output during the entire working day.

On either the double-faced match plate pattern or the cope plate and drag plate type of patterns, provision may be made for the use of a power vibrator for loosening the pattern from the sand, after the sand has been rammed into the flask and the work of making the mold has progressed to the point where the pattern is to be withdrawn. The use of this device not only increases the rapidity with which this part of the work can be accomplished, but also insures the making of more perfect molds.

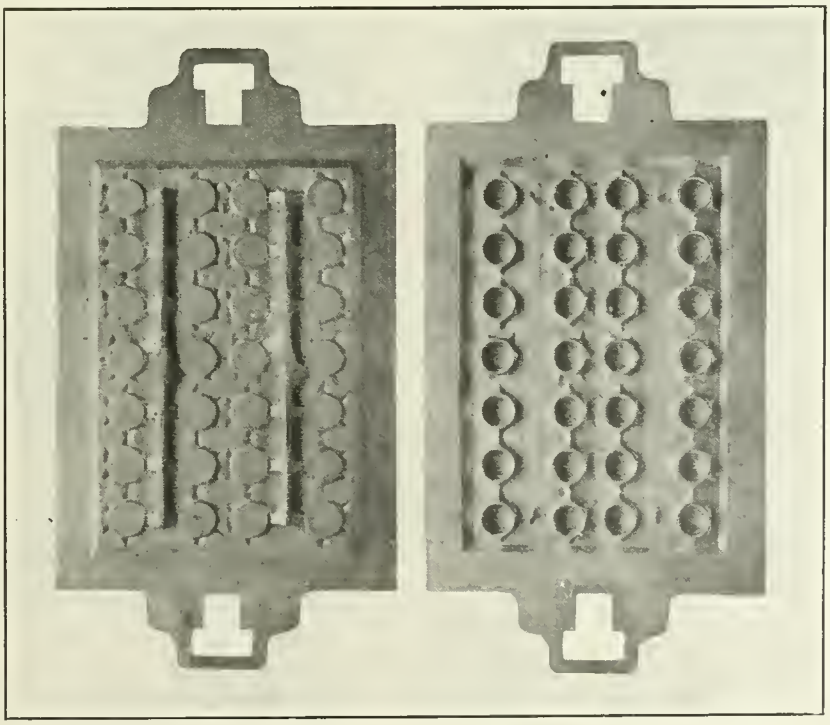


Fig. 5. Cope-plate and Drag-plate Patterns used in casting Brass Nuts for Pipe Unions

* * *

An international aeronautic exhibition will be held at Gothenburg, Sweden, from July 20 to August 12, under the auspices of the Royal Swedish Aero Club. Flying contests, in which more than thirty airplanes from different nations have already been entered, will be held on August 4 to 12. It is also planned to hold an automobile exhibition in the same city during May, June and July, in connection with the Tercentennial Exposition celebrating the three-hundredth anniversary of the founding of the city.

LAPPING FOUNTAIN PEN POINTS

By JOHN A. HONEGGER

The lapping machine shown in Fig. 2 is one of a series of machines recently built for a concern engaged in the manufacture of fountain pens of the type shown in Fig. 1. Previous to the construction of these special machines, all operations on the pen were performed by hand. The cap, stylo-holder, and ink magazine are of hard rubber, and are now turned and bored in automatic machines with special tools. The two holes *A* and *B* in the cap are drilled on a two-spindle drilling machine, one spindle being in a horizontal position and the other in a vertical position. Both spindles are actuated by means of links operated by a lever or handle. The cap is held in a small fixture during the drilling operation.

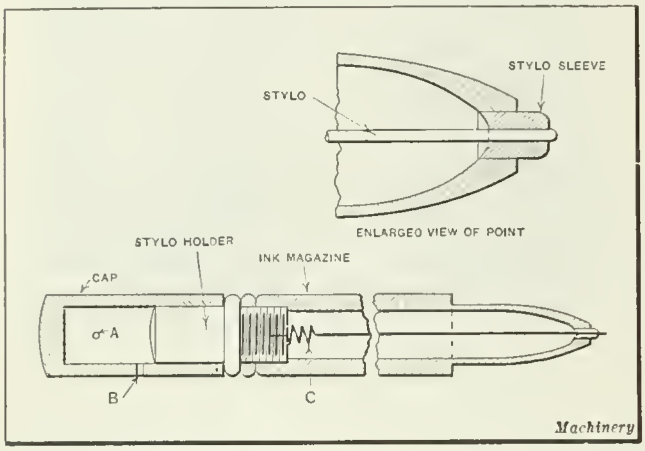


Fig. 1. Sectional View of Fountain Pen and an Enlarged View of Point lapped by Machine shown in Fig. 2

The stylo sleeve is made from 10-karat gold seamless tubing with an outside diameter of 0.070 inch and an inside diameter of 0.032 inch. The countersinking and forming operations are performed on a watchmaker's lathe equipped with an automatic collet feed, a small countersink, and a combination forming and cutting-off tool. The tools are operated by a set of cams attached to the back of the lathe and geared from the headstock. The winding of the coil *C* at the upper end of the stylo is performed in a bench lathe, and the assembling of the pen is accomplished by hand. The stylo is made from 0.037-inch wire of a gold and nickel composition.

When the pen is completely assembled, the stylo and stylo sleeve are lapped. This operation is very important, as it is essential that the stylo slide over the paper very smoothly; otherwise it will dig in and either tear or blur the paper. Originally, the lapping operation was performed by hand, the workman using a motion similar to that often employed in penmanship practice, with the point of the pen resting on a cast-iron plate charged with emery dust and oil. This was a time-consuming operation and, moreover, the lapping was not uniform, in some instances a flat place being lapped on one side of the stylo. The lapping machine not only increased production but also insured a more uniform product.

The cast-iron base *A*, Fig. 2, of the lapping machine has a three-point bearing, each bearing having a bolt hole in it to permit clamping the machine to the bench. From the center of the base a boss projects, which is faced, counterbored, and recessed to receive the rotor shaft *B*. The rotor shaft is made of Shelby seamless tubing, turned to a running fit in the hole in the base, and threaded near the center and also at the lower end to receive the nuts *C* and *D*. These nuts are held in position by set-screws, which bear on small brass shoes *E* and *F*, as shown. The upper end of shaft *B* is turned to a press fit in the hole in spider *G*, and a cone-point set-screw *H* prevents the spider from turning on shaft *B*. A worm-wheel *I* is keyed to the lower end of shaft *B*, and is driven by a worm *J* keyed to the driving shaft *K*. The shaft *K* passes through the bosses on each side of the base *A*. A grooved driving wheel is attached to one end of shaft *K*.

The spider *G*, which is fastened to the upper end of the rotor shaft, consists of six arms which terminate in six bearings for the pen-holder tubes, one of which is shown at *N*. These bearings are accurately bored to insure alignment with the groove in the lapping plate, which is made up of the two rings *O* and *P*. A stationary shaft *Q* extends the entire length of the rotor shaft. To the upper end of this stationary shaft is fastened a friction cone *R*. The lower end of the shaft passes through a bracket which is fastened to the base. This shaft is held in place by a set-screw and thrust nut.

The pen-holder tubes *N* are also made of Shelby seamless tubing, turned to a running fit in the spider bearings and threaded to receive the adjusting nuts *S*. These nuts are prevented from rotating by set-screws which bear on small brass shoes. The upper ends of the tubes have an elongated slot machined in them to receive set-screws *T*, which are threaded into the small friction cones *U*. The lower end of tube *N* is milled back a distance of $4\frac{7}{8}$ inches to provide clearance for inserting the pen. A clearance for the fingers is also milled at *V*, as shown in the side view. The spring clip *W* performs the function of approximately locating or aligning the pen with the hole in the adapter *X*. Spring

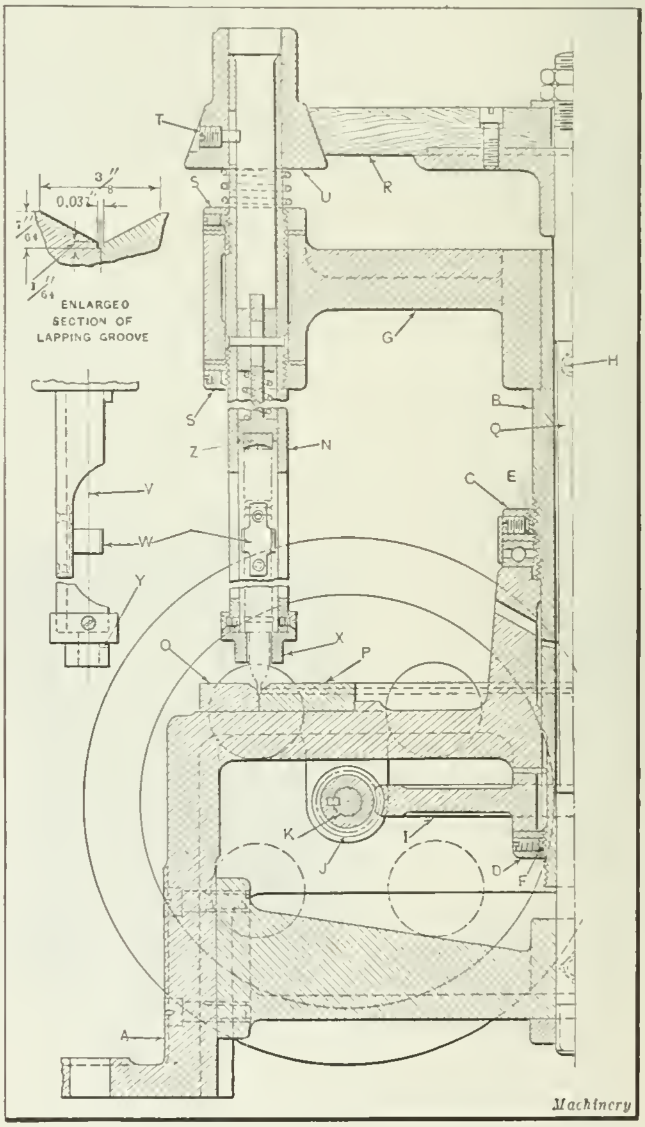


Fig. 2. Half-section View of Six-spindle Lapping Machine

plungers are inserted in the pen-holder tubes, the ends of which are tipped with rubber pads *Z* to provide a good grip on the work. The spring that actuates the plunger is designed to exert just the right pressure to hold the pen in place.

The adapter *X*, at the lower end of tube *N*, is held in place by means of small flat-head screws. As two different diameters of pens were lapped on the machine, it was necessary to make an adapter for each size. These adapters function as gages or locating stops, the shoulder of the pen resting against the bottom of the counterbore. The nose of the pen is allowed to float in the hole of the adapter, thus permitting it to align itself with the groove in the lapping plate. A small slot is cut through the adapter *X* and tube *N* at *Y*, to give sufficient clearance for inserting the pen easily in the holder. The small cone *U*, attached to the tube *N*, is held in contact with the stationary wood driving cone *R* by means of helical springs. These springs are sufficiently flexible to allow the operator to push down the small cone and thus disengage it from the stationary driving cone.

The lapping plate is made up of two rings *O* and *P*, to facilitate machining the groove. The inner ring is made a close fit in the outer ring, after which both rings are grooved. The smaller diameter of the inner ring is also made a tight fit around the shoulder on the base *A*, which serves to locate the assembled lapping plate concentric with shaft *B*. The machine was belted up to give the spider of the lapping machine a speed of 2.1 revolutions per minute, and the ratio between the diameters of the stationary driving cone and the small cones *U* was calculated to give the pen-holding tubes a speed of about 5 revolutions per minute. These speeds were selected after experiments had been conducted to determine how many circular movements were required to lap the stylo point to the desired smoothness and form.

The pens are inserted and removed from the machine while it is in operation. As each holder reaches a position in front of the operator, the small cone *U* is pushed down with one hand and the work inserted with the other. The pens are brought to the operator with the cap assembled. On releasing the cone, it again engages the large stationary cone, thus causing the work-holding tube *N* to rotate. Although the spider rotates continually, the speed is so slow that the operator can easily remove the pen and insert a new one in one-sixth to one-eighth of a revolution. In inserting a pen in the holder, the cap is placed in contact with the rubber pad *Z* of the spring-actuated plunger in tube *N*, and an upward pressure is exerted on the pen in order to bring the point above the bottom of the slot at *Y*, so that the pen can be pushed into the holder and allowed to drop down into contact with the lapping plate.

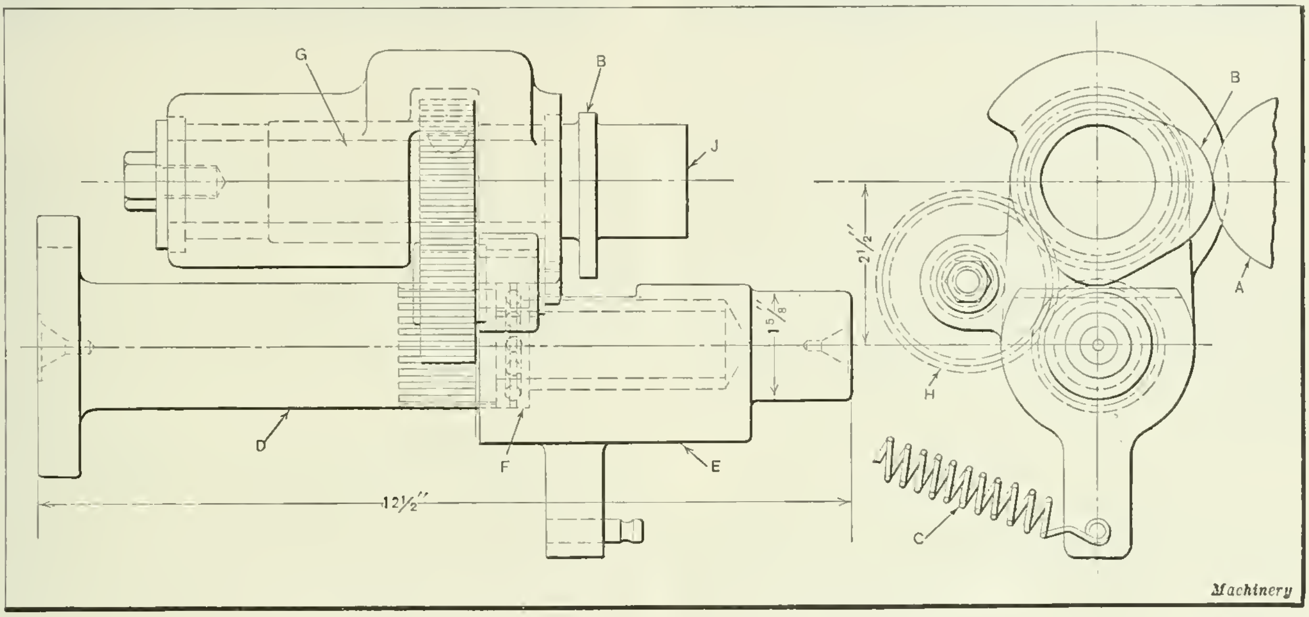
The compound used for lapping is made of a light grade of lard oil and diamond dust, the mixture being of such a consistency that it flows freely. At the end of each day the operator inserts two small brushes in two of the work-holding spindles, and after pouring a small quantity of kerosene into the lapping groove, allows the machine to rotate in order to clean out the groove. The groove is then wiped out with a piece of cloth. About once a week the outer ring is removed from the inner one, and the grooves given a thorough cleaning.

* * *

CAM-GRINDING ATTACHMENT

By J. E. COLLINS

A cam-grinding attachment designed for use on a regular grinding machine is shown in the accompanying illustration. It is mounted on centers, and can be quickly set up or removed from the grinding machine. The attachment is primarily intended for quantity production work, and has a capacity for grinding cams of any shape up to 3 inches in diameter. A special casting (not shown) is also attached to the grinding machine ways to hold the stationary cam-throw wheel *A* in the required position. The master cam *B* is held in contact with wheel *A* by spring *C*.



Cam-grinding Attachment designed to be mounted between the Centers of a Grinding Machine

The center of shaft *D* is mounted on the faceplate center of the grinding machine. One end of the shaft is made a running fit in the body casting *E*, and is provided with a ball thrust bearing *F* which takes the end thrust of the tail-stock center. The jack-shaft *G* which carries the master cam *B*, is driven by shaft *D* through the idler gear *H*. The cam to be ground is attached to the face *J* of jack-shaft *G*. As the master cam *B* rotates against the cam-throw wheel *A*, a rocking motion is imparted to the body casting *E* which results in the production of a cam that is an exact duplicate of the master cam *B*. The grinding wheel must, of course, be properly set and the work correctly located on face *J* of shaft *G*. Cams of different shapes are produced by replacing shaft *G* with a similar shaft provided with a master cam of the desired shape.

* * *

The United States Geological Survey estimates that the potential water power of the world totals about 440,000,000 horsepower, of which so far only 23,700,000 or hardly more than 5 per cent has been developed.

Reboring Automobile Cylinders

By GEORGE WILSON

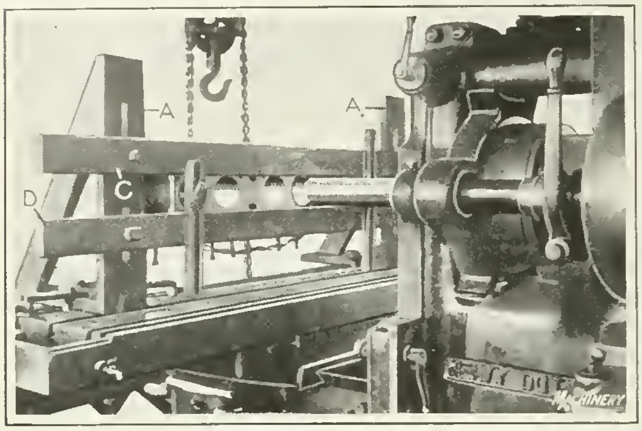


Fig. 1. Milling Machine equipped for reboring Automobile Cylinders

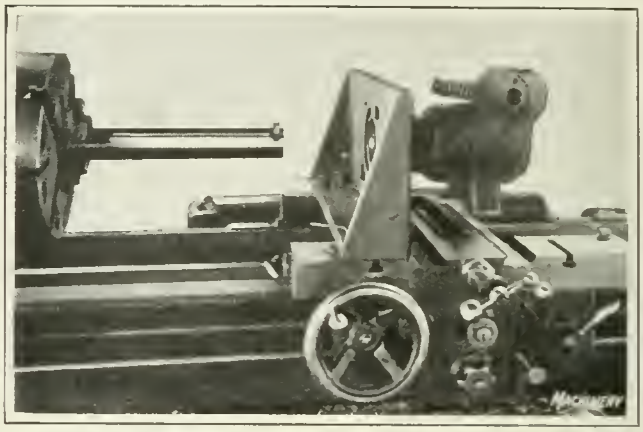


Fig. 2. Lathe Set-up for reboring a Tractor Cylinder

THE small job shop or repair shop is frequently called upon to refinish cylinder bores that have become worn or scored. The cylinder grinding machine provides an ideal means of accomplishing this operation, but the volume of work obtainable by many small shops does not warrant the purchase of a machine of this kind. However, if the small shop is equipped with a milling machine or lathe of suitable dimensions, cylinders can be refinished by providing simple fixtures and tools for these machines. The rate at which cylinders can be refinished by machines equipped in this way compares favorably with that obtained by grinding.

Boring Automobile Cylinders on a Milling Machine

In Fig. 1 is shown a milling machine equipped for boring automobile cylinders of any standard size. This machine has a longitudinal table travel of 34 inches, and a cross feed movement of 12 inches. A six-cylinder casting is shown mounted on the fixture. The fixture consists mainly of a pair of cast-iron brackets *A* which support two bars *C* and *D* to which the cylinder casting is clamped. Brackets *A* are accurately machined on two sides and located on the milling machine table in such a way as to bring the work-supporting bars exactly at right angles with the spindle of the milling machine. Strips are fastened to the brackets which fit into the slots in the milling machine table so that accurate alignment is always assured.

The method of clamping the cylinder castings to the bars *C* and *D* is shown in the illustration. It will be noted that the angle brackets are slotted to permit the work-holding bars to be adjusted to accommodate cylinders of different sizes. Bars *C* and *D* are made from rolled stock, 1 inch by 4 inches in cross-section.

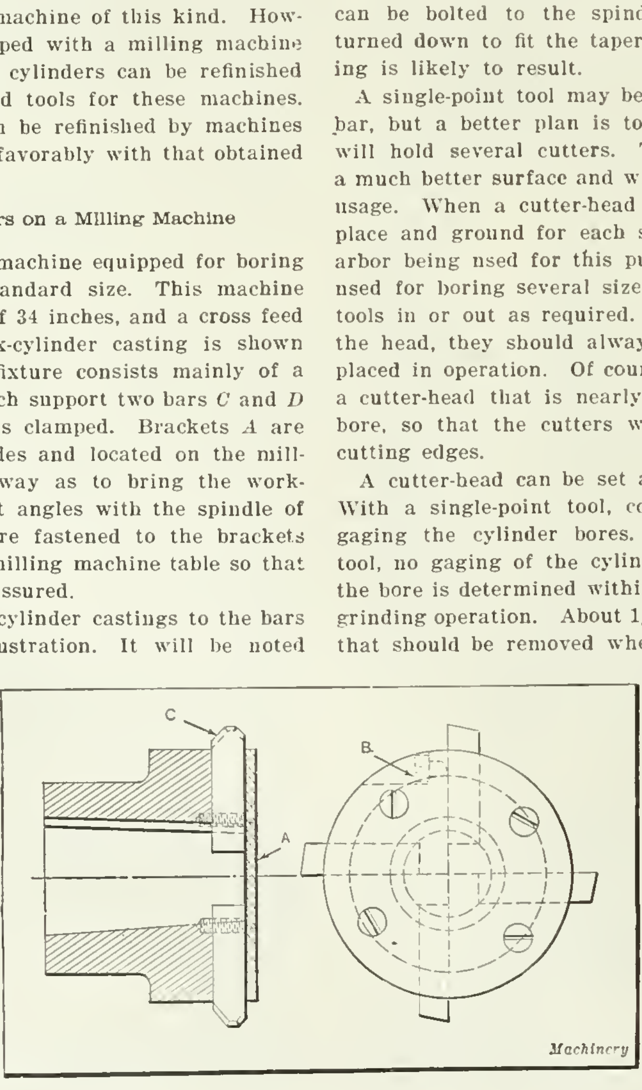


Fig. 3. Tool-head designed for Use in reboring Cylinders

The boring-bar should be made as large as the smallest size of cylinder that is likely to be bored will permit. A boring-bar 2¼ inches in diameter is about the right size for the general run of work. The boring-bar may be fitted in the tapered hole of the milling machine spindle, and held in place by means of a draw-in bolt, but as this usually necessitates reducing the diameter of the bar a better plan is to fit the bar to the spindle nose in the manner employed for face milling cutters. If necessary, a flange can be shrunk on the bar which can be bolted to the spindle nose. If the boring-bar is turned down to fit the tapered hole in the spindle, chattering is likely to result.

A single-point tool may be used in the end of the boring-bar, but a better plan is to make up a cutter-head which will hold several cutters. This type of tool will produce a much better surface and will stand up longer under severe usage. When a cutter-head is used, the cutters are set in place and ground for each size of bore, a special grinding arbor being used for this purpose. One cutter-head can be used for boring several sizes of cylinders by adjusting the tools in or out as required. After adjusting the cutters in the head, they should always be ground before the tool is placed in operation. Of course it is always desirable to use a cutter-head that is nearly the same size as the cylinder bore, so that the cutters will be supported close to their cutting edges.

A cutter-head can be set and ground in about 1½ hours. With a single-point tool, considerable time is required in gaging the cylinder bores. With the cutter-head type of tool, no gaging of the cylinder is necessary, as the size of the bore is determined within very close limits by the cutter grinding operation. About 1/32 inch is the minimum amount that should be removed when reboring a cylinder in order to assure cleaning up the cylinder walls. If a finer cut is taken, it will be difficult to keep the point of the tool under the glazed surface. Unless the cylinder is scored deeply, the depth of cut need never be much over 1/32 inch deep, but this is controlled to a certain extent by the accuracy with which the cutter is centered in the bore.

The end cylinders are leveled up with the table, so that only a horizontal adjustment is necessary when changing from one bore to another. This can be done very quickly by determining the center-to-center distance between the cylinders, and employing the dial on the longitudinal feed-screw to measure or gage the required movement from one bore to another.

One cut through each cylinder bore, using a rather fine feed, is usually sufficient to obtain a surface of the required smoothness. Deep scores can be filled with silver solder or one of the special solders made for this purpose, before performing the boring operation. The cutter-head can be of either cast-iron or steel, and should have a tapered hole carefully fitted to the tapered end of the boring-bar. A key should be employed to prevent the cutter-head from slipping on the bar.

As many cylinders are designed with blind ends, or in other words, with the heads cast on the cylinder walls, it is necessary that the design of the boring tools be such that the cutting edges will be as close to the end of the head as possible in order to permit them to pass completely through the bore into the narrow combustion space at the cylinder head. This requirement can be fulfilled by milling slots across the end of the head to receive the cutters, as shown in Fig. 3.

The cutters are ordinarily made of square high-speed tool-steel bits that are ground smooth on all four sides so that they will be a fairly close fit in the slots. The cutting edges of the tools can be located in planes that pass through the center of the head. A thin plate *A* fastened to the tool-head with flat-head screws in addition to set-screws *B*, serves to hold the cutters in place.

The best results will be obtained by grinding the cutters so that only a small portion of their ends will be in contact with the cylinder. A cutter of about the right shape is shown at *C*. By using a comparatively sharp-pointed tool, chattering will be reduced to a minimum, and the tools will not be likely to jump or dig in when passing over openings in the cylinder wall. A wide-faced tool is likely to leave a high spot opposite any opening in the cylinder wall, due to the springing of the tool-bar as the opposite cutter passes the opening.

This trouble might be overcome in a measure by using a cutter-head with an odd number of cutters, but if this is done, it is necessary to provide a removable pin that is inserted opposite one of the cutters during the grinding operation, so that the diameter of the hole that will be produced by the cutter can be easily determined by taking a measurement over the end of the pin and the point of the cutter opposite.

When a properly constructed cutter-head provided with accurately ground cutters is used, the variation between the diameter of the first and last bores finished on a six-cylinder block will not be more than 0.001 inch. Perhaps the best results are obtained by using a portable electric grinder to sharpen the cutters in the boring head without removing the latter from the milling machine spindle.

Boring Automobile Cylinders in a Lathe

In Fig. 2 is shown an 18-inch lathe equipped for boring automobile cylinders. An accurately machined cast-iron angle bracket, long enough to accommodate the average cylinder block, is bolted to the carriage of the lathe. To facilitate setting up the fixture and also to assure squareness with the lathe spindle, the bracket may be doweled to the carriage.

The hole through the vertical face of the angle bracket or plate is bored true with the spindle, to permit the cutter- or boring-bar to pass through. A cutter-head similar to that used on the milling machine shown in Fig. 1 can be used on the spindle, if desired. The bar may be threaded to fit the spindle, or it can be flanged and bolted to the faceplate. Dowel-pins can be used in the flange and the faceplate to assure accurate alignment of the bar when it is replaced after it has been removed for grinding or to permit the lathe to be used for other work.

For large cylinders having an open head, a boring-bar held between the lathe centers may be used. When this is done, a single-point cutter mounted midway between the ends of the bar is used. However, this method requires the use of a very heavy boring-bar to prevent chattering. For boring cylinders 6 inches in diameter, for instance, a bar about 4 inches in diameter and not longer than is absolutely necessary should be used.

* * *

ANALYZE STEEL BEFORE CONDEMNING HEAT-TREATMENT

By ARTHUR L. COLLINS

The failure of heat-treated parts to stand up is often attributed to some fault in the heat-treating process, when the trouble is actually to be found in the quality or nature of the steel used. Mistakes of this kind are seldom made, however, in plants provided with testing laboratories where all raw materials are carefully analyzed.

In a plant employed in the manufacture of knitting machines, large quantities of 0.40 to 0.60 per cent carbon steel tubing was used in making the knitting cylinders. Grooves were cut in these cylinders to receive the needles, and the walls separating the grooves were only about 1/16 inch thick. The cylinders were required to be hard enough to prevent these walls from being bent over, and at the same time tough enough to eliminate the danger of cracking or breaking. The operation of cutting the grooves required about two days, and consequently the finished article represented a considerable labor cost. The cylinders were heat-treated just before the final operation of polishing.

After a lot of these cylinders had failed in service by having the thin walls bend over, blame was placed on the heat-treating process. The whole plant was tied up and production curtailed until the heat-treatment was carefully investigated. Finally a chemical analysis was made of the steel in one of the cylinders that had failed. It was discovered that the material instead of being 0.40 to 0.60 per cent carbon steel contained only 0.10 to 0.20 per cent carbon, which on heat-treatment would not show any appreciable hardness. It would have been an inexpensive proposition to have taken an analysis of each piece of tubing as it came in. But this plant had no works laboratory, yet they lost enough in labor and material on this one item to support a laboratory for six months.

In the same plant, it was customary to buy all kinds of steel for tools—alloy, straight carbon, and high-speed steel. When received, these steels were put into a bin without further marking, and as needed, a piece was drawn out of the bin, ground, or machined to shape, and sent to the hardening room to be hardened. The hardener would take a look at it, and harden it for a straight carbon or high-speed steel or an alloy steel, depending on what he thought it was. As a result, about half the tools were ruined. It would have been an easy matter to distinguish between a straight carbon and a high-speed steel by means of the "spark test."

When doubt exists as to whether a tool is straight carbon or high-speed steel, the tool should be put on the grinding wheel and the character of the spark noted. The presence of tungsten in the high-speed steel causes a dark spark, while the straight carbon or tungstenless steel will give a voluminous bright spark. An apparatus has been built for this particular kind of testing, and it is claimed that with it an experienced operator can tell the carbon content of a sample within five points (0.05 per cent).

* * *

At the end of 1922 there were 12,357,375 automobiles and motor trucks registered in the United States, a gain of 17.6 per cent over the figures in 1921. This indicates that there is an automobile or motor truck for every ninth person in the country.

Gage Inspection Methods

Use of High-grade Measuring Equipment for the Inspection of Small Tools

By FRED R. DANIELS

THE object of this article is to present, by an examination of the inspection methods employed in a plant where precision tools are made, a comprehensive idea of the methods used in modern gage inspection.

The influence of changing temperature, causing expansion and contraction of the metal, is one of the chief difficulties encountered in high-grade small tool inspection. Both the work and the instruments used are affected, each in proportion to its mass. Gage-blocks, which represent the highest degree of perfection in commercial accuracy, are only guaranteed at a given temperature. Hence, it will be seen that temperature is a very important element in the inspection of high-grade gages and small tools.

The small tool inspection department of the Taft-Peirce Mfg. Co., Woonsocket, R. I., is designed with a view to eliminating, as far as possible, errors due to changes in temperature. This department is in proximity to the grinding and lapping departments, but separated from them by another room, and is accessible only to those concerned with the inspection of gages and tools. The room itself is provided with a double ceiling and a secondary partition, located about three feet from the outer wall of the building. In severely cold weather an electric heater is used to maintain as uniform a temperature as possible; it is never allowed to vary more than 5 degrees from an average of 68 degrees F. A Bristol temperature recorder registers the changes throughout the day, and furnishes a record which is available as a means of determining the temperature at any given time when a certain tool was inspected. This reference chart makes duplication of measurement possible. Knowledge of the temperature at the time a gage is measured is also a decided help in checking up errors reported by customers, particularly if it is known that the gage has actually been used in a very different temperature from that at which it was inspected. If a large instrument, such as a measuring machine, is used, the work is often laid on the machine for awhile before taking a measurement, until it acquires the same temperature as the machine.

Wear of Inspection Standards a Troublesome Factor

Wear is another troublesome factor in the attainment of precision measurements. No matter how accurate the

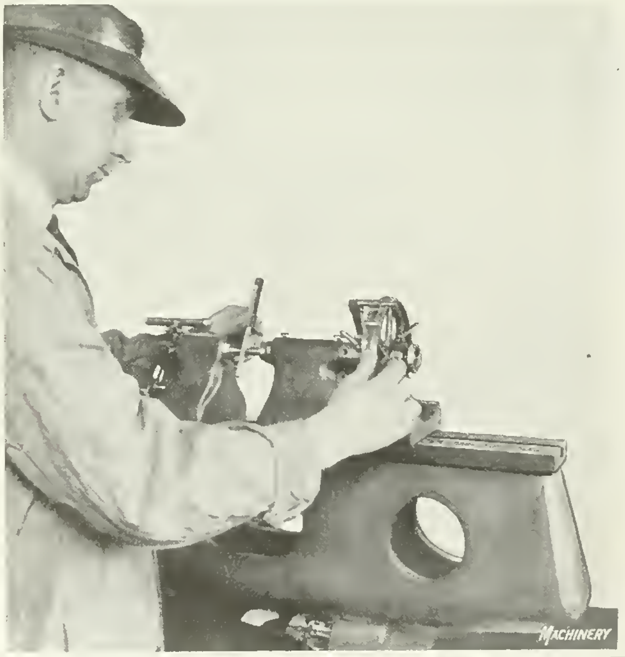


Fig. 1. Measuring Machine for inspecting Small-diameter Work

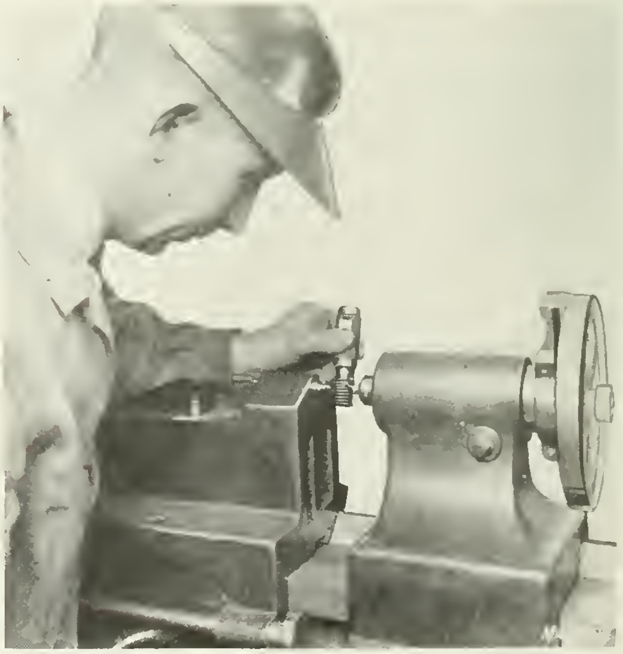


Fig. 2. Inspecting Screw Thread Diameters by Three-wire Method

gage-block, thread measuring wire, parallel, or other unit may be when it is new, the condition of the instruments must be very carefully watched and periodically checked. The amount of wear must be ascertained if dependable results are to be had. In the inspection room mentioned a practice is followed of checking the gage-blocks at stated intervals with a master set of blocks, which is calibrated from time to time by the Bureau of Standards at Washington. The amount under size that each block may be found to be, as compared with the master block, is tabulated for reference, so that when subsequently used, allowance for this wear is made. Likewise it is vital that the exact size of used screw thread measuring wires be determined, for these wear considerably, and all three wires of a set must be of the same size throughout; otherwise, the results will be inaccurate.

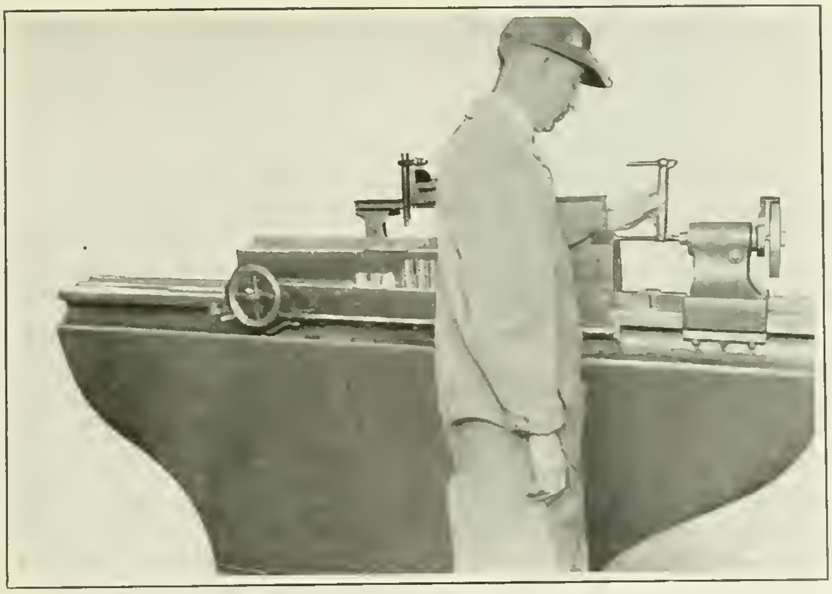


Fig. 3. Use of Measuring Machine for inspecting Pin Limit Gage

The diameters of thread measuring wires are inspected in a Newall machine of the type shown in Fig. 1. If wear is discernible by the use of this machine, a note is made of the amount on the size tab in the measuring wire case, so that no excuse can be offered for errors made in inspecting screw threads with wires of uncertain diameter.

Some Uses of Measuring Machines

There are two designs of measuring machines used in the Taft-Peirce small tool inspection department. The Newall machine, shown in use in Fig. 1, is generally employed on the smaller class of work of less than one inch in size. Its main feature is the spirit level, which, by a very slight movement of the left-hand anvil, will tilt and cause the bubble to reveal, greatly magnified, even a slight movement.

The graduations on the level are coarse, and three divisions are equivalent to a movement of the anvil of 0.0001 inch, so that fractions of this unit of measurement are easily detected. For this reason, a machine operating on this principle will easily show not only errors in diameter and length, but also inaccuracies in roundness. These errors would be difficult to detect in a machine where the hands are used directly in setting the gaging anvils. The vernier wheel at the right is graduated to 0.0001 inch, and by the use of the vernier scale, direct readings to 0.00001 inch are possible. There is also a scale at the top of this wheel which permits a one-inch longitudinal movement of the vernier head, although such a movement is rarely required.

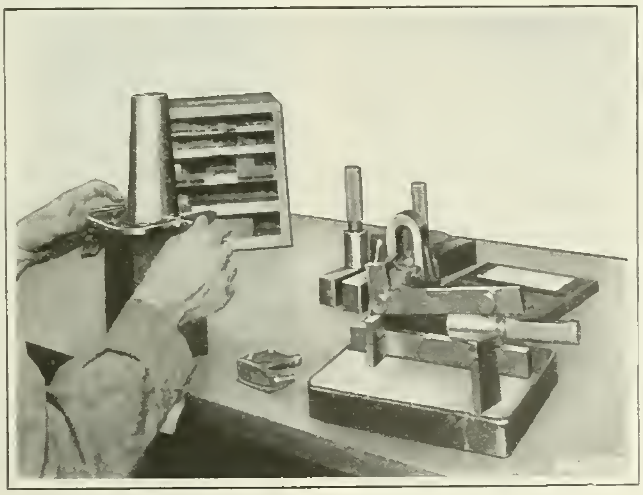


Fig. 4. Taper Work—inspecting Angularity and Diameters

The Taft-Peirce measuring machine, shown in Fig. 3, is of an entirely different design from that just mentioned, both as regards appearance and method of use. It will be seen that this is not a bench machine, but rests on the floor, and has a massive bed on which a 400-pound slide is accurately fitted. The rear bearing is a V-way, and the front a flat surface. With this bearing, the heavy slide can be moved very easily by turning the hand wheel shown at the front of the machine, because there is always a film of oil between the bearing surfaces.

In adjusting the machine for taking a measurement, the slide is first moved to an approximate setting, and the final adjustments are obtained by the vernier head shown at the end of the machine, which adjusts the movable anvil. There is a length standard in the form of a rectangular bar on the top of the slide, in which gold pins are set at intervals of one inch, and at one end at intervals of 1/4 inch, accurately tested for spacing by the Bureau of Standards at Washington. Each gold pin is scribed with a fine hair line. This is used in connection with a Bausch & Lomb microscope, on the lens of which there is a hair line which is brought to coincide with a given hair line, on the length standard, when setting the slide amounts of 1 or 1/4 inch. The slide may also be set by using precision gage-blocks.

In setting the machine, with the aid of the microscope and standard, to check the measuring lengths of the pin gage shown in Fig. 3, this procedure would be followed: The limits on this gage are 5.249 and 5.2515 inches. The slide would be set first to 5 1/4 inches by bringing the hair lines into coincidence. Then the setting for the low limit would be obtained by advancing the movable anvil 0.001 inch, reading from the graduated micrometer head on the end of the movable anvil. A movement in the opposite direction of this movable anvil is then made, without changing the setting of the slide, to obtain the high limit. The slide is clamped when the hair lines coincide, and remains in this position as long as the adjustments can be taken care of by the anvil, which has a movement of 1/4 inch.

Another method of setting this machine, and one that is frequently employed, is that of using precision gage-blocks to set the slide to the nearest thousandth reading, and then getting the finer adjustments by the micrometer head. In the case of the pin gage shown in Fig. 3, this method of setting was employed, gage-blocks being used to obtain a distance of 5.249 inches between the anvils. In like manner, the maximum reading is obtained.

If the gage-blocks used have been calibrated and shown to be slightly under size, the accumulated error, which will

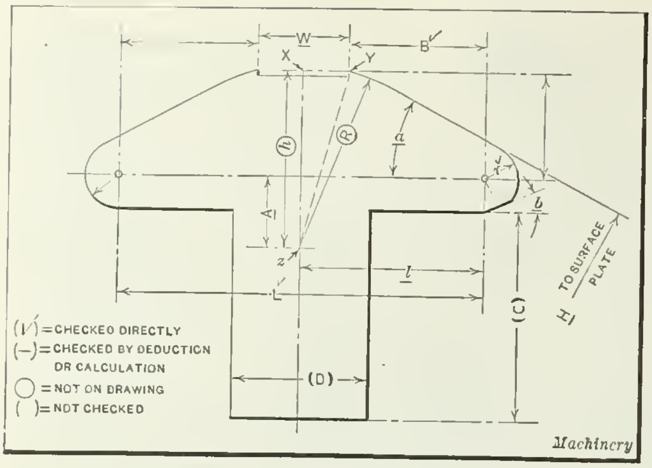


Fig. 5. Profile Gage checked with Sine Bar Fixture

probably not be more than 0.0001 inch, must of course, also be taken into account in setting the movable anvil. There is a vernier scale used in connection with the graduated micrometer wheel for obtaining readings to ten-thousandths inch. On the slide of the machine may be seen a number of plug gages placed there to acquire the temperature of the slide. The high degree of accuracy obtainable with this machine is made possible by the rigidity of its construction. It is regularly used for all work larger than one inch in size, generally in connection with precision gage-blocks.

This machine is also used for measuring the pitch diameter of thread gages by the three-wire method, as shown in Fig. 2. The rigidity of the machine makes it valuable for this purpose. The gage shown is 1 inch in diameter and has eight U. S. standard threads per inch. For inspection work of this kind, a chart is used, giving the measuring wire sizes that can be used for different pitches, and the "best" wire size for a particular pitch. The formula for the particular form of thread being inspected is then applied, and the result should correspond with the reading obtained on the machine. These formulas may be found on pages 1031 and 1032 of MACHINERY'S HANDBOOK.

Use of Lead Measuring Machines

The use of a Taft-Peirce lead testing machine is shown in the heading illustration. The slide of this machine has a three-point ball bearing on the bed, one ball being at each end of the slide, and the third under a supporting arm which extends at the rear. The work is located between adjustable centers, and the setting of the slide is accomplished by revolving the micrometer head at the end, and checking the setting by means of a hair line on the extreme end of stylus arm *A*, which is made to coincide with a hair line on the microscope lens. The outer end of the stylus arm is flattened and gold-plated, and the hair line is scribed on this surface.

The opposite end of the stylus arm has a ball point which, when correctly set, bears equally on each flank of the thread. When this setting is obtained, the opposite end of the arm is central in a guide. The arm is supported directly back of the gage by a flat vertical spring, parallel with the axis of the thread gage, which permits a pivotal movement for the stylus arm in a horizontal plane only. If the slide is operated to change the position of the gage, the ball point on the stylus arm will slide up on one flank of the thread and locate in the next thread space. If the movement of the slide to bring about this result agrees with the correct lead measurement, then the hair line should again coincide and the stylus arm be central in the guide at its outer end.

Usually, in measuring lead, it is customary to locate the stylus in a given thread first, and then calculate the distance to some other thread, skipping, perhaps, four or five threads. In this way any accumulated error can be readily detected and the average per thread found. The gage shown being inspected, is 1¼ inches in diameter, and has six Acme threads per inch.

Although plaster casts of a section of the thread in a ring thread gage are sometimes made and inspected by the use of a thread comparator for thread profile, it has been found by the Taft-Peirce Mfg. Co., that adequate inspection of ring thread gages is usually obtained by inspecting the finishing lap and fitting it to the plug thread gage after it has passed inspection.

The Inspection of Taper Plug Gages

For the inspection of tapers and for all angular measurements on small tools and gages, the Taft-Peirce sine bar fixture shown on the surface plate in Fig. 4 has general application. The sine bar is in the form of a try-square with one leg much shorter than the other. For work of average size, such as the taper plug gage shown in position, the long arm is used, and the sine of the angle employed in making the calculations; but on small work, particularly where the taper is slight, there is considerable opportunity for inaccuracy in using the long arm, because the gage must be held so far from the apex of the included angle. For work of this kind, the short arm is used, and the cosine of the angle (or the sine of the complement of the angle) employed in making the calculations, or else the sine bar is set while the fixture rests on its end, as shown in Fig. 7.

A parallel forms the under locating surface, and the gage is measured between the parallel and the sine bar. On high-grade inspection, the setting of the sine bar requires the use of gage-blocks. An adjustment is provided so that the correct setting can be obtained after first locating to the approximate angle by sighting between the gage and the sine bar. Then gage-blocks are used under the buttons to check the angle. On the surface plate directly in back of the sine bar fixture in Fig. 4 there will be noticed a set of thin gage-blocks. These are accessories to the regular gage-block sets, and are especially useful when fine settings are required, as is nearly always the case when angles are involved. On certain classes of work the height gage may be used satisfactorily to check the setting of the bar.

After the included angle has been inspected, the diameters at the large and small ends should be measured. To do this conveniently, the gage is sometimes stood on its small end and stacks of gage-blocks used on opposite sides, on which accurately ground measuring pins (usually of ¼ inch diameter) are supported. Measurements are then taken with the micrometer at two or more heights, and

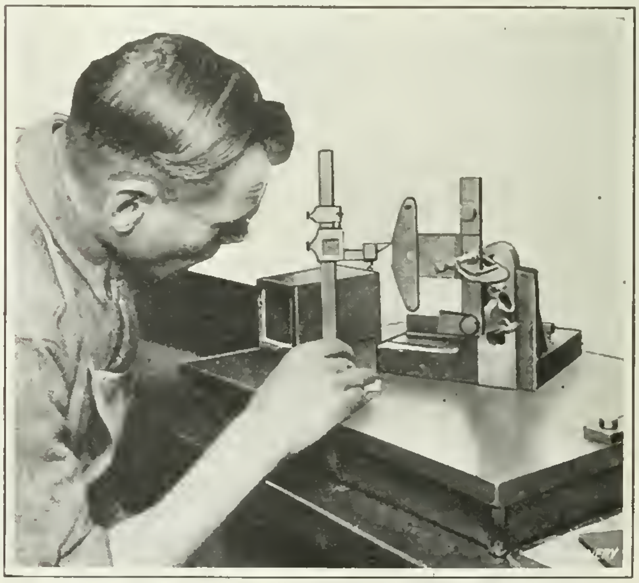


Fig. 6. Using Height Gage to check Dimension, with Fixture resting on its Base

the readings used to check the taper per inch or included angle of the gage.

Another convenient way of taking these measurements is to use a hollow block or parallel, as in Fig. 4, and insert the handle of the gage with the large end resting on the end of the block as shown. The measuring pins are then used, as before, and a measurement taken over them as shown. This set-up permits the micrometers to be used with greater convenience, perhaps, than when gage-blocks are employed to support the pins, and probably this method gives practically as accurate results. In measuring the small end of a taper plug, the same method is used with the gage resting on the surface plate itself. It is good practice to calculate the diameter of the small end after the measurement at the large end has been obtained, and then check this diameter with the actual measurement.

Application of the Sine Bar Fixture

Profiles and angles can best be inspected by the use of the sine bar fixture. For this class of work, however, the requirements for accuracy are usually less severe than for a limit thread, plug, or snap gage. For that reason, a vernier height gage is often suitable for setting the sine bar and for taking measurements on work of this kind.

The use of the sine bar fixture for inspecting the dimensions and angles of a profile gage is illustrated in Figs. 6 and 7. The gage is shown in Fig. 5, partially dimensioned. Those dimensions that are to be checked directly are indicated by a check mark; those checked by calculation, by underscoring; those enclosed in circles are dimensions not found on the drawing of the gage; and those designated by arrowheads only, indicate measurements taken to verify or recheck those already inspected. The other dimensions C and D are not checked.

The sine bar is reversed from the position shown in Fig. 4, so the surface plate can be used as a measuring surface, instead of the limited area of the sine bar fixture base. The gage is clamped to the long arm, and the height gage used under the buttons to locate the bar horizontally, the fixture resting on its side. After the bar has been clamped securely in the horizontal position, the fixture is turned on its base and the height gage used along the lower straight edge of the gage, to set it at right angles to the sine bar. The clamp is then tightened. While in this position, all dimensions that can be reached are checked.

These are two construction holes in the ends of the gage in which 1/8-inch measuring pins are used. The first reading is taken from the under side of the lower pin, and the next from the extreme lower end of the gage. This checks radius r, Fig. 5, and a measurement is then taken between the two pins to check L. The measurement shown in Fig. 6 is next taken. This is from the under side of the notch to the under side of the upper pin, and when a corresponding measurement is taken in inspecting the other half of the gage, the width of the notch can be checked and dimension L verified. This measurement and the one at the opposite end should, of course, agree.

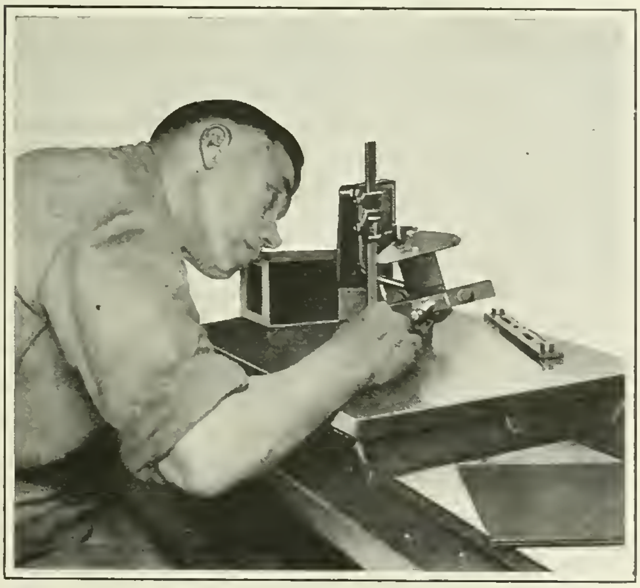


Fig. 7. Checking Another Dimension after Fixture has been turned on its End

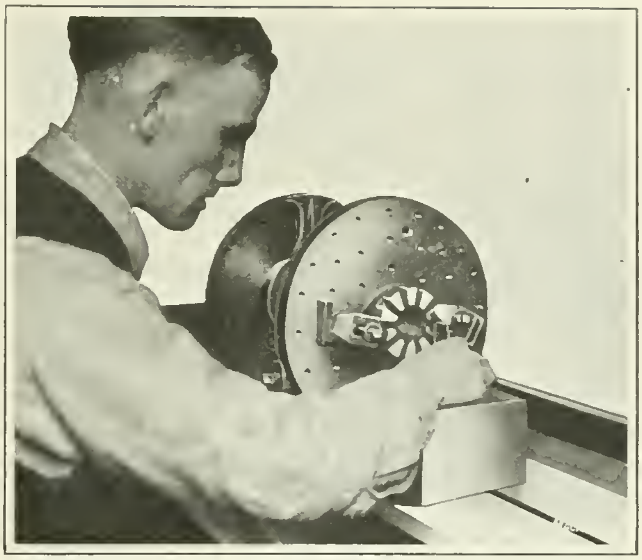


Fig. 8. Checking the Spacing of Slots in a Ten-slot Spline Gage

The fixture is next turned on its side, and the sine bar reset to an angle that will bring the measuring point of the height gage into a line tangent with the rounded end of the gage. Gage-blocks or the height gage are then used to take measurement H (see Fig. 5) from which the sine of angle a can readily be calculated. The height gage is then moved over to the position shown in Fig. 7 with the measuring point at the corner of the notch, tangent to radius R, Fig. 5. This requires changing the angularity of the bar so that the triangle XYz can be solved, and then the distance h and radius R, which are not given on the drawing, can be checked.

To verify or recheck distance h, the sine bar is set horizontally, and the perpendicular distance taken from point Y to a 1/8-inch test pin. This reading added to dimension A is a check for h and the radius R. Finally, the bar is reset for checking angle b, and the perpendicular distance from this angular side to the test pin is obtained, from which measurement and the radius r, the angle b can be calculated.

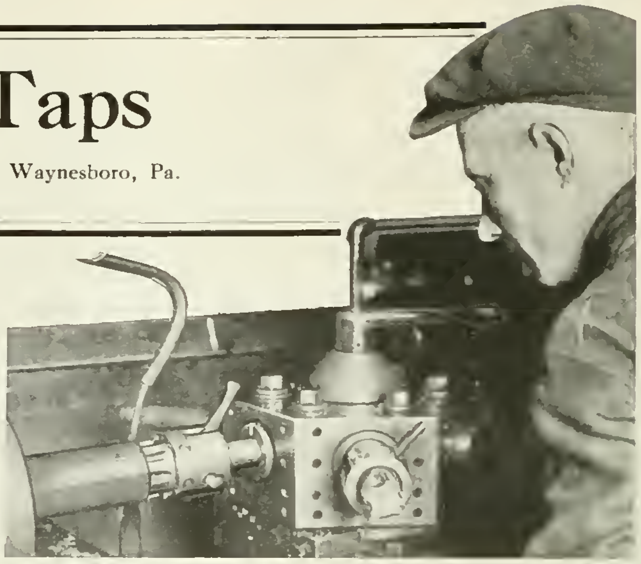
Bench Centers with Dividing Head

For the inspection of gages requiring angular settings from a center, such as the spline gage shown in Fig. 8, the Taft-Peirce bench center with a dividing head is used to advantage. The work is clamped to the faceplate of this head and located centrally. For convenience in clamping work to the faceplate, the latter is tapped for 3/8-inch bolts at various radial distances. If the gage is of comparatively small diameter, a parallel is used from which to take the measurements, which in this case are checked by Johansson gage-blocks, using an auxiliary scriber, wrung on the uppermost block, to serve as a precision height gage.

The scriber is passed along the side of a slot, and the dividing head is then set the required angular amount between slots, which in this case would be 36 degrees, for a ten-slot spline gage. On the opposite end of the bench center head from that shown in Fig. 8 there is a sine bar attachment mounted on a faceplate which is used in connection with graduations on the periphery, in obtaining the angular setting. By the use of the sine bar, the head is set to the new position, 36 degrees advanced, and a second measurement is taken with the gage-block height gage, and so on until each slot has been checked for spacing on one side.

Collapsible Taps

By ROY G. MUMMA, Victor Tool Co., Inc., Waynesboro, Pa.



WHILE collapsible taps have been used for, perhaps, twenty years or more, it is only within comparatively recent years that they have come into general use and been considered standard tools. Taps of this type have not only found a place in turret lathe tooling equipment, but are also being applied, on an increasing scale, to various other kinds of machines. The forerunner of the collapsible tap was undoubtedly the self-opening die-head for external threading, which has been on the market for probably fifty years. The many advantages of this tool over the ordinary solid dies which had to be backed off the work after the thread was cut were so apparent that men began to experiment in applying the same idea to internal threading, or a tap with cutters that could be collapsed, just as self-opening die-head cutters or chasers were expanded to free them from the threads.

The first serious handicap encountered was the question of size, since it was necessary to keep the body of the tool small enough to enter the hole being tapped. This naturally placed severe limits on the size and construction of the mechanism necessary to actuate the chasers, and is still a serious handicap to the extent that even up to the present time no collapsible tap smaller than one inch in diameter has been produced that will stand up when subjected to hard service, and even then its use is restricted to cutting fine pitches in soft metals. It was important that experiments should be made on the smaller sizes of taps due to the fact that the bulk of tapping is done with the smaller sizes, and consequently the best market is for the small taps. The cost of building large taps for experimental purposes was also prohibitive. For this reason efforts were largely concentrated on taps for cutting standard pipe threads. Sizes from one inch up were large enough to warrant experimenting, and there was a sufficient potential market to develop.

Until shortly after the outbreak of the world war, or about 1915, collapsible taps were almost entirely in the development stage. They were little known and certainly far from being in general use. The manufacture of modern ordnance and shells in great quantities, first for European countries and later for the United States, opened up a market and new field for the collapsible tap. The few concerns that were then making them at once endeavored to adapt them to this new class of work, and did so very successfully. They were first used extensively for tapping the nose and base of shells, as well as for a hundred and one varieties of other war work. Many of the large shell plants used hundreds of collapsible taps continuously, and it can be said that this tool contributed a great deal to the manufacture of shells on a real production basis. The expansion of the automotive business at about the same time also opened up a large field for this style of tap.

Advantages of Collapsible Taps

What advantages do collapsible taps have to justify them being called production tools? Their biggest asset undoubtedly is in the fact that they need not be backed out of the hole at the completion of the thread, thereby reducing the actual tapping time and naturally increasing the production. While it does not take quite as long to back a tap out as it does to run it into a hole, due to the faster travel of the machine when reversed, yet, when compared with the instantaneous withdrawal of a collapsible tap all the time so consumed can be considered as lost. Saving in time and increase of production ranging from 10 to 100 per cent have frequently been shown.

Another big advantage over ordinary solid taps is found in the fact that when the chasers become dull they can be ground or sharpened, and then, by means of the size adjustment, can be set to maintain exactly the desired size. This is not usually possible with the solid tap, especially if accurate size is required, as a solid tap, once ground, loses its size. Furthermore, the chasers permit of several grindings, which increases their life considerably beyond that of the solid tap. It is generally conceded that a tap becomes dull and worn while being backed out rather than in the actual tapping, and as there is no backing out with a collapsible tap this condition is naturally eliminated. When the chasers are finally worn out, they can be renewed at practically no greater expenditure than the cost of a solid tap without the necessity of buying an entire new tool, the principle being the same as in a safety razor. Records ranging as high as 80,000 threads in steel with a single set of chasers are known to have been made. Chasers must be renewed, however, in complete sets, and not singly in case of breakage.

When a solid tap is backed out of a tapped hole, it frequently happens that the threads are torn, often spoiling the entire job. Due possibly to the faulty action of the reversing mechanism of the machine, the tap is not properly started, and forcing sometimes causes the threads to be stripped. This is not possible with a collapsible tap, as the chasers are provided with sufficient drop to fully clear the threads. At the same time, well formed threads will insure a better fit of the parts and improve the quality of the work. This condition is especially true in brass work, where good threads are usually required, and where, due to the nature of the metal, the threads are easily torn.

Collapsible taps are usually provided with means for adjusting the chasers for size, making it possible to cut as tight or loose a thread fit as desired. If, by chance, the male threads are cut slightly off standard, it is possible to set the collapsible tap to the required size and obtain a correct fit. Usually this adjustment is about 1/32 inch, either over or under size, there being a total range of 1/16 inch on one set of chasers. This feature also permits setting the chasers to compensate for grinding. Because of the accuracy of size obtainable with collapsible taps, they are frequently used for sizing after the thread has previously been cut with solid tap or chased. A collapsible hand sizing tap especially designed for this work is made by one of the leading collapsible tap manufacturers.

It is not necessary to use a separate tap for each diameter, as with a solid tap, since each collapsible tap body will accommodate several sizes of chasers. This range is not as great, however, as in a die-head for external threading, due to the fact that the nose or front part of the tap must be kept small enough to enter the smallest hole to be tapped. The maximum diameter is controlled by the point to which the chasers may be permitted to extend above the body without support and still be strong enough to bear the strain when cutting. This point is largely determined by the nature of the material and the pitch of the thread being cut. The capacity of the tap varies according to size—the larger the tap, the greater the capacity. For example, in a 1-inch tap, a range of approximately ⅛ inch is all that is practical, while in a 6-inch tap it may be 1 inch or even more. Usually the range also extends from a short distance below the specified size to a trifle above. For example a 3-inch tap would probably have a range of 2¾ to 3¼ inches. Ordinarily, collapsible taps for standard pipe threads are confined to one nominal pipe size, as the range between sizes is too great.

Limitations in Regard to Pitch of Thread

Next to size the most serious limit in the use of collapsible taps is in the pitches that can be cut. If it were possible to cut standard-pitch threads, as specified for any particular diameter in the various established specifications for different forms of threads, the field for collapsible taps would be greatly enlarged. This limit, therefore, becomes quite serious, as it means that only fine pitches can be cut. This is due to the fact that the chasers cannot be dropped far enough into the body to clear the threads and permit withdrawing the tap. As the tap body must be kept small enough to enter the hole, it is necessary to drop or withdraw each chaser a distance somewhat greater than the depth of the thread, which would be impractical on coarse pitches. Furthermore, the body being so small, would not have sufficient strength to bear the strain, and would possibly twist or even break. For example, the pitch of a 2-inch thread, U. S. standard, is 4½ threads per inch and the thread depth is 0.1443 inch, but it is not practical to tap a coarser pitch than ten threads per inch with this size tap, the thread depth in the latter case being 0.065 inch. This is a point frequently overlooked by shop men considering the use of a collapsible tap, and when their inquiry is turned down by the manufacturer they are disappointed and their general prejudice against collapsible taps is increased.

For practical purposes and as a general rule, it might be stated that the coarsest pitches within the range of these taps run probably from eighteen threads per inch with a 1-inch tap to six threads per inch with a 6-inch tap, other sizes being in proportion. The literature of the different tap manufacturers is usually very clear on this point. This does not apply, however, to standard S. A. E. threads, as these pitches are practical in sizes above 1⅛ inches. Neither does this condition apply to taps for cutting standard pipe threads, either Briggs or Whitworth, as these pitches are sufficiently fine to come within the range of collapsible taps. There is no limit either, to the forms of thread that can be cut, as U. S. form, Whitworth, V, Acme, and many special forms are practical as long as the pitch is not too coarse.

Some General Classes of Work for which Collapsible Taps are Adapted

The fact that collapsible taps are confined largely to cutting fine pitches makes them especially adaptable for automotive work. Since the close of the war and the discontinuance of shell work, the manufacturers of automobiles and also parts and accessories have undoubtedly been the largest users of collapsible taps. The constant introduction of so-called "novelties" in this field, such as wire wheels, hub caps, radiator caps of many styles and varieties, etc., constantly increases the amount of work on which these taps can be used to advantage. Other common parts on which they are frequently used are gasoline tank filler caps, cylinder blocks, axle and axle housing parts, carburetor parts, steering gear parts, and dozens of others. Another class of work that lends itself readily to the use of collapsible taps is the manufacture of pipe fittings such as tees, ells, Y's, crosses, unions, flanges, etc. The use of these parts in such immense quantities and the keen competition in this work makes their production at low cost necessary, and as practically the only work necessary on many of them is boring and tapping it is easily seen that collapsible taps can be used to great advantage. Special tapping machines are on the market for doing this work, and many of them are fitted with collapsible taps in order to save the time required for hacking out solid taps.

Most collapsible tap manufacturers make combination taps with a reamer attached to the front, or reamer blades set between the chasers, making it possible to finish the job complete with one tool. Where there is sufficient room ahead of the thread to pass the reamer, there is an advantage in using a rose reamer ahead of the chasers, as this permits boring and tapping with one pass of the tool. This style is also desirable in small sizes, from 3 inches down, as it does not rob the body of the tap of the necessary strength to withstand the strain. When there is insufficient room to pass the reamer ahead of the thread, and also in sizes 3 inches and larger, it is possible to set the reamer blades between the chasers. This requires two passes of the tool, one with the chasers collapsed while reaming and a second one with the chasers set in position for tapping. Collapsible taps are used extensively in valve bodies made of cast iron, steel, or brass. The screwed ends of these bodies are usually tapped with standard tapered or straight pipe threads. Combination tools are frequently used on this work. To enumerate all the work for which collapsible taps are used or for which they are adaptable would be a difficult task, and the object of this article is to show in a broad way the general classes of work only.

Different Styles of Collapsible Taps and their Application

Generally speaking, collapsible taps are made in two chief styles—stationary and rotary. Stationary taps are used on such machines as turret lathes, hand screw machines, certain automatic machines, boring mills, and any machine where the tap is held stationary and the work revolves. Rotary taps are used on drill presses, radial drilling machines, tapping machines, certain automatic machines, or any machine on which the work being tapped is held stationary and the tap revolves.

In the stationary style, a lever is employed for expanding the chasers into the cutting position by hand. Frequently this is automatically accomplished by bolting a bar of steel to the turret slide guide, which engages the handle on the backward travel of the turret. The rotary tap can be expanded by arranging a yoke or suitable fixture to the spindle housing to press against a collar or flange provided for the purpose, as the spindle is backed away or withdrawn from the work. This permits setting the chasers while the tap is in motion. The ordinary method of collapsing the chasers is by means of a tripping collar which is set according to the depth of thread desired, and which comes into contact with the face of the work. Several makes of taps are also on the market in which the chasers are collapsed in what is generally known as the "pull off" manner. With these taps the turret is retarded either by hand or by stop-screws, and the action of the chasers in pulling on the threads already cut, operates a cam, which collapses the chasers.

Collapsible taps may also be divided into two other classes, namely, those for cutting straight threads and those for cutting tapered pipe threads. While it is possible to cut tapered pipe threads with a straight-thread tap, and vice versa, it is not common practice to do this. On account of the length of standard pipe threads, and the fact that chasers of sufficient length and having the proper taper are required for cutting them, the chasers in pipe taps are longer than ordinarily required for cutting straight threads. The length of the chasers used is practically the only difference between straight thread and pipe taps.

There are, however, two classes of taps for cutting tapered pipe threads on the market, one using tapered chasers of sufficient length to produce pipe threads of standard taper and length, and another that employs short chasers which are made to recede as the tap is fed into the hole. The former style requires considerable power to drive, due to the friction resulting from the long bearing which the chasers have, whereas the receding-chaser tap produces a tapered thread in virtually the same manner as a straight thread, and without requiring any more power for driving. This results in power economy, as well as less wear of both the tap and the machine on which it is being used.

Because of these features, the receding-chaser tap can be successfully applied for cutting tapered pipe threads in steel, for which the tapered-chaser tap usually proves impractical and fails to stand up on continuous service. Such work as cast and forged steel flanges, fittings, such as tees, ells, Y's, crosses, etc., oil-well supplies, such as drill and rotary line pipe couplings, casing heads and shoes, tool joints, valve bodies, and numerous similar pieces can be successfully and economically tapped. Records of two minutes have been made in tapping standard length and taper pipe threads in 6-inch forged steel flanges. This receding-chaser tap is also suitable for use on cast iron as well as steel, especially for the larger sizes, on account of the power economy.

Solid adjustable or inserted-chaser taps are so closely related to collapsible taps that they should have a place in this discussion. While these taps must, of course, be backed out, they have many advantages over the ordinary solid taps. Owing to the size-adjusting feature, the chasers can be frequently reground and accurate size maintained, whereas after a solid tap has once been ground, its exact size is lost. This makes these taps especially adaptable for hand sizing work. When the chasers are worn out, they can easily be replaced at about the same cost as a solid tap with the advantage of longer life due to the possibility of grinding. It is also possible to use the same holder for different sized chasers. Usually the chasers in solid adjustable taps are interchangeable with those in collapsible taps of corresponding size.

Chasers for Collapsible Taps

Possibly the most important feature in the success of collapsible and solid adjustable taps is found in the chasers used. These must be very accurately made, a fact to which most manufacturers are keenly alive. The steel is first carefully selected, and usually special heat-treating and hardening processes are used. The chasers are generally hobbed or chased with tools made with the greatest care and to very close tolerances, measured with delicate microscopic instruments to insure threads of perfect form and accuracy in lead. The chasers themselves are subjected to careful inspection and test to insure correct results after they reach the customer. These parts must also be made absolutely interchangeable so that when additional chasers are ordered, after the tool is in service, there will be no trouble in having them fit properly when received by the customer.

The grinding of the chamfer or the throat and the cutting edges of the chasers is also of great importance, and various types of fixtures and grinding machines are available. The cutting edges must be ground with the proper rake angle for different metals, or poor threads will result. A large percentage of the troubles reported to the manufacturers are traced to improper grinding, and the literature of most manufacturers gives detailed information on this subject. The chamfer or throat angle on all chasers in a set must also be uniformly ground to insure an equal distribution of the cutting strain on all the chasers in the set instead of having a few of them doing all the cutting. This is also necessary to insure cutting a thread that is of the correct lead.

While collapsible taps are becoming more and more commonly used, there is still a large field for their development, and rapid progress is being made toward applying them to different classes of work. The time has passed, however, when they must be considered in the experimental stage, and they have rightfully earned their place among modern production tools.

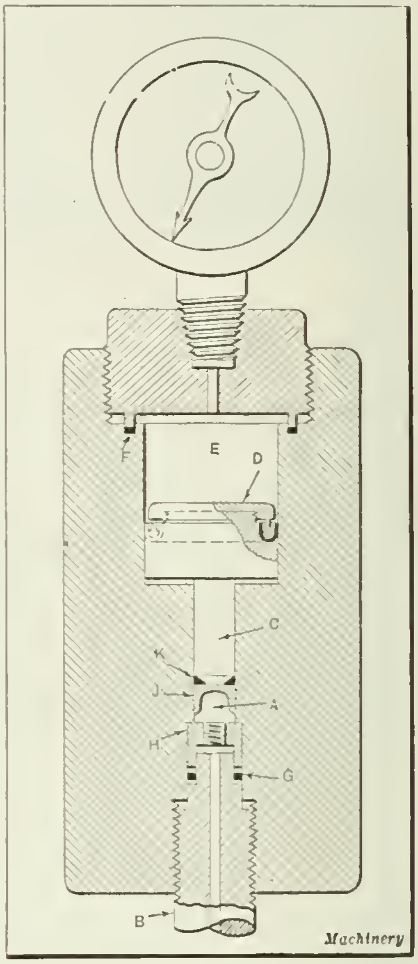
HYDRAULIC PRESSURE INDICATOR

By JOHN N. SIOUSSA

Difficulty in obtaining a commercial pressure gage for indicating extremely high pressures led to the development of the device here illustrated. This device proved satisfactory for determining pressures of more than 100,000 pounds per square inch. The principle employed is that of reducing the pressure by using differential cylinders so that a commercial pressure gage of a dependable size can be used. The cylinders and plunger of the device have differential areas, in the ratio of 10 to 1

The liquid under high pressure is admitted to the small-area cylinder *A* through a tube *B*. The liquid in cylinder *A* acts upon the small area *C* of the floating plunger, and the large end *D* of the floating plunger, in turn, acts upon liquid confined in the larger cylinder *E*. The reduction in the pressure thus obtained is in the same ratio as the areas of the cylinders located on each side of the plunger. It was necessary to modify the indicator dial by adding a cipher to each of the numbers in order to have a direct indication of the existing high pressure. The gage is secured to the head of the cylinder *E*.

The best material obtainable was used in this device, but even then it was found necessary to make the cylinder extra heavy. A lead gasket *F* is used to seal the cylinder head and the tube so that they will be leak-proof. A lead gasket *G*, with a steel washer on each side, was placed between the gland cup *H* and the shoulder near the end of tube *B*. Leakage around the inner wall of the cylinder and the plunger is prevented by the use of specially treated leather packing. The leather cup packing *J* is restricted by an expanding ring *K*, which compensates for the dilation of the cylinder, when the pressure increases. The U-shaped packing on the low-pressure side of the plunger is of the kind generally employed for hydraulic work. The friction surfaces of the cylinder and plunger are lapped smooth, and the plunger is left free to reciprocate.



Device employed in Connection with Commercial Gage to indicate High Pressures

* * *

The storage of coal underground at the mines is suggested by the United States Bureau of Mines as a practical step toward the accumulation of the coal reserves necessary to stabilize industry and to protect the domestic consumer in periods of actual coal shortage. The seasonal demand for coal can to some extent be met by storage by the consumer or the distributing agent; but on a large scale, the storage would have to be located underground at the mines, because it is not feasible to provide more than a limited amount of storage above ground.

High-speed Spindle for Screw Machine

IN the production of small parts averaging 1/8 inch in diameter, or less, on standard makes of automatic screw machines, a considerable loss in productive efficiency occurs. This loss may be attributed to a number of causes, but the principal one is lack of proper cutting speed due to the comparatively low spindle speeds available. It has been possible to obtain automatic screw machines with a maximum spindle speed of 5000 revolutions per minute, in which the spindle could be started, stopped, and reversed instantly, or practically so. With the spindle running continuously in one direction, a speed of 6000 revolutions per minute could be secured on these machines. However, even these speeds are not high enough for work below 1/8 inch in diameter. In order to handle work of this size the high-speed spindle shown in Fig. 1 was designed and installed in a small bench screw machine. The maximum diameter of work that can be machined with this equipment is 0.100 inch, and the maximum length 1 inch. This machine has produced small screws at the rate of 1600 per hour, including the forming, threading, and slotting operations.

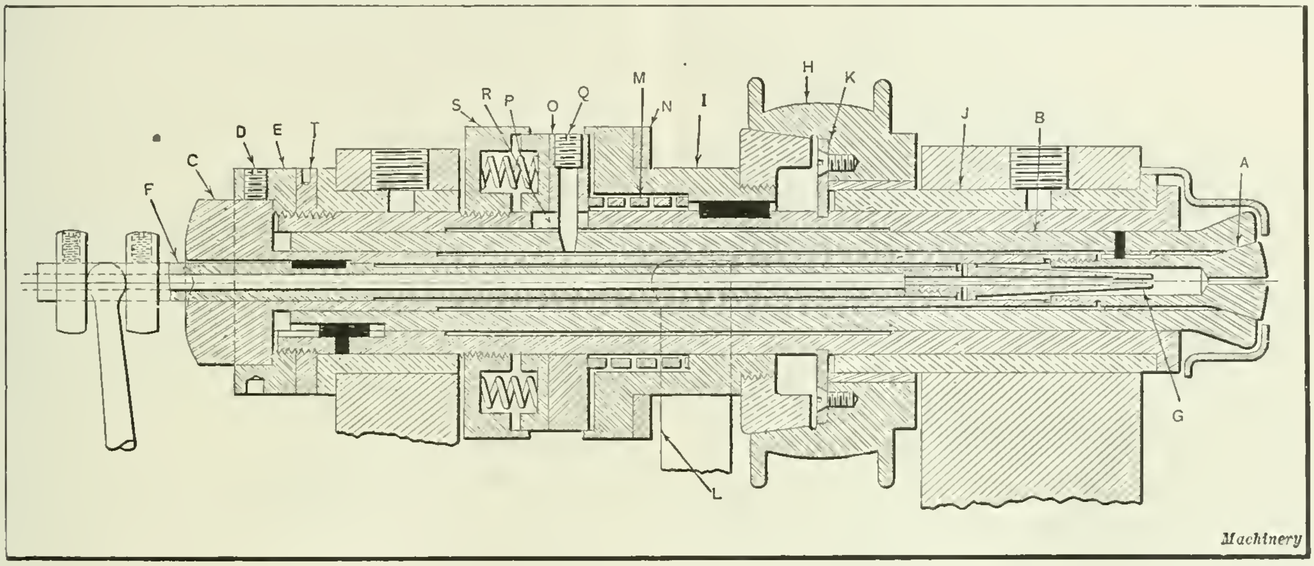


Fig. 1. Sectional View of High-speed Spindle designed for Use on a Bench Screw Machine

The new design of spindle has been operated eleven hours a day for a period of four months, at a speed of 9000 revolutions per minute. After this usage, the machine was disassembled and examined, and the wear was found to be so slight that the original lapping marks on the spindle had not been obliterated. After the change in design shown in Fig. 2, this spindle was run at a speed as high as 14,000 revolutions per minute on parts requiring a high cutting speed.

When it is considered that the type of bench screw machine which this newer design superseded was never operated at a spindle speed of more than 4000 revolutions per minute, the gain in productive efficiency can be appreciated. Considerable experimenting was done before the final design shown in Fig. 1 was adopted. At first it was thought that lubrication of the bearings should be accomplished by pressure feed, but in practice it was found that lubrication from sight-feed oilers was sufficient.

Construction of High-speed Spindle

Referring to Fig. 1, it will be noted that the spring collet *A* is keyed to the collet sleeve *B*, and is drawn into position by tube *C* which is squared on its rear end to receive a wrench. The spring collet is held stationary longitudinally by locking the head of tube *C* in place by means of a set-screw *D* located in the end-thrust lock-nut *E*. The feed-tube *F* is keyed to the draw-in tube *C*, as it was found that in operating the spindle at high speed the friction of the feed-finger *G* on small diameters was insufficient to rotate the feed-tube with the work. This slippage caused considerable injury to the stock until the key was included, thus insuring positive rotation of the feed-tube.

The spindle is driven from pulley *H* through clutch *I*, which is keyed to the main spindle. Attention is directed to the method of attaching the driving pulley to eliminate end play and to prevent the belt pull from acting on the spindle. The front bushing *J* extends through the front bearing and serves as a rigid bearing for the pulley. A plate *K*, made in halves and screwed and pinned to the pulley, is inserted in a groove in the spindle. When the clutch is disengaged, the pulley runs free on the front bushing. End play is prevented by plate *K*. When the clutch is engaged so that the spindle rotates with the pulley, plate *K* acts as an end thrust bearing and absorbs the force employed to keep the clutch in mesh with the pulley. This allows the pulley to rotate on its own axis without transmitting the side pull of the belt to the spindle.

Method of Stopping the Spindle

In producing screws, the threading operation is performed by a rotating die held in the turret while the work remains stationary. This necessitates stopping the spindle without opening the chuck. It should be noted that both the stopping of the spindle and the opening of the chuck are performed with one lever *L*. The clutch body is recessed to receive a spring *M*, designed to exert sufficient pressure to properly engage the clutch with the pulley. A friction plate *N* is interposed between the clutch and lever *L*. Plate *N* is prevented from rotating by a pin carried on the head casting, which engages a slot in the edge of the plate.

When lever *L* is operated by the cam that controls it, the clutch is disengaged sufficiently to clear the pulley, and yet not enough to bring it into contact with collar *O* which carries chuck sleeve pins *Q*. Neither is spring *M* compressed sufficiently by this movement to cause springs *P* to be compressed. The friction between plate *N* and the clutch body caused by lever *L* is sufficient, however, to stop the spindle in less than one-fourth second. The drop on the cam that controls lever *L* is designed so that when the clutch engages the pulley there is no friction between plate *N* and the clutch.

In the operation of opening the collet to feed the stock forward, the lever *L* carries the clutch back farther until collar *O* causes springs *P* to be compressed. It should be noted that pins *Q* pass through elongated slots *R* and engage the collet sleeve *B*. As springs *P* are compressed, the collet sleeve *B* is carried to the rear so that the collet jaws are allowed to open. By providing a quick drop on the cam that operates lever *L*, springs *P* serve to close the collet instantly after the stock is fed forward. The casing *S* which contains springs *P* is threaded on the spindle to permit the adjustment required to obtain any tension that may be necessary to hold the stock securely in the collet.

As the collet does not move during the opening and closing movement of the collet sleeve, accuracy in the length of the piece machined is not affected by variations in the diameter of the stock. It will be noted that the collet sleeve is also keyed to the spindle. The throat angle and collet bearing were ground out after assembling, the spindle being rotated in its own bearing during this operation. The hole in the collet was also finish-ground after assembling, thus securing a minimum of eccentricity, and since all parts are keyed together this condition is maintained.

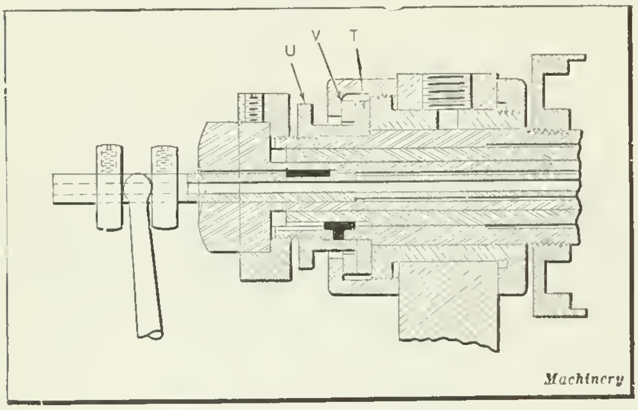


Fig. 2. Rear Bearing of Spindle shown in Fig. 1 with Improved Means of taking up End Thrust

All the parts are extremely simple, and the only taper-grinding necessary is on the clutch, pulley, and chuck seat. The bearings are made solid with straight holes. Of course, excessive wear means replacement of the bearings, but this is accomplished at a minimum cost. The first machines of this type to be made have been in service two years and the original bearings are still in good condition.

Provision for Taking up End Play

Originally end play was taken up between the head shoulder of the spindle and nut *T* which was locked in place by nut *E*. It was found that if the end play was taken up when the machine was at room temperature, inaccuracies appeared in the work after the machine had warmed up due to the longitudinal expansion of the spindle. If the end play was taken up when the spindle was hot from running, it would "freeze" or bind in the bearings over night so that trouble would be experienced in starting the next morning.

This difficulty was avoided by changing the design of the take-up members as shown in Fig. 2. In the improved design, the rear bushing is extended, threaded on each end, and adjusting nuts are fitted to the threaded ends so that longitudinal adjustment of the rear bearings can be obtained. The spindle is provided with an end-thrust collar *T*, which is securely held in place by nut *U* and a key, so that it rotates with the spindle. This prevents the spindle from having any play as it rotates between the end of the rear bearing and the end-thrust washer *V* held by the rear bearing adjusting nut. The head of the spindle is relieved so that there is a clearance between its rear face and the front bearing.

The end play is taken up by loosening the front adjusting nut of the rear bearing and tightening the rear nut so that the end-thrust washer *V* is brought up against the collar *T*. While the spindle is left free to expand in length, this expansion does not affect the adjustment for end play. Satisfactory operation in every respect resulted from this improvement.

Experiments with High-speed Spindles

Some interesting experiments have been conducted along the lines of high-speed spindle construction. A speed of 80,000 revolutions per minute has been obtained with an air-driven spindle operating on the turbine principle. These experiments indicate the possibility of considerable advancement in the grinding and drilling of holes through the use of spindles designed to run at speeds heretofore believed impractical.

A test machine was used with a vertical spindle mounted in two cylindrical bearings, the weight of the spindle resting on a ball. The air pressure used in driving the spindle was about 35 pounds. Failure of the bearings and the inability to secure high speeds indicated the need of extremely close dynamic balancing, even on a straight spindle of uniform diameter. By relieving the bearings so that a clearance of 0.030 inch was obtained around the spindle, the fact was revealed that inequalities in the metal of the spindle caused the axis of rotation to be approximately 0.024 inch away from the longitudinal axis of the spindle when the speed of rotation reached 80,000 revolutions per minute. This change made it possible to secure the higher speeds that could not be attained when the bearings fitted the spindle closely. At this speed the spindle spun upright without any means of support other than the ball in the cup depression at the lower end of the spindle, the gyroscopic action being apparent. B. G. C.

* * *

HARD AND FAST RULES ARE EXPENSIVE

By CHARLES W. LEE

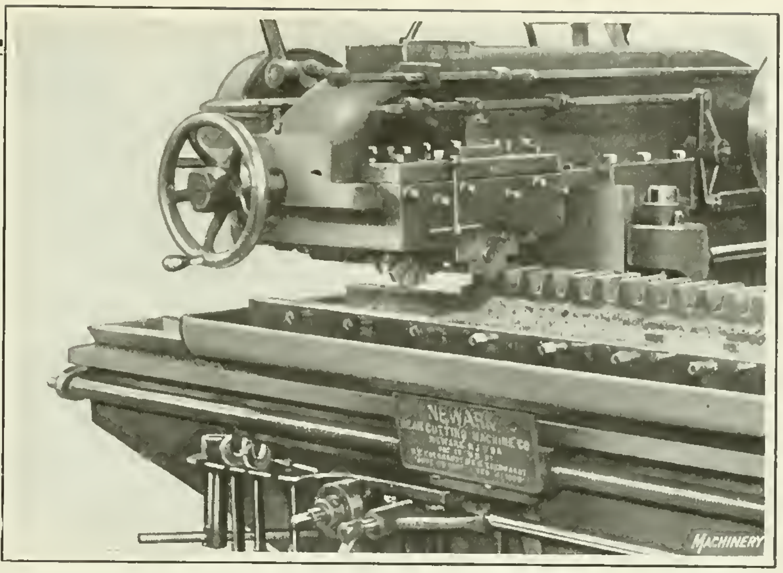
Perhaps too many shops are run in accordance with such hard and fast rules—with such an adherence to system—that a good deal of money is spent simply to avoid the use of individual judgment. The writer recently visited a shop where the foreman had a lot of small bolts to make. The bolts were intended to hold some strips of wood together, so that a variation in diameter of 1/64 inch, or more, would make no difference. The foreman took advantage of this fact and rigged up a screw machine with a broad tool in the cross-slide, and turned the bodies of these bolts with one sweeping cut. The superintendent came along and told him to stop using that method and to produce them in the regular way, based upon the rule: "The way to turn work in a screw machine is to rough out with a hollow mill and finish with a box-tool." This method of producing the work, of course, required a much longer time, but the rule was not violated.

In another case, the writer learned of a certain machine that produced more work than a machine formerly used for the same purpose, simply because the new machine was so designed that the work and cutting tool were more easily and quickly handled, and the cutting tool was so designed that it would stand a heavier cut at a somewhat lower speed. This machine was brought to the attention of a man who managed his shop by set rules. He entirely refused to listen, because, as he said, he had been brought up to believe in quick speeds and light cuts. Somebody once said something about consistency being a virtue of certain minds, and the writer begins to believe he was right.

Rack-cutting

General Practice in Cutting Racks on Machines Designed for this Work

By FRANKLIN D. JONES



RACK teeth are cut ordinarily by milling with a formed cutter, although in some shops they are cut by planing with a formed tool. While the teeth of racks may be cut by a generating method, this has been applied to a limited extent only. The milling process is employed much more than any other for commercial rack-cutting. The rack teeth are produced either by feeding a formed cutter across the rack blank or by causing the rack to feed past the cutter. After milling each tooth space, either the rack or the cutter is indexed an amount equal to the linear pitch of the rack teeth (or circular pitch of the mating pinion) except when two or more finishing cutters are used, as explained later.

When racks are cut on ordinary milling machines, the feeding movement is, of course, applied to the work-table and rack. Special rack-cutting machines have been designed along similar lines, with certain features introduced to make them more efficient and better adapted for cutting racks on a quantity basis. Other rack-cutting machines are arranged to hold the work stationary, except for the indexing movement, and the cutter-slide is given a feeding movement.

Racks are frequently cut on planers, especially where the number required does not warrant installing a special machine, and shapers may also be used for relatively small sizes. When a planer or shaper is used, it is common practice, except for small pitches, to first rough out the teeth by cutting rectangular slots, and then finish the rack teeth with the tool ground to the correct angle and width at the point. This planing method, however, is utilized in connection with standard planing machines and has not been applied to commercial rack-cutting machines which are designed for milling the teeth with formed cutters.

Most of these special rack-cutting machines operate automatically except for the insertion and removal of the work. After the rack to be cut has been placed in position and the machine is properly adjusted, all the teeth are cut without further attention on the part of the operator. The indexing movements between successive passages of the cutter are controlled through change-gearing which may be arranged to transmit motion from a "one-revolution" shaft (which revolves only when an indexing movement is required) to the lead-screw through which the position of the work-table is shifted.

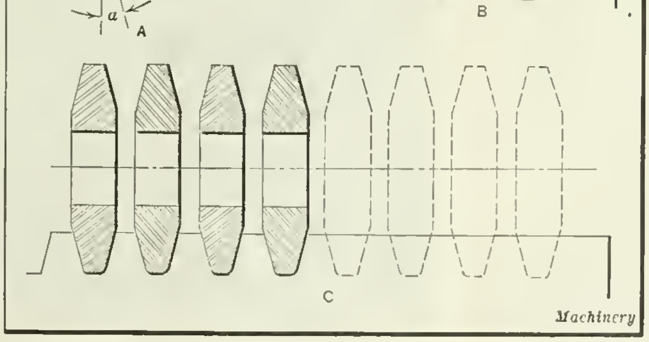


Fig. 1. Different Methods of milling Rack Teeth

General Shape and Proportions of Rack Teeth

Rack teeth for the involute system of gearing have straight sides (subject to certain modifications, as explained later) which incline at an angle *a* (see diagram *A*, Fig. 1) equal to the pressure angle of the gearing. For instance, if the pressure angle is 14½ degrees, as is generally the case, the included angle of the rack teeth will be 29 degrees. Incidentally, this straight-sided rack tooth is an important feature of involute gearing, because it simplifies the making of cutters for producing gears by generating processes.

While involute rack teeth theoretically have straight sides, in practice the teeth may be straight except for a slight curvature at the points to avoid interference, such, for example as would occur between perfectly straight teeth of the full length and a pinion that is too small. The amount of interference increases as the number of teeth in the pinion decreases, and begins with 31 teeth when the pressure angle is 14½ degrees. If the pressure angle is 20 degrees, interference begins with 17 teeth. Straight-sided rack teeth are sometimes shortened to avoid this interference, a certain amount being removed from the tops of the teeth. Another method is to simply round the corners of the teeth. A modification in rack tooth forms is obtained when the teeth are milled with a regular No. 1 cutter, which is common practice. Since this cutter is intended for involute spur gears including all numbers of teeth from 135 to a rack (which may be regarded as a spur gear of infinite radius), the shape of the cutter is necessarily a compromise, and when applied to a rack it forms teeth having curved sides. This curvature is sufficient to prevent interference under ordinary conditions.

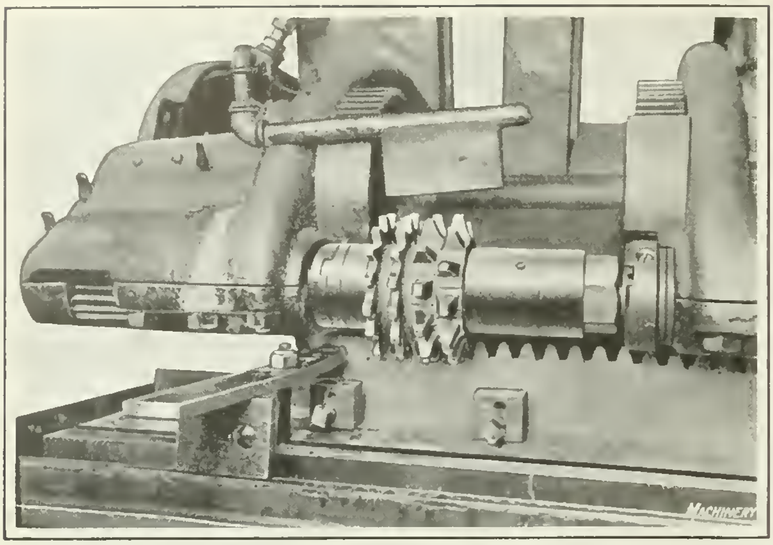


Fig. 2. Machine equipped with a Gang of Two Roughing and Two Finishing Cutters

Aside from any change in the height of the tooth to avoid interference with a meshing pinion, rack teeth are made to the same dimensions as spur gear teeth of equal pitch. The whole depth equals 2.157 ÷ the diametral pitch, or it may be found by multiplying the circular pitch by 0.6866. The linear pitch of the rack, or the distance from the center of one tooth to the center of the next one, is the same as the circular pitch of the pinion that is to mesh with the rack. The tooth width at the pitch line equals one-half the linear pitch, and the vertical distance from the top of the tooth to the pitch line equals the linear pitch times 0.3183. The latter dimension would be used in setting the vertical scale of a vernier gear tooth caliper, assuming that the latter were employed for measuring the tooth width.

General Methods of Cutting Racks by Milling

Racks may be milled either by using a single cutter or by the use of gang cutters consisting of two or more cutters on the same arbor. Diagram *A*, Fig. 1, illustrates the single-cutter method. Each successive tooth space is formed by this cutter, and the rack is indexed an amount equal to its pitch after each space is milled. Diagram *B* indicates how roughing and finishing cutters are often used together. The roughing cutter, which should preferably be of the stepped form to break up the chips, is mounted on the same arbor as the finishing cutter and precedes the latter. Roughing cutters which simply mill straight-sided slots are sometimes used instead of the stepped form.

The lower diagram *C* illustrates the application of a gang of finishing cutters, which is used to mill four tooth spaces simultaneously. The cutters are spaced on the arbor to suit the pitch of the rack to be cut, and the indexing movement between successive cuts equals the number of cutters in the gang multiplied by the linear pitch of the rack. In one shop where this method has been employed, the number of cutters used in a gang is made equal to the diametral pitch of the rack. For example, if the rack is of 4 diametral pitch a gang of four cutters is used. Where racks are cut by the gang method, it is applied, as a rule, to the smaller pitches.

Operation of Commercial Rack-cutting Machines

The cutting of a steel rack of rather large pitch is shown in the heading illustration. The machine employed is a Newark rack-cutting machine. The cutter-slide of this machine is given the feeding movement, being traversed by a reversing screw driven through forward and return clutches. These clutches are controlled by adjustable dogs which govern the length of the stroke. The indexing of the work-table occurs automatically at the end of each stroke of the cutter-slide, and is regulated by a suitable combination of gearing, through which motion is transmitted to a screw connecting with the table. The indexing mechanism is equipped with a "stop gear" having an inserted tool-steel notch engaged by a stop-lever. This device serves to lock the mechanism and accurately locate the work, irrespective of lost motion in the change-gearing. A vertical adjustment is provided for the work-table to permit setting the rack blank at the proper height relative to the cutter.

Fig. 2 shows a rack-cutting operation at the plant of the Simonds Mfg. Co., Pittsburg, Pa. It will be seen that in this case, two roughing cutters precede two finishing cutters, and two teeth are milled at each passage of this gang of cutters, the work being indexed after each cut an amount equal to twice the linear pitch of the rack. This rack has a face width of 1½ inches, and the teeth are of 3 diametral pitch. The material is mild machine steel. The two gashing cutters are ⅜ inch wide, and mill straight-sided slots which are about the same width as the points of the forming cutters. The cutters have a feed of 1 inch per minute.

The cutter-spindle of this machine is driven from each end. The work-table is indexed after each cut, and the saddle beneath the table is given a lateral feeding movement along the knee which supports it. The knee is adjustable vertically for setting the cutters relative to the rack. The arrangement of the table with its saddle-supporting knee is similar in construction to the ordinary column-and-knee type milling machine. The indexing mechanism may be arranged either for single indexing, or for multiple indexing, as required when employing the gang method of rack cutting.

Gang cutters are used for the finer pitches, the number in a gang depending on the pitch. The change-gears ordinarily furnished with this machine are based on diametral pitches, but gearing for cutting circular pitches may be obtained. Aside from inserting and removing the work, this machine is automatic, including the feeding and index-

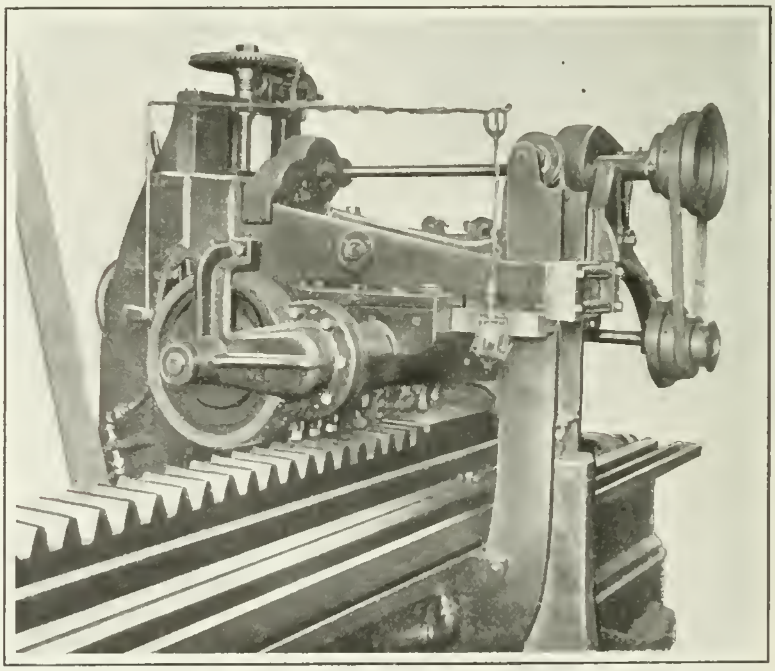


Fig. 3. Another Type of Rack-cutting Machine

ing movements, as well as stopping of the machine, either at the end of the table travel or at any point within the range of the movement.

A rack-cutting machine designed somewhat along the lines of a planer is shown in Fig. 3. The rack to be cut is mounted on a horizontal table which indexes after each passage of the cutters, and the cutter-slide is given a crosswise feeding movement for milling the teeth. For the particular rack-cutting operation illustrated, a gang of three cutters is used, there being two roughing cutters and one finishing cutter (see the detail view, Fig. 4).

The work in this case is a cast-steel rack, having a linear pitch of 2½ inches and a face width of 6 inches. The first cutter makes a channel 1 1/6 inches wide by ⅞ inch deep. The second gashing cutter increases this depth to 1 13/16 inches and the width to 13/16 inch, leaving only a small amount of stock to be removed by the finishing cutter. A feed of ⅝ inch per minute is used, and one tooth is finished at each passage of the cutters. This machine has been used for cutting teeth as large as 3½ inches linear pitch, and as small as 8 diametral pitch. For 8 diametral pitch, six finishing cutters are used at once, no gashing or roughing cutters being used. For 4 diametral pitch, four gashing and four finishing cutters are used. The machines shown in Figs. 2 and 3 were made by the Walcott Lathe Co., Jackson, Mich.

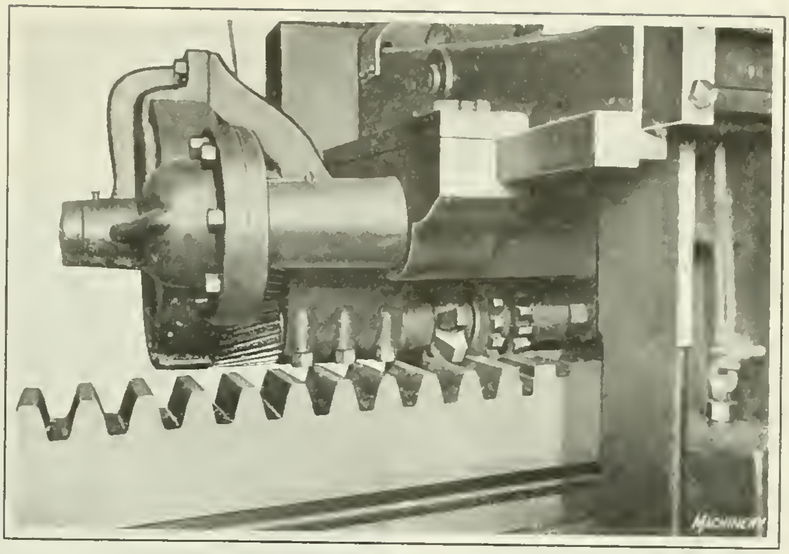


Fig. 4. Close-up View of Rack-cutting Operation shown in Fig. 3

Rack-cutting on Machine of Vertical Design

The rack-cutting machine shown at work in Fig. 5, is a vertical-cutting type, made by Gould & Eberhardt, Newark, N. J. The cutter-slide feeds vertically along the face of the column, and the rack is held in a vertical position by a multiple type of clamping fixture, similar to a series of machine vises. With this arrangement the thrust of the cut is taken directly by the machine table and bed, and the chips fall freely from the cutter.

Adjustment of the work-table along the bed is provided for setting the work relative to the cutter. The indexing movements of the table are automatic, and the mechanism may be arranged either for single spacing or for multiple spacing, as when using gang cutters. An adjustment with micrometer graduations enables the work-table and rack to be moved slightly without disturbing the indexing change-gears. This adjustment is convenient when milling a long rack in sections. The particular machine shown in Fig. 5 is cutting a steel rack having a pitch of 1¼ inches, a face width of 12 inches, and a total length of 56 inches. Sometimes two or more racks are cut simultaneously, by placing a stack of blanks between the jaws of the multiple fixture.

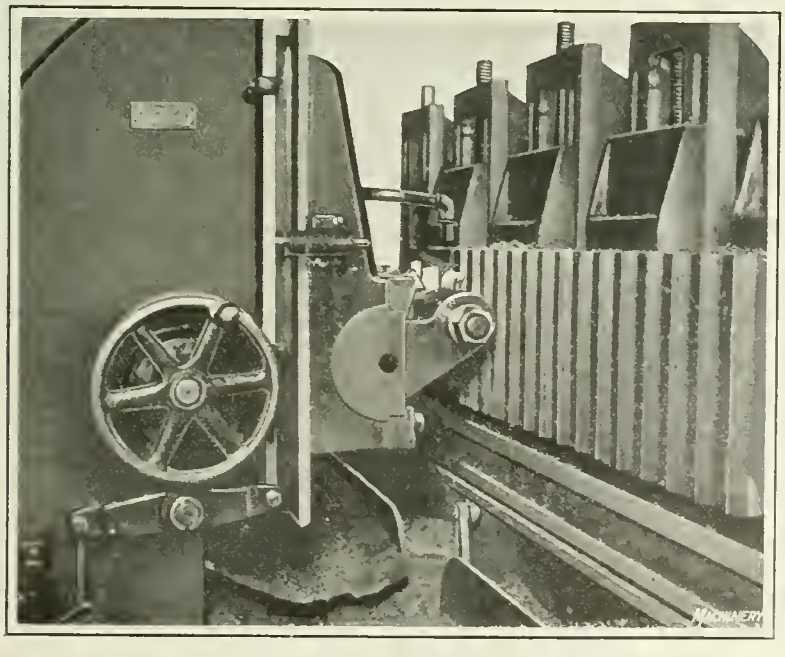


Fig. 5. Rack-cutting Machine of the Vertical-cutting Type

Generating Rack Teeth

Rack teeth may be formed by a generating process, as when using a Fellows gear shaper equipped with a suitable attachment. This attachment consists mainly of a work-table or slide mounted in the horizontal ways of a guiding frame. A rack on the slide engages a pinion secured to the work-spindle. The rack to be cut is attached to the horizontal slide; consequently, when the work-spindle and cutter are rotated at the proper ratio through change-gearing, the pinion on the work-spindle causes the work-holding slide to move along just as though the rack being cut were in mesh with a pinion corresponding to the cutter, which has a rolling and reciprocating motion the same as when generating the teeth of a spur gear.

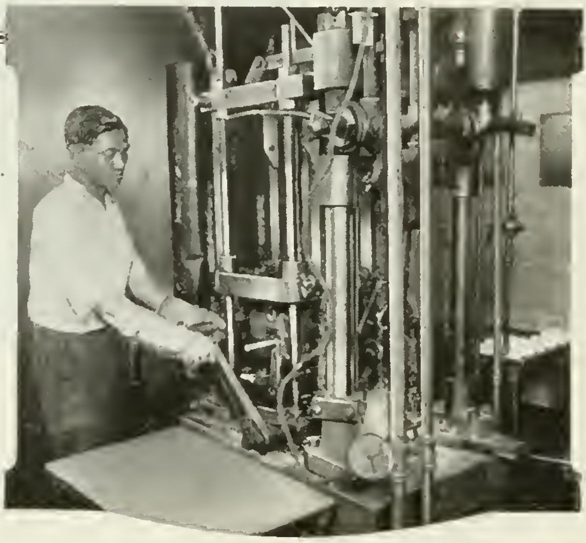
* * *

HEAT-TREATMENT OF GAGES

The ordinary type of working and inspection gages employed in interchangeable manufacturing work are made by several large companies from low-carbon cold-rolled steel containing from 0.15 to 0.25 per cent carbon. Gages made from this steel are carburized, permitted to cool, reheated for hardening, and quenched in oil. The carburizing temperature is about 1450 degrees F., and for gages of the ordinary size met with in the manufacture of small machine mechanisms, the time the gages are left in the carburizing furnace is about five and a half hours. After having cooled down, the gages are repacked in packing material that has previously been used in the carburizing process and that is therefore partly spent. The reheating temperature is about 1400 degrees F., which is maintained for about five hours, after which the gages are hardened by quenching in oil. Thread gages are drawn after hardening, to a temperature of about 375 degrees F.; those having a sharp V-thread are drawn to a temperature of 400 degrees F. The higher temperature for the sharp V-thread gages prevents brittleness on the extreme sharp top of the thread, which is likely to become quite hard when quenched in the hardening operation.

Design of Die-casting Dies

By CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



THE die-casting process tends to produce a casting less dense than the original metal, and in this respect is diametrically opposite the drop-forging process. In producing die-castings, the formation of blow-holes must be constantly guarded against, and this must be given serious consideration in the design of every part to be die-cast, as well as in the construction of the dies. There are a number of conditions that give rise to blow-holes in die-castings, the four principal ones being (1) drossy or porous metal; (2) the presence of air in the die; (3) rapid chilling of the metal around the inner cavity of the die, preventing the metal from completely filling the mold because of the solidification; and (4) piping.

Much has been done to eliminate blow-holes in castings, but with varying results. The vacuum process is one method that has been tried in an effort to produce sound castings. This process is based on the assumption that blow-holes in die-castings are always due to air entrapped in the die, and consists of exhausting the air as a means of eliminating the blow-holes. In practice it has been found that this hypothesis is not correct. It is evident that the vacuum process would not prevent the formation of blow-holes due to drossy metal or to piping.

The third cause of unsound castings, namely, the rapid cooling which prevents completely filling the dies, cannot be corrected by the vacuum process, as a simple diagram will demonstrate. Such a diagram is shown at *D* in the line illustration in which there are two sections of unequal size connected by a comparatively narrow section. The metal, as before stated, flows around the walls of the die cavity, and chills, so that in a design similar to this, the connecting section has an opportunity to freeze solid before the larger section is filled. Since the metal can no longer be forced through, a void or cavity results in the section of greater area. The chilling of the metal around the walls of the die cavity closes all vents and makes it necessary for this void to fill in from the inside, leaving a porous section (blow-holes) in the center of the larger section, as indicated in the diagram.

The vacuum process is not the means for preventing blow-holes arising from any of the four causes previously mentioned, with the possible exception of the second cause—air in the die. It is possible, however, by the careful location of the gate through which the metal is fed to the die and by providing suitable vents, to produce a casting that is practically free from blow-holes. On a part of irregular shape, it is often possible to concentrate on one particular portion and produce that part free from blow-holes, but the same practice applied to another part of different shape will not necessarily produce a solid casting. The conditions shown in diagram *D* could be overcome by relocating the gate and feeding the metal through suitable passages to both large portions.

The proper placing of the gate, in designing the die, will also save much trouble in finishing that particular die-casting. The location of the gate may affect the appearance of the product, because the metal connecting the casting with the gate must be ground or filed off. The gate should not be connected with any portion of the casting where such filing or grinding will impair the appearance of the article. Two examples of this are shown in the illustration. The window regulator *C* for an automobile is of an ornamental design, the contour lines of which must be preserved, so the gate could not be placed at any portion that is exposed to view. By placing the gate on the under surface that comes next to the automobile door, subsequent finishing may be performed without affecting the appearance of the finished piece.

Another example in which the appearance of the part is affected by the location of the gate is the aluminum French heel shown at *A*. In this case the gate is located on the tread, where subsequent removal can be accomplished without defacing the contour of the casting. The placing of the gate on any other portion than that indicated would not only result in the disfigurement of the casting, but would also cause some difficulty in removing the connecting metal.

Importance of Proper Venting

Venting may be accomplished in a number of different ways. The simplest method is to plane a strip about 1 inch wide, and from 0.005 to 0.010 inch deep, on one of the dies at the parting line. Another method of venting often resorted to in dies of intricate design consists of using slabbed or loose-fitting ejector-pins in round holes, which provides for the escape of the air.

A part having a number of thin projections, the corners of which must be kept sharp, is shown at *E*. It is obvious that air would be trapped in the parts of the die forming these thin sections, if proper vents were not provided. If the air can be expelled, the metal will fill these narrow sections completely and the projections can then be cast with sharp corners. In this case, sufficient vent will be afforded by simply driving in pins opposite these sections. The space between each pin and hole will permit the air to be forced through by the metal even though this space is not greater than that required for a light driving fit. The location of gates, parting lines, cores, as well as information regarding other details of die construction, can be best learned from an inspection of a number of dies. Examples of dies illustrating good practice in regard to these various points will be shown in a later article.

Factors Influencing the Cost of Die-casting

The cost of die-castings depends on the material used and the quantity to be made. Dies of aluminum castings have a much shorter life than dies for other white metal castings.

Pound for pound, aluminum is about two and a half times as expensive as other white metals, but its specific gravity is so much less that the same volume will produce two and a half times as many castings as the heavier alloys. The comparative cost of die-castings is not, therefore, greatly affected by the cost of the metals alone; but the kind of material cast does have an important influence on the life of the dies, and the length of life, in turn, is reflected directly in the cost of the castings.

The die cost, which is distributed over the quantity of castings produced from each set of dies, is evidently affected by the number of impressions (whether single or multiple) in the die. A single-impression die has a lower initial cost, but will add more to the cost of the casting than a multiple die, owing to the fewer number of castings produced in a given time. Die-castings cannot be considered economical when only small quantities are required; in fact, according to the Doehler experience, it has been found that there is seldom any saving realized over other methods of production where the quantity is less than one thousand.

Factors Affecting the Life of Dies

Dies for making zinc, tin, or lead die-castings will last almost indefinitely, if properly constructed, while those for making aluminum castings will produce from 30,000 to 100,000 castings before they need to be discarded. The difference in length of life is due to the difference in casting temperature. The melting point for aluminum is about 1300 degrees F., or 500 degrees higher than for any other white metal. The effect of this higher temperature on the die is destructive, so that to prevent its rapid deterioration recourse must be had to artificial means of cooling. As previously stated, all dies for bulky castings made of any alloy (also large cores) often require cooling.

When the casting is removed from the die, the temperature of the die impression is lowered, so that when the hot metal is admitted it will be properly chilled, which is necessary for producing a satisfactory die-casting. This repeated heating and cooling of the dies is what is so destructive to the die surface. In time, the fatigue point of the steel is reached, and checks appear on the surface of the impression. This results in castings having imperfect surfaces, and the dies should be discarded when this condition is reached. In the case of white metals other than aluminum, however, the difference in expansion and contraction is not so great, due to the lower melting temperature, and hence such severe strains are not imposed on the die metal.

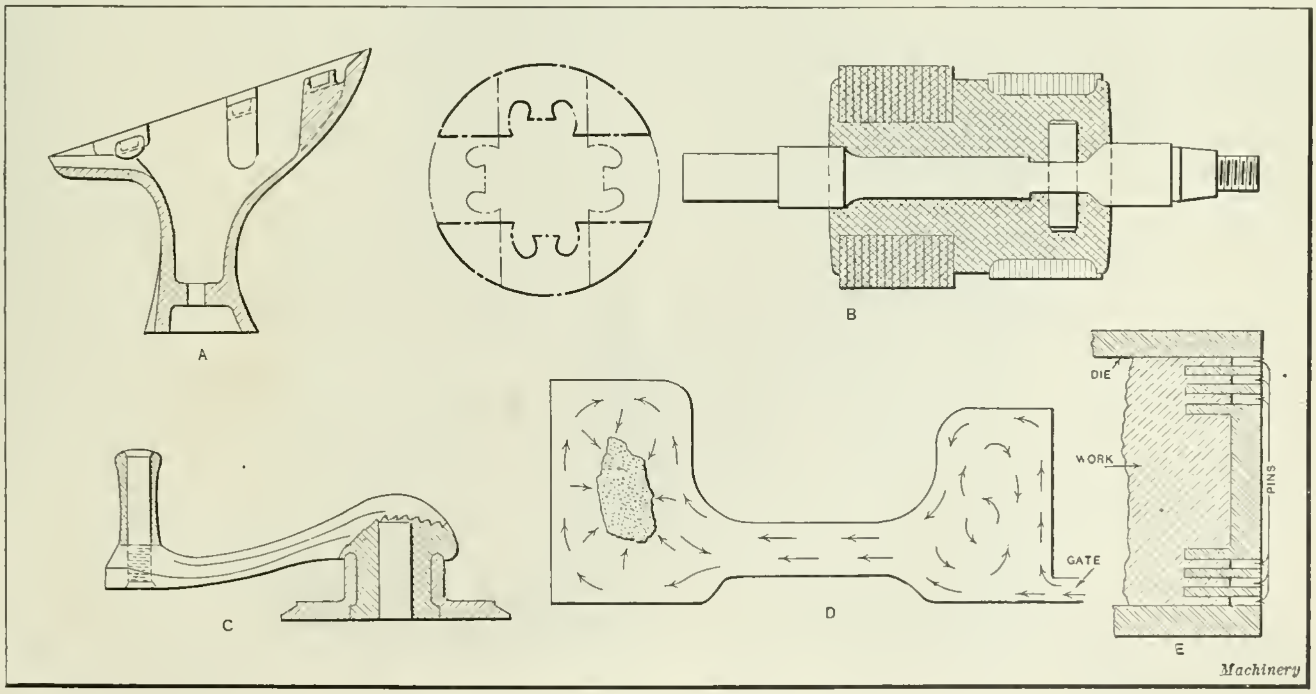
This problem has been partly solved by the compounding of a steel that would stand repeated expanding and contracting. Chrome-vanadium steel of a special analysis gives satisfactory results after being heat-treated to prolong its elastic limit, for it is the elastic limit that governs its resistance to the casting strains. It may be stated that alloy die steels have done more to make the casting of aluminum feasible than any other single factor.

Brass and bronze castings can be die-cast, the same as aluminum, but with limitations due principally to the failure of the steel at the higher casting temperatures. The inability of any steel to withstand this high temperature has so limited the production of brass and bronze die-castings made in metal molds, under pressure, that this process is at present commercially impractical. There is a method of casting these metals which is commercially practicable, but it is a gravity pouring process rather than a pressure process.

Dies designed to produce articles of a rather uniform section, where the amount of metal in each part of the die is about the same, will have a much longer life than where the design requires much more metal in one portion than in another. For example, consider a spider with a hub: There is much more metal at the center than in the arms, so that consequently there is more concentrated heat at this part of the die than in those parts forming the arms. The unequal expansion and contraction due to this condition would have a serious effect on the life of the dies.

Accurately Sinking the Die Impression

In machining the dies, warpage may occur if special precautions are not taken. Warpage may be minimized by first obtaining a steel that has been properly forged and not over-worked at the steel mill. The steel should be free from segregation. After the die-block has been attached to the machine, clamping strains are likely to be set up, and it is often necessary to relieve these strains after most of the machining has been completed, by means of heat-treatment. Otherwise, the dies may warp when released. The heat-treating must be carefully performed, because warpage is again likely to occur if this is not carefully watched.



Diagrams illustrating Gate Location, Insert Work, Formation of Blow-holes and Venting

Hogging out of the metal may be done accurately on any standard milling machine or shaper, but where there is much die work to be done, automatic machines are usually preferable. The Keller mechanical engraving machine is used at the Doehler plant. It is especially useful for sinking impressions in replacement dies, using the old impression as a model; that is, in place of the regular plaster-of-paris model commonly used, the old die itself is employed, and the stylus point follows the die impression. The stylus point causes the frame on which it and the milling cutter are carried, to swing in or out according to the contour of the master impression.

Die-castings with Inserts

Die-castings are often made with steel or brass inserts. These inserts are placed in the die at the time of casting, and the process involves no special feature except that the inserts are usually knurled or provided with some other means of anchoring them in the molten metal. The principal purposes of inserts are: (1) To lend added strength; (2) to furnish electrical or mechanical properties; and (3) to simplify assembly.

A good example of the use of inserts for adding strength and mechanical properties to a specific section of a casting is the window regulator shown at *C* in the illustration. This casting also is an example of insert work for facilitating the assembling of the arm with the hub. There are three distinct parts to this unit, all made by die-casting, and assembled during the process. The hub member is a separate casting, and is used as an insert in casting the complete article. The arm is free to turn within the hub, the latter being coated with a composition of graphite and molasses to prevent the metal from adhering to it when the handle portion is being cast around it. The construction of the hub is such that the handle is assembled within the hub (similar to a spun rivet) and cannot be removed without breaking the casting.

The threaded steel pin for the handle is also cast in the arm at the same time, and a graphitic lubricant used on the extending end to prevent the metal adhering to the handle. The part is placed in a vise after removal from the dies, and given a slight twist with a wrench to disengage the metal adhering to the insert, where it is exposed at the end, after which it will rotate around the insert. This gives the needed strength at this portion.

The use of inserts for adding special electrical properties is exemplified in magneto housings in which are cast the laminated field pieces; also in magneto rotors, such as shown at *B*. The field pieces consist of steel laminations riveted together, which are placed in the die, after which the metal is cast around them. In the rotor illustrated, it will be seen that there are four assemblies of these laminations, two arranged opposite in pairs at one end, and the other two similarly arranged at the opposite end, but at right angles to the other two, as the diagram shown in broken lines indicates. The rotor shaft is also cast in place, and it has a driving pin assembled in it to prevent the rotor body from turning on the shaft.

A common practice is to cast inserts at specific points to provide bearing surfaces. This is often done in housings for magnetos. The magneto housings are also sometimes of such design that special means for lubricating are necessary, and it is common practice to cast in oil-tubes, bent in almost any shape, to provide accessibility for lubricating.

* * *

Shipments of railroad locomotives from the principal manufacturing plants increased to 282 in March, and were the highest since December, 1920, according to figures published by the Department of Commerce from compilations of the Bureau of the Census.

SEASONING CAST-IRON PISTONS

In reply to a question as to the value of heat-treating and seasoning piston castings in the rough, in order to make them easier to machine and to relieve them of strains so as to keep them from warping after they are finished, the Journal of the Society of Automotive Engineers collected directions from a number of manufacturers on this subject. These directions are of considerable value as regards the seasoning not only of cast-iron piston castings, but also of similar castings for other purposes. One manufacturer makes the following statement: "For practical production work, it has been our practice to heat-treat or anneal the pistons after the roughing cut at as low a temperature as possible, that is, not over 750 degrees F. After annealing, we grind or take a light finishing cut before grinding. I do not think this method is as good as ageing before the finishing process, but it is more practical as a production method."

Another manufacturer writes as follows: "We have had intermittently considerable experience with the treatment of gray iron for pistons, and feel that the highest grade product is made from castings that have been subjected to a preliminary tumbling process in the foundry cleaning room and then for a period of about six weeks to a yard-seasoning, where the castings are exposed to the elements. Such castings are not so easy to machine as those that have been heat-treated from the standpoint of annealing. When time will not permit yard-seasoning, we resort to heat-treatment. We find that the castings cut much more easily, but the metal becomes somewhat lifeless from the standpoint of resilience, and a slight bump or shock of the finished piece will cause a permanent set, which is not the case with castings that have been yard-seasoned only. It has been our experience that change of shape in the engine is prevented by sufficient yard-seasoning, as well as by heat-treatment. Either method may be used, but we prefer seasoning."

Another engineer states: "It is my opinion that pistons for internal combustion engines should be heat-treated. In the first place, light weight pistons must be made of very strong iron which almost approaches steel castings. Inasmuch as the combined carbon depends upon the rate of cooling, and the graphitic carbon is very much less than in ordinary cast iron, piston castings, especially the thin sections, are likely to chill or harden in the mold, and thus become difficult to machine. For that reason alone, piston castings should be annealed. Furthermore, even with the most thorough annealing, some internal strains may remain; therefore, for a first-class job, pistons should have an additional treatment between the roughing and the finish-machining processes, in order that they may keep a permanent form after the last finish-grinding."

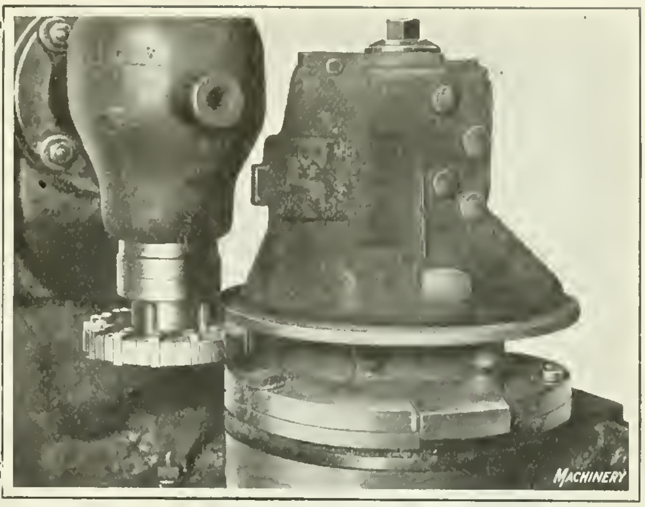
A fourth opinion is as follows: "The main purpose in heat-treating is to relieve the internal strains. Our present method for doing this is as follows: The pistons are first rough-turned, packed in boxes or containers which hold about twelve pieces each, and then placed in a furnace that has been brought to a temperature of 1450 to 1500 degrees F., the heat then being turned off. The procedure of preheating the furnace was found necessary to eliminate the scale that would otherwise form on the exterior due to flame contact. The pistons are allowed to remain in the furnace from 2 to 2½ hours, after which they are removed and cooled in the air. After this treatment, the pistons present a bluish tint in the way of discoloration. Our old practice on larger sizes was to place the pistons in the furnace as received from the foundry. The heat was then applied and the contents heated to a cherry red, when the flame was turned off and the pistons allowed to cool in the furnace. This was more of an annealing process, but we found in some instances that the castings were too soft to conform to our standard."

The Bureau of Standards recently started an investigation on this subject, but no data are as yet available.

Milling With Stellite Cutters

Directions for Obtaining the Best Results and the Highest Efficiency in Using Stellite Milling Cutters

By C. W. METZGER, Haynes-Stellite Co., New York City



THE best peripheral cutter speed for roughing cast iron or semi-steel with stellite cutters on a line type machine feeding in a straight-line direction is 100 feet per minute, and on a rotary type or a drum type machine, 120 feet per minute. For the second or finishing cut on any type of machine, 170 feet per minute is recommended. In some cases, on light castings, speeds up to 195 feet per minute have been used. When only one cut is taken, using a straight-line feed machine, stellite cutters should be run at 125 feet per minute; for the rotary and drum-type machines a speed of 150 feet per minute should be used.

The rate of table travel depends on the peripheral speed, and is usually from 0.010 to 0.015 inch per tooth, although sometimes, according to the material milled, a table travel of 0.030 inch per tooth has been employed. These figures vary, because neither the work nor the fixtures are always rigid enough to withstand, without springing, the pressure caused by the feed which otherwise could be used.

These speeds and feeds demand a rigid machine with a steady powerful drive. Many of the earlier designs of milling machines were not intended for such operative speeds as are permissible with stellite, so that sometimes it has been necessary to depart from the recommended speeds, to obtain the best results without changing over the drive and the spindle mountings. When it is necessary to reduce the speed, the conditions can be improved by grinding the cutter blades to a special form, as explained in the article entitled "Stellite Cutters for Milling" in April MACHINERY. Modern types of production milling machines, whether of the rotary or straight-line design, are usually capable of supplying the power demanded, and can be operated to give the best results with stellite milling cutters. Since stellite cutters do not burn under high speeds, the life of the cutters is long, and no breakage of cutter teeth, machine parts, or work will occur if the machine is in proper condition.

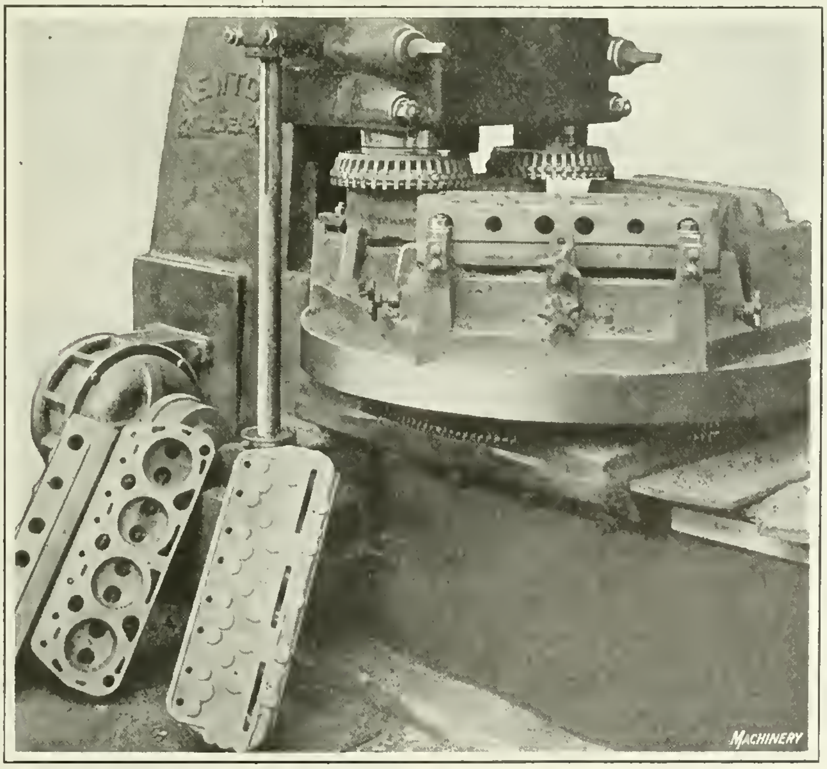


Fig. 1. Milling with 14-inch Cutters, One Roughing and One Finishing, 40 Stellite Blades Each; Speed, 117 Feet per Minute; Table Travel, 12.8 Inches per Minute, or 0.010 Inch per Blade; Depth of Cut, 1/8 to 3/16 Inch; Surfaces per Grind, 519

Conditions of the Milling Machine and Cutter

As stellite operates best at high speeds, it is essential that special attention be given to the condition of the milling machine used. Satisfactory production cannot be expected from a machine that is not in first-class condition. The present article will point out the most common difficulties met with, where trouble should be looked for, and how the conditions can be remedied. If the causes of unsatisfactory work were known, the conditions of the machines in many plants would be remedied, and the obstacles in the way of greater efficiency would be removed.

Three of the most common causes of poor results in milling are due to improper fit of the spindle, condition of the arbor, and mounting of the cutter. The following questions cover the most important points that ought to be looked into before the machine is started on high-production work with stellite cutters.

1. Is the spindle straight?
2. Are the bearings worn or out of round?
3. Is the face of the spindle true and clean?
4. Is the arbor straight and does it fit properly?
5. Is the end of the arbor true and clean?
6. Is the thread on the arbor a good fit for the clamping nut?
7. Have the adjustments for the spindle bearings been set too tight or too loose?
8. Is the back of the cutter clean and square with the arbor hole?
9. Do the cutter blades cut on the periphery?
10. Is the cut deep enough to enable the blades to get under the scale?
11. Are the spring supports under the casting of suitable design and are they adjusted correctly?

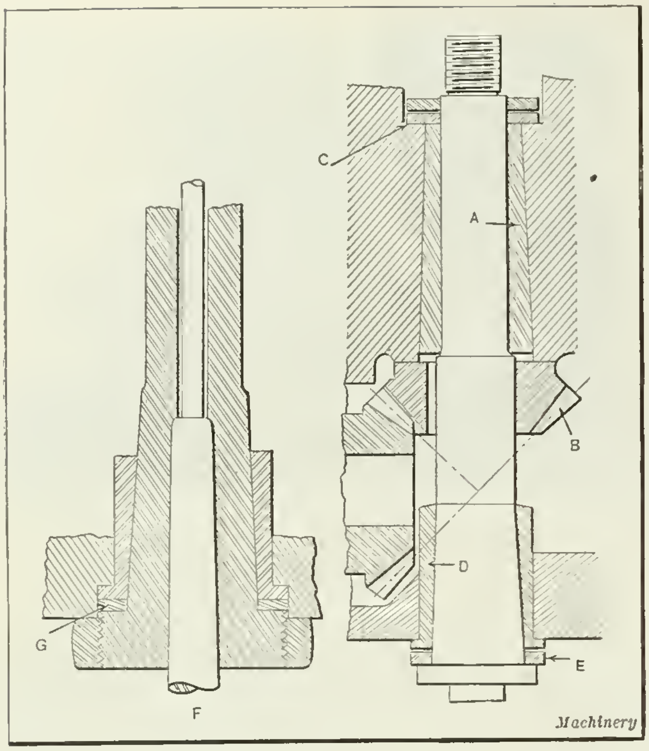


Fig. 2. Diagrams of Milling Machine Spindle Mountings

12. Does the operator stop the machine with the blades in the cut and the feed engaged?

13. Can the machine furnish the proper speeds and feeds?

14. Is the machine sturdy enough to deliver constant power at high speeds?

15. Have the gibs been adjusted?

16. Is there lost motion of the table due to loose gears, screw, or nut?

17. Do the cutters receive painstaking attention in the grinding department, and are they inspected and handled with care?

18. Do the blades fit the cutter body?

19. Do the clamps seat evenly on the blades and hold them firmly against the uneven thrust of the cut, hard spots, etc.?

20. Are the blades broken under the clamps?

The details on the milling machine that require careful attention must also be given attention on the cutter grinder. In fact, negligence in the cutter-grinding department may undo all that has been gained by care in putting the milling machine in first-class order.

Unsatisfactory Fit of Spindle Bearings

In order to obtain maximum results from milling machines when stellite cutters are used, it has been found necessary by those who have thoroughly investigated the matter to align the machine bearings; change the speeds and feeds; make suitable adjustments of bearings, thrust collars, etc.; provide for overhang of arbors; remedy lost motion and backlash of gears; give special attention to the design and care of the cutters; and in fact instruct operators as to the correct way to handle the work.

The diagram Fig. 2 shows a typical spindle design for a vertical milling machine. Side or end play of the cutters produces a rough finish and shortens their cutting life. When the straight bearing of the spindle is loose in bushing *A*, the drive on bevel gear *B* will force the spindle to one side of the bushing, out of line with the taper bushing, and if this is allowed to continue, the bushing will become worn, so that the spindle cannot be adjusted correctly. If this condition becomes pronounced, the cutter will have a tendency to gouge into the work and leave tool marks on the surface.

The thrust collar *C* at the end of the spindle should be of uniform thickness, and should be a few thousandths inch over size, say 0.005 inch, to furnish the necessary space for lubricating the taper bushing and prevent it from heating. Since it is practically impossible to eliminate all end play and still have the spindle operate freely, it is evident that this collar should be well lubricated and in good condition, otherwise the uneven pressure of the cut will cause it to wear, resulting in excessive endwise movement of the spindle and in chatter.

If the bushing *A* is not in accurate alignment with the taper bushing *D*, the operator may be unwise enough to try to correct the condition by making adjustments. In one instance, where the spindle had been running loose in the taper bearing, this attempt was made, with the result that the taper bearing ran free in the bushing and the cutter floated on the work. Also, under these conditions, it usually is found that the machine has been slowed down so that not only inferior but also less work is produced. Efficient service with cutters that operate at high speeds will not permit makeshift adjustments of this kind. These conditions should be corrected by making permanent change-overs or repairs.

Thrust Collars may Cause Trouble

If the spindle mounting has a thrust collar at *E*, its sides should be parallel and it should be a good fit between the end of the taper bushing and the shoulder on the arbor. If there is a space between them, as shown in the diagram, all the end thrust will be directed against the taper bearing—and not against the thrust collar. This is often the cause of a milling cutter dragging at the back after the forward half of the cutter has passed over the work. If allowed to run for a considerable time, the bearing becomes hot and wears away on one side, leaving the spindle loose in the bearing. This condition will shorten the life between grindings, even if it does not continue long enough to wear the taper bearing seriously. It may even be necessary to replace the taper bearing with a new one and to regrind the spindle if it has worn out of round.

When the design of the spindle is of the type shown at *F*, with a thrust collar *G* between the spindle head and the end of the taper bushing, trouble from a loose fit in the taper bearing often occurs, due to this collar being too thick. This leaves the spindle supported only by the upper straight bearing, so that side movement of the cutter, due to the cutting pressure, will cause the spindle to spring. Then, after the advancing half of the cutter has passed over the work, the stress is gradually diminished so that the cutter will advance slightly to its normal position and take an additional cut or at least drag on the surface. The result

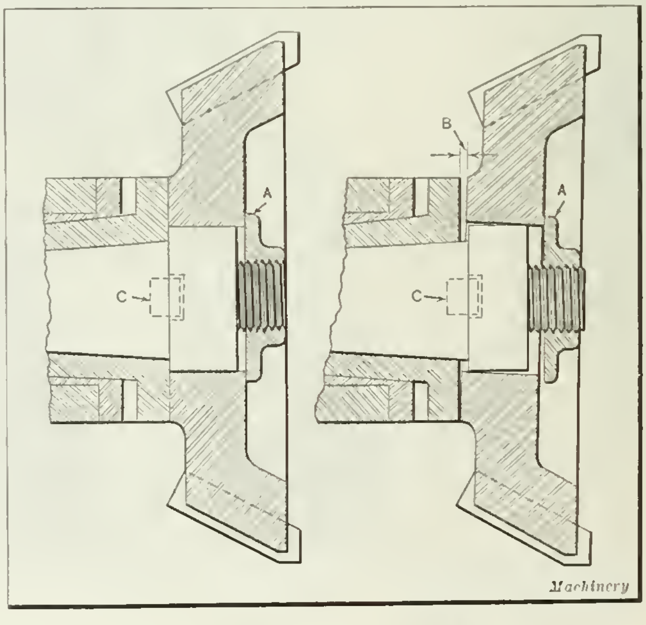


Fig. 3. Correct and Incorrect Cutter Mountings

is shortened life between cutter grindings and an inferior surface. This condition may cause the spindle to spring out of true to such an extent that it cannot be adjusted correctly in its bearing. When this occurs, the bearings and the face of the spindle should be reground, and the bushings replaced. If the cutter is free to move vertically and is adjusted to float on the work when taking a finishing cut, it may perform satisfactorily for awhile, but soon poor work will result.

A worn spindle mounting may have a greater or a less effect on the quality of work, depending on the design of the machine. When the drive is close to the end of the spindle, it is obvious that there will be the least cutter deflection.

Mounting the Cutter on the Arbor

The diagram at the left in Fig. 3 shows the proper mounting of the cutter on the arbor and its correct relation to the spindle. The nut *A* must seat evenly on the cutter body, and have a good thread fit on the arbor; otherwise the cutter is likely to become loose on the arbor, causing chatter, rough finish, breaking and crumbling of blades, or breaking of the edges and corners of the work. The back face of the cutter must be held squarely against the end of the spindle. The nut may locate the cutter properly against the end of the spindle, but in so doing it may draw out the arbor, leaving it loose in the taper hole in the spindle. This condition is of course objectionable, and the results are the same as those where the spindle is a loose fit in its taper bushing.

A slight space between the nut and the cutter or between the cutter and the spindle will cause the face of the cutter to run out of true, as shown by the exaggerated view at the right, and the amount multiples as the diameter of the cutter increases. With a 12-inch diameter cutter, a space of 0.002 inch at *B* will cause the face of the cutter to run out 0.004 inch. The arbor hole in the cutter must be kept free from burrs and chips; so must also the large diameter of the arbor, because this fit does not hold the cutter to the spindle, but merely locates it centrally with the spindle. The face of the spindle must be depended upon entirely to locate the cutter true with the spindle. The end of the spindle should be indicated, and be absolutely true before the cutter is put in place, and then the surface against which the nut bears should be indicated and should also be true.

The driving key *C* should have clearance in the driving slot of the cutter. If the key is a close fit in the slot and slightly out of square, it will bind and prevent the cutter from seating properly against the end of the spindle. Obviously the key must not bear in the bottom of the slot.

Changes Necessary to Correct Unsatisfactory Conditions

In one instance, on a planer-type machine, milling cylinder blocks 30 inches long with a table travel of 18 inches per minute and a depth of cut of 1/4 inch, a production of 330 castings per grind was obtained with two of the cutters. The third cutter failed after 125 pieces. It was found that the condition of the machine was responsible for the failure of the third cutter, because the cutter was not presented to the work at the proper angle; the side spindle to which it was attached was found to be so much out of position relative to the table that the vertical driving shaft was binding in its bearings and the cutter could not be raised to the proper position. Incidentally, the driving spindle was running hot in the bearing. It was a simple matter to correct this condition by bringing the spindle head to the proper angle with the table. After this was done, the trouble disappeared, and each of the three cutters had an equal life between grinds.

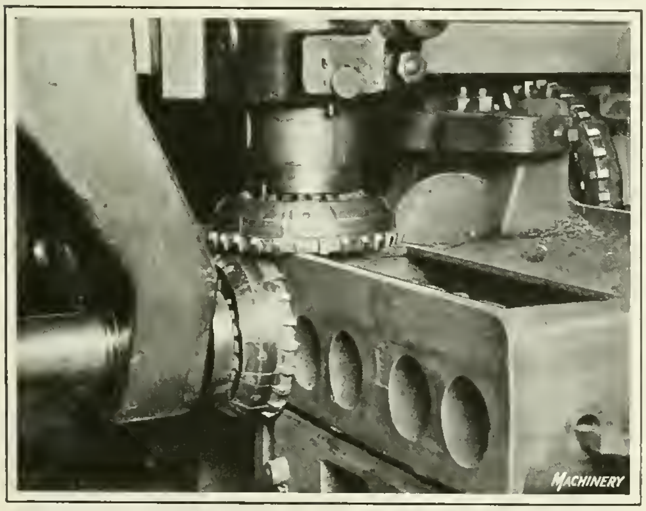


Fig. 4. Milling Machine with Auxiliary Brace for Side Spindle

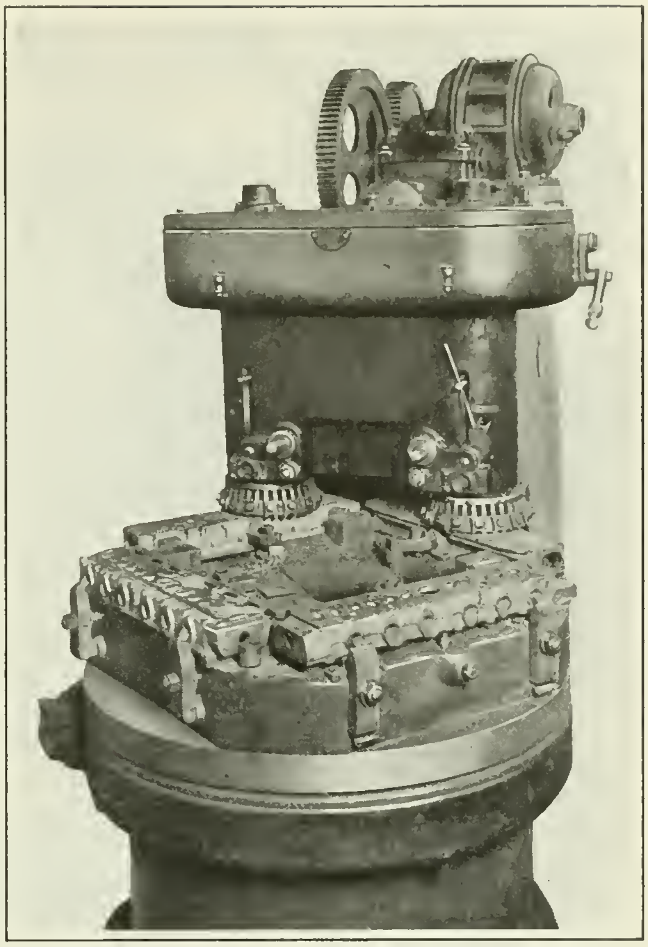


Fig. 5. Vertical Rotary Milling Machine on which Changes were made to adapt it to Stellite Cutters, thereby increasing Production 60 Per Cent

Vibration of the cutter and lack of rigidity of the work prevent rapid, accurate production with any milling cutter. In the case of worn spindle bearings, the unsatisfactory conditions may be intensified by an overhanging cutter, but it is usually possible to provide a brace or arm, as was done on the machine shown in Fig. 4, and thus eliminate vibration. The arm furnishes a bearing close to the cutter and gives the spindle the rigidity that a cutter of large diameter needs. This is a straight-line type machine with the arm used to support the side-head spindle. Another instance where the machine was changed from the usual practice is shown in Fig. 1. This machine was equipped with gears to obtain such a speed that 1280 blades were passed over the work per minute.

Fig. 5 shows a rotary milling machine, equipped with two inserted-tooth stellite milling cutters, on which changes were made to speed up production and enable all-around satisfactory results to be obtained. The operation is that of milling the bosses on a cylinder head casting. The areas milled are indicated by the sectioned portions in Fig. 6. It was found that the backs of the cutters were low, and

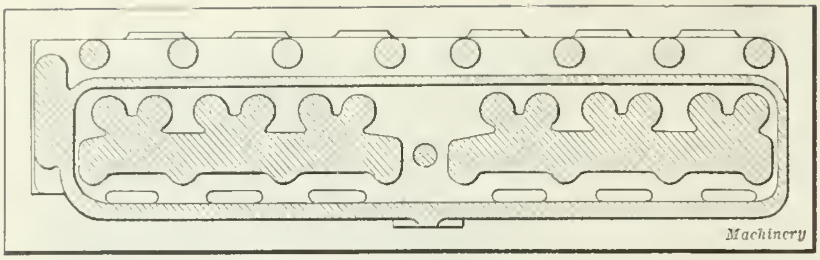


Fig. 6. Diagram of Cylinder-head Casting showing, in Section, the Areas milled on the Machine shown in Fig. 5

that it would be necessary to shift the housing to allow clearance. The speed of the machine was doubled by using a larger pinion on the motor.

On account of the inability to raise the cutter sufficiently, the bosses had been milled off to such a depth that the cutter blades were scraping on the scale of the casting in the recesses around the bosses. This, of course, decreases the life of a blade, and this condition was remedied by changing the locating points of the fixture so that they would bear between the bosses on the under side, instead of against the bosses.

These changes resulted in an increase in peripheral speed for the roughing cut from 55 to 110 feet per minute, and on the finishing cut, from 68 to 136 feet per minute. An increase in the life of the cutters also resulted, 200 cylinder heads being milled per grind instead of 44. The increase in production was 60 per cent, and the finish produced was smooth and clean.

* * *

MULTIPLE-JAW MILLING VISE

By J. T. LONGDON

The vise shown herewith was designed by the writer to hold six studs of the type shown by the dot-and-dash lines at *A*. The operation to be performed was milling the flats on the stud heads. Referring to Figs. 1 and 2, *B* is the cast-iron base of the vise. The jaws, one of which is shown at *C*, are T-shaped, and are made a snug sliding fit in a slot in the base. The jaws are held in position by plates *D*. They are a sliding fit on surface *E*, Fig. 2, and have a clearance on surface *F*. All the jaws are tightened simultaneously by a movement of lever *G*, the pivoted end of which is provided with a cam, which engages the end surface of jaw *H*, Fig. 1.

The end plate *J* acts as a stop which takes the thrust or clamping force exerted by the cam. The jaws are bored out to receive springs *K*. These springs expand the jaws when they are released by moving lever *G*. The position of the cam at the end of lever *G* can be adjusted in relation to the jaws. The adjustable feature was obtained by providing the head of stud *L* with a tongue *M*, as shown in Fig. 2, which fits into a slot milled in the boss on the under side of base *B*. This tongue positions stud *L* centrally, and also prevents it from rotating when the clamping lever *G* is actuated.

The stem of stud *L* passes through an elongated hole in the base of the vise, and then through the packing collar seen at *N* and the spacing bushing *O*, which serves as a bearing for the cam end of lever *G*. After the best working position of the cam has been found, the nut *P* is tightened, thereby clamping stud *L* firmly in position, and leaving the cam free to revolve on bushing *O*. A flat is milled on the back of the cam portion of lever *G* to permit the jaws to be opened wide when the cam is fully released. This enables the vise to be quickly loaded and unloaded. The shields *Q* prevent an excessive amount of chips from finding their way down into the chip space in the base of the fixture. By equipping a vise of the kind described in the foregoing with special jaws, it can be adapted for handling many different classes of milling and grinding work.

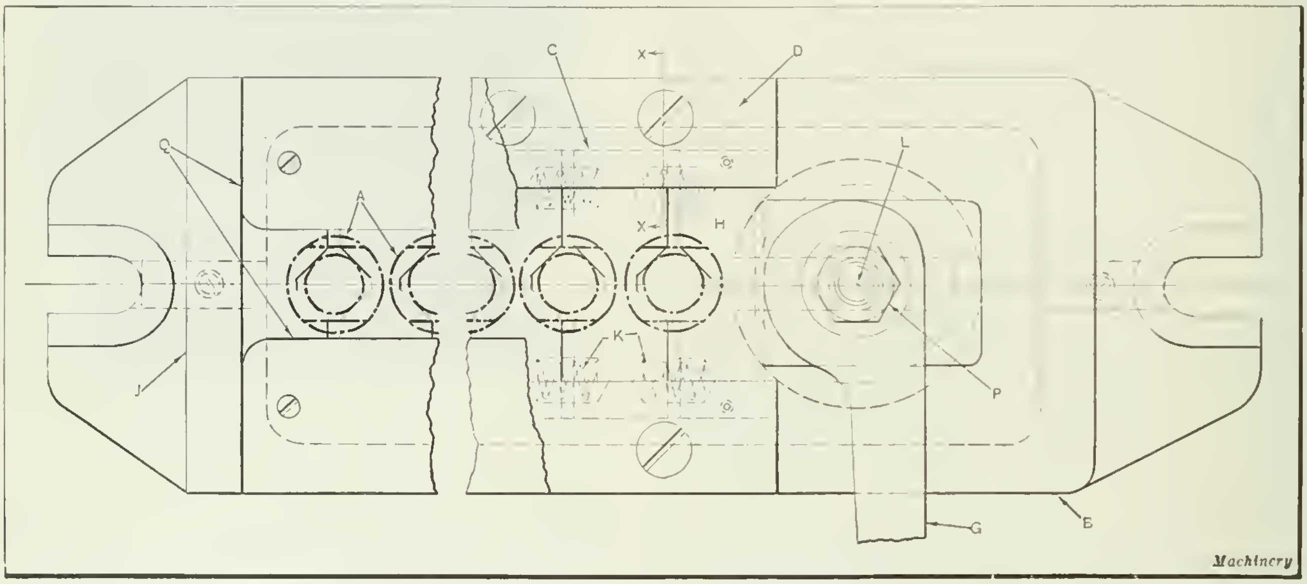


Fig. 1. Plan View of Multiple-jaw Milling Vise

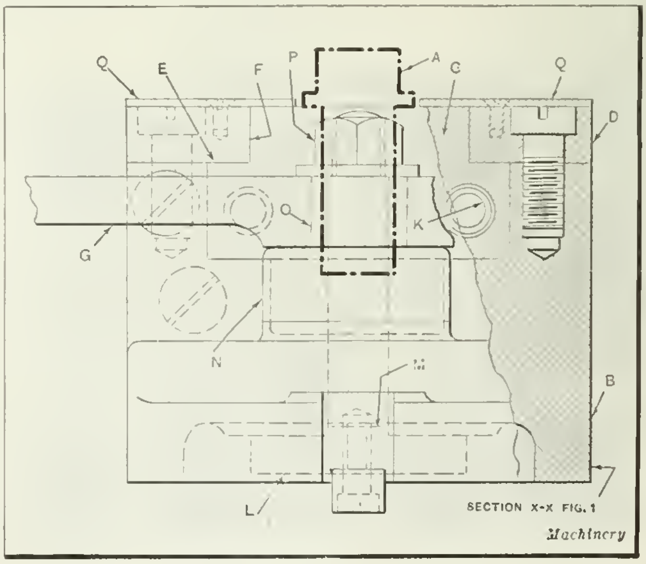
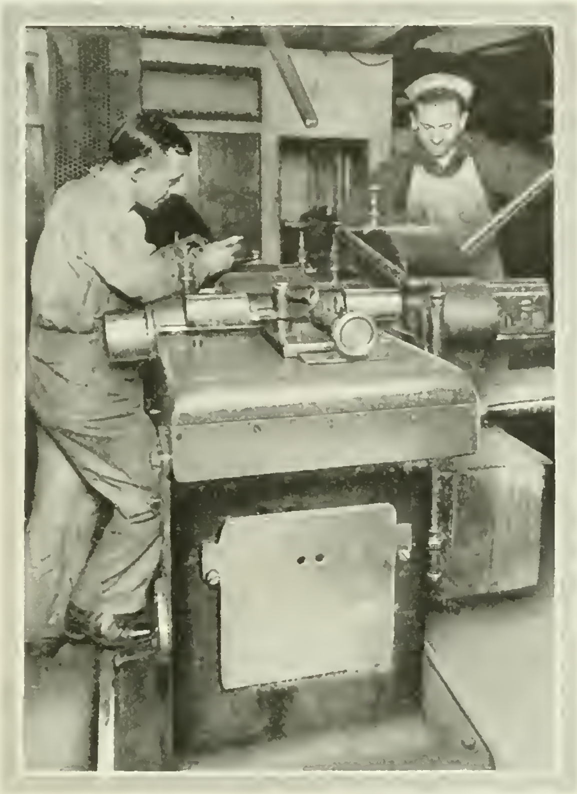


Fig. 2. End View of Vise shown in Fig 1

Centerless Grinding Methods



CENTERLESS grinding, as the name implies, is the grinding of cylindrical work without supporting it on centers in the usual way. In the Heim centerless grinding machine, on which the operations described in this article are performed, this is accomplished by employing two abrasive wheels. One of these wheels rotates in contact with the work at a very slow speed and serves only to rotate the work and advance it through the machine; the other wheel, located directly opposite it as shown in Fig. 2, does the grinding. It is possible to handle any plain cylindrical work without shoulders or tapers, but the best results are obtained on short cylindrical parts, such as rollers for roller bearings, wrist-pins, short shafts, and similar work of comparatively short lengths.

Before describing some of the details regarding the work of the centerless grinder, the design of this class of machine, in so far as it departs from older principles of grinding will be briefly described. In Fig. 1, which is a view from the driving side of a Heim centerless grinder, built by the Ball & Roller Bearing Co., Danbury, Conn., it will be seen that the end of one of the two wheel shafts is considerably lower than the other shaft. This shaft *A* supports the feed or regulating wheel at the opposite side of the machine, and it is inclined downward at a slight angle. This provides for spinning the work to advance it along between the wheels.

The work is loaded in a suitable support *B*, extending outward from the wheels, as illustrated in Fig. 2, and this support passes through the machine to the driving side. Each wheel is provided with a diamond dresser, which may be independently adjusted by means of a handwheel *C*, Fig. 1, as the diameters of the wheels are decreased through constant wear and truing. In dressing the regulating wheel, which, on account of not doing the cutting, wears slowly and consequently requires little truing, the handwheel shown at the front of the machine in Fig. 5 is operated to release a friction clutch, thereby increasing the speed of the regulating wheel during the dressing operation. A graduated collar facilitates the setting of the wheel-truing device, and a lever arm or handwheel is used to pass the diamond over the face of the wheel by turning the gear segment *D*, Fig. 1, which engages a rack for this purpose.

The normal operating speed of the grinding wheel is 1100 revolutions per minute, and this speed is constant, while the maximum speed employed for the regulating wheel is only 28 revolutions per minute. The regulating wheel is driven from a cone pulley within the frame of the machine, so that three speeds are available, although for the majority of the work the maximum speed is employed. The wheel speeds are calculated to give standard grinding speeds, and the changing of the regulating wheel speed is all that is necessary to give the correct grinding speed for work of different diameters and for roughing or finishing cuts.

If the work is not too long, it is usually fed into the support through a chute, as shown in the heading illustration, and for this class of work it is desirable to employ two operators, owing to the rapidity with which these parts are passed between the revolving wheels. A compound hand-

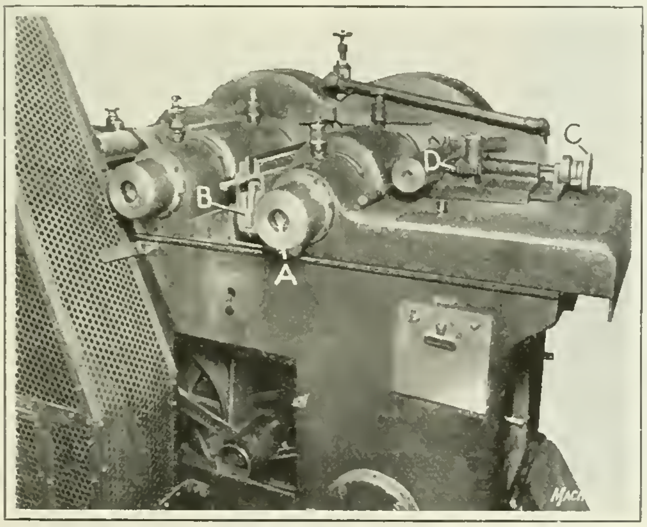


Fig. 1. Driving Side of Centerless Grinder, showing Grinding Wheel and Regulating Wheel Shafts and Wheel-truing Device

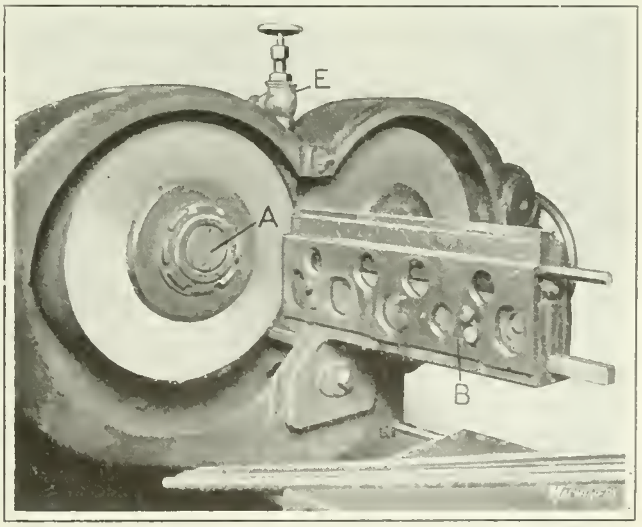


Fig. 2. Operating Side of Machine, with Grinding and Regulating Wheels exposed—also showing Fixture for grinding Rods

wheel at the end of the machine, which may be seen by referring to Fig. 5, is used to adjust the positions of the regulating and grinding wheels relative to the work, by moving the slides on which the wheel-heads are mounted. During the operation of the machine a stream of coolant is directed down between the two wheels (see valve *E*, Fig. 2) directly on the revolving work. The work revolves clockwise, as indicated by the arrows in Fig. 3, so that the grinding grit passes down and is washed away.

Types of Work-supports

In order to describe the work-supports used, it is necessary first to broadly classify the work. Short cylindrical parts up to and including, say, 5 inches in length and 1½ inches in diameter can be conveniently handled by feeding them through a chute into a support of the type shown in Fig. 4; the longer shafts up to possibly 3 feet in length must be passed through horizontally by hand. This is illustrated in Fig. 2, where the support for handling long work is shown attached to the machine.

In general appearance, the work-supports are very similar. An inspection of Fig. 3 will show the construction and adjustments incorporated in the fixtures for work of both classes. The two side members of these fixtures may be adjusted by means of the knurled screws shown on the sides, to give the proper opening for the diameter of work for which they are to be used. These side members have steel faces at the top on the inside, against which the work bears as it is fed through the machine.

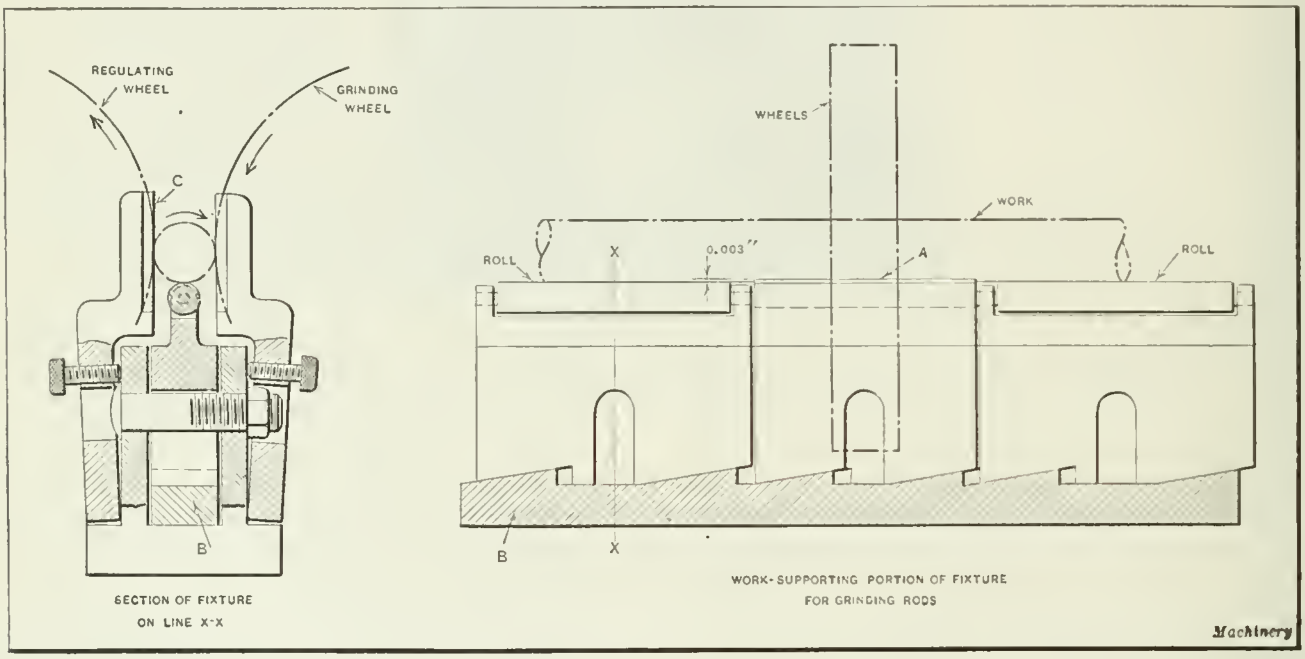

REGULATING WHEEL
GRINDING WHEEL
C
B
SECTION OF FIXTURE ON LINE X-X
WHEELS
WORK
ROLL
X
0.003"
A
ROLL
B
X
WORK-SUPPORTING PORTION OF FIXTURE FOR GRINDING RODS
Machinery

Fig. 3. Diagrams showing Construction of Work-holding Fixtures for Centerless Grinding and Relation of Work to Regulating and Grinding Wheels

The position of the work is indicated in broken outline as it rests between the steel faces, supported from beneath; also the relative position of the grinding and regulating wheels, as well as the directions of rotation, are shown. The under support may be either a roll or a stationary straight steel piece, depending on the work. If the work is long, the fixture contains at least three supporting sections. The middle section is located directly beneath the wheels and carries a steel strip *A* instead of rolls. These steel strips project slightly above their vertical support, and in the case of small-diameter work, the strip may be quite narrow at the top and slightly concave. The two end sections of the fixture carry rolls, the top surfaces of which are 0.003 inch above the strip *A*. The vertical supports for the rolls and for strip *A* are adjustable for height by means of a wedge member *B*.

In the case of short cylindrical work, the fixture has no rolls, and is made similar to the central portion of the fixture for rods, but in this case the steel strip has an angular face inclining toward the regulating wheel and extending above the support about 0.005 inch. The vertical support itself is not made of sections, like the rod fixture, but the strip mentioned is composed of small casehardened steel sections. This construction is a decided advantage, because when wear occurs, the worn sections can be replaced without disturbing the remainder of the support. The same wedge arrangement shown in Fig. 3 is used for raising or lowering the vertical support. Either type of fixture may be quickly attached to the side of the machine and adjusted to the diameter of work to be ground.

Setting up the Machine

In setting up the grinder, after the work-support has been attached, the necessary adjustments of the wedge are made to bring the work to the proper height. To do this, the bolts that clamp the vertical supports in position are loosened, and the wedge moved along. It will be noticed that the wedge *A*, Fig. 4, is graduated to facilitate this setting. Then the side members of the fixture are brought together sufficiently by means of knurled screws on the sides, to permit the work to be passed through without obstruction.

The operator next adjusts the handwheel at the end, as shown in Fig. 5, to bring the grinding wheel against the work, which has been pushed through the fixture. The grinding wheel forces the work against the left-hand face *C*, Fig. 3, of the fixture, leaving a space between the work and the right-hand face of 0.003 inch in width. A feeler gage of this thickness is then passed between the work and the face of the fixture in the manner shown in Fig. 5. This is the allowance recommended so that the work will pass freely through the fixture.

It may be necessary sometimes not only to adjust the sides of the fixture, but also to move the vertical support sidewise slightly to bring it exactly central relative to the two wheels, but this is usually unnecessary after the fixture has once been set and clamped together. The work is next passed through by hand, and the regulating wheel brought into contact with it by turning the smaller of the two handwheels at the end. The machine is started and further adjustments made if necessary, to increase the contact

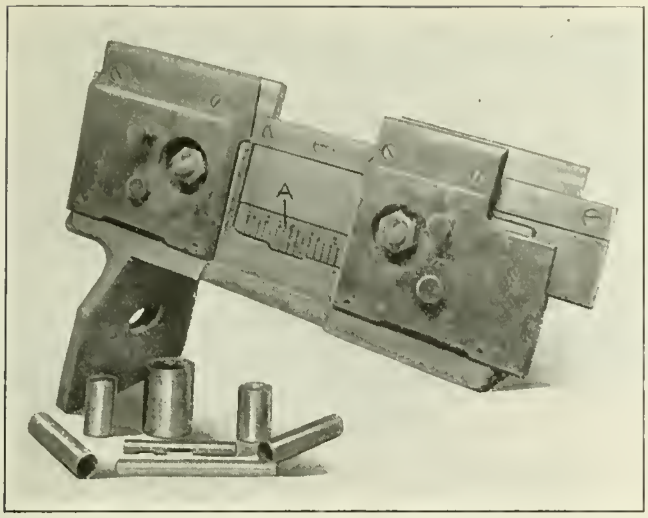


Fig. 4. Typical Cylindrical Work for the Centerless Grinder and Fixture used to guide Work of this Class

between the work and the regulating wheel enough to feed the work along.

When the regulating wheel has been set correctly, its face will extend in past face *C*, Fig. 3, about 0.003 inch. This amount, it will be remembered, is the same as that allowed for clearance between the work and the opposite face of the fixture in setting up. When the machine is set in this way, the work is ready to be ground and the operator need not make further adjustments until one cut has been taken on all the parts in a lot, at which time it is necessary to move the grinding wheel in for taking subsequent finishing cuts. Adjustment of the wheels is also necessary, of course, every time they are dressed.

Grinding Type-bed Rollers for Printing Presses

The Heim centerless grinders illustrated in this article are installed in the plant of the American Type Founders Co., Jersey City, manufacturer of Kelly printing presses. The rollers on which the type-bed of this press operates constitute a representative example of centerless grinding work. They are 1 inch in diameter, 1½ inches long, and must be ground uniformly and without taper to within a tolerance of 0.0002 inch on the diameter. There are thirty-six of these bed rollers on a machine, nine in a row, and they must be as near the exact size specified as possible so that the bed will not bear unevenly on them.

It is usual to allow about 0.006 inch on the diameter for grinding, and to employ three or possibly four cuts. In roughing, 0.004 inch is removed, and on the second cut 0.001 inch. The operator then examines his machine adjustments before taking the finishing cut. In cases where some of the parts do not come within the requirements, it is sometimes necessary to take a light fourth cut.

These rollers were formerly ground between centers at an average rate, for roughing and finishing, of 80 grinds per hour. When thus ground, centers had to be machined in the ends and a driving hole drilled, all of which is unnecessary with centerless grinding. Work of this size and type can be fed into a chute and passed through a centerless grinding machine at the rate of about 45 per minute, which is 2700 per hour for each pass, or a production of over 600 complete rollers an hour, allowing four passes per roller.

Finishing Rods by Centerless Grinding

The gripper rods used on Kelly printing presses represent an example of long work which must be fed through the machine horizontally by hand. These rods are about 0.50 per cent carbon steel and carry fingers for gripping the paper as it is passed over the press cylinder. The rods are shown in Fig. 2—one in the fixture and others on the shelf beneath it. They are ⅝ inch in diameter and about 25 inches long, and an absolute measurement of 0.625 inch on the diameter is the standard in grinding them. The same amount of stock, 0.006 inch, is left for finishing as on the rollers, and the same number of cuts is usually required.

A great deal more care must be exercised in performing the grinding operation on these rods than is necessary for the short rollers. In the first place, it has been found that irregularities on the work cannot be corrected by this method of grinding, and as a consequence the rods must be carefully straightened before each grinding operation, if a smaller tolerance than 0.002 inch is required.

There is another limitation that must be considered in grinding long work by the centerless method, and that is its weight. It has been found, when grinding heavy shafts, considerably more than an inch in diameter, that the weight is greater than the regulating wheel can drive without causing the work to lift. In fact, it would seem that this class of work is rather beyond the scope of centerless grinding, at least in its present stage of development, although there has been some heavy work ground on this style of grinder, 2 to 3½ inches in diameter and up to 39 inches long, using a fixture especially designed for this class of work. The production time for the gripper rods on a cylindrical grinder was forty-five minutes, as compared with from fifteen to eighteen minutes apiece by centerless grinding, for rods 25 inches long.

The speed and accuracy which can be obtained on rolls and similar work by centerless grinding constitute its chief advantage. The machines can be arranged for chute feed without difficulty, and a high production obtained. On the other hand, when long cylindrical parts are to be ground, it is necessary to take into consideration the extra work required between grinds in straightening, and the need of a helper, as well as a trained operator, for grinding this class of work. Although the production is high, even on rods and shafts, as compared with straight cylindrical grinding,

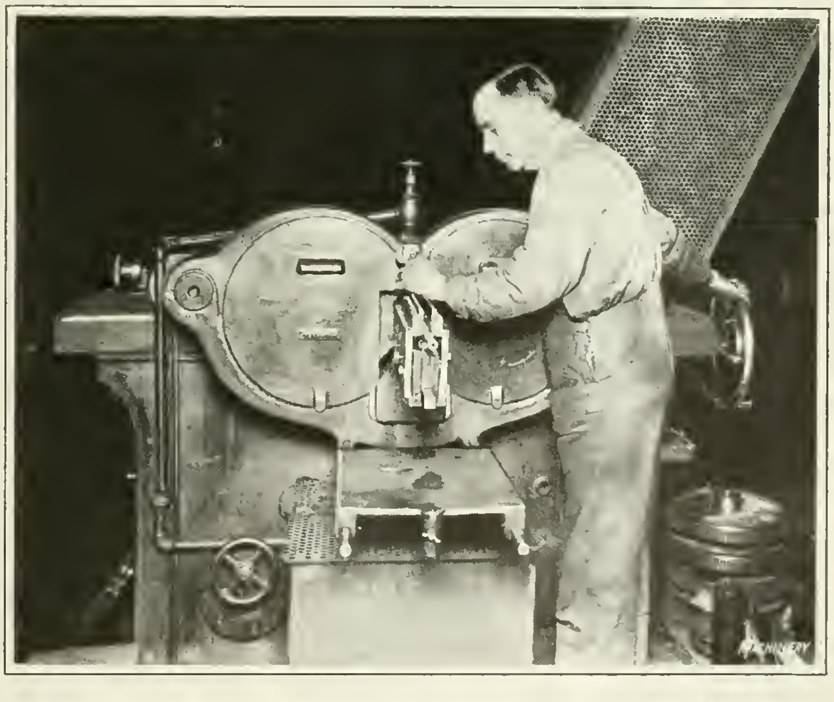


Fig. 5. Setting up the Machine, using a Feeler Gage between the Work and One Face of the Fixture

the additional cost of a helper, special fixtures, and straightening, detract somewhat from the advantage of greater production.

While it is customary in the plant referred to in this article to use a helper and an operator on all work, it is possible for one operator to attend to a machine alone, and under a favorable arrangement of machines to attend to two. The work of the helper is largely that of attending to the feeding while the operator, working from the opposite side, is gaging and clearing away the fast accumulating rollers and other parts fed to the machine from the chute, to prevent them from interfering with the flow of work and to safeguard them from injury in falling into a box or other receptacle.

* * *

ASSEMBLING GENEVA STOP-WHEEL MECHANISM

In order to insure the proper operation of a Geneva stop-wheel mechanism, such as shown in the view at the left-hand side of the illustration, it is necessary that the driving roller *A* be very accurately located on its arm. It is common practice for the draftsman to specify the distance between the centers of the arm hub *B* and the roller *A* in thousandths of an inch, and the shop man takes particular care to work closely to this dimension. When this method is employed, it is essential that an equal degree of accuracy be maintained in the center distance between the hub *B* of the arm and the shaft *C* on which the star wheel is mounted, since any error in this dimension would render useless the care taken in locating the roller on the arm. When jigs are not used, time can be saved by working to a nominal dimension for the center distance between hub *B* and wheel shaft *C*, and then locating the roller on its arm in the manner described in the following.

The stud hole in the arm is first located by scale measurement and bored 1/16 inch under size. A dummy stud, such as shown at *D*, having a shank 1/8 inch smaller than the finished stud, is then inserted in the arm *E*, an enlarged section of which is shown in the view at the right-hand side of the illustration. The roll *A* is placed in position on the dummy stud before the arm is assembled on its shaft. By turning the wheel and the arm, and adjusting the stud *D*, so that the roller is brought into exact alignment with the slot in the star wheel at its point of entrance, the position of the roller can be easily established.

The arm *E* is next removed from its shaft and set up in a lathe chuck, using an indicator for centering the roller *A*, which is clamped to the arm by the dummy stud *D*. The dummy stud is next removed, and the hole in the arm rebored to fit the shank of the finished stud. P. R. H.

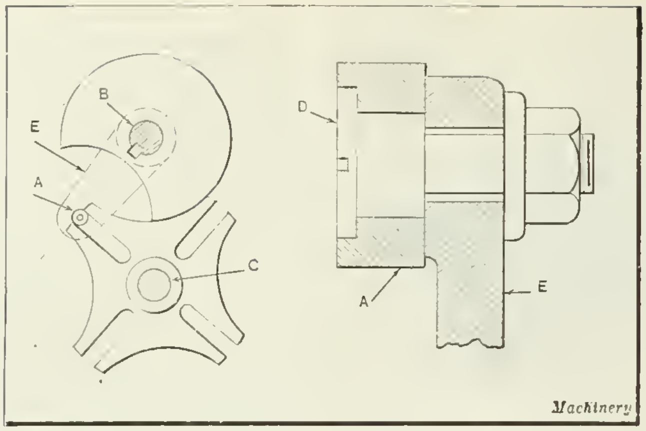


Diagram illustrating Use of Dummy Stud in assembling Geneva Wheels

* * *

PRICES OF MACHINE TOOLS AND COMMODITIES COMPARED

In order to show in a graphic manner the relation between machine tool prices and the prices of general commodities, the builder of a well-known line of machine tools prepared the three charts shown herewith. In these charts the full lines show the price fluctuations in general commodities, based on the wholesale prices as published by the United States Chamber of Commerce. These prices include the cost of clothing, farm products, house furnishings, etc.—briefly, the necessities of life. The dotted lines in each chart show the price of one specific line of machine tools built by this manufacturer. It will be seen that during the entire period of 1917, 1918, 1919, and 1920, when prices of other products mounted to such high levels, the prices of machine tools were far behind the cost of general merchandise. It will also be seen that at the end of 1922, the average prices of machine tools were slightly below the average price level, as far as the machines produced by this manufacturer were concerned, because one line of his product is ten points below the average, while the other two lines are only two points and four points above.

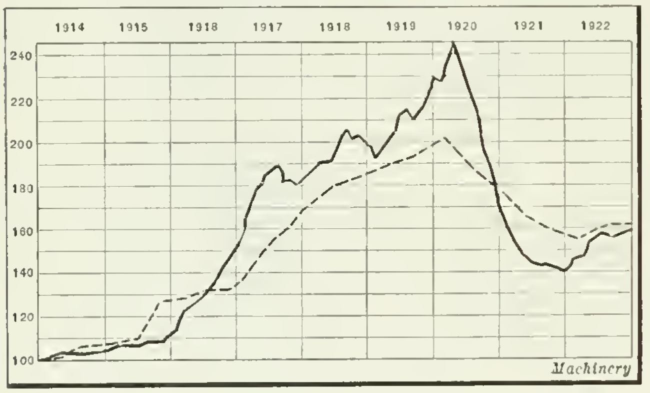


Fig. 1. Comparison between the Price of a Line of Machine Tools and the Price of General Commodities

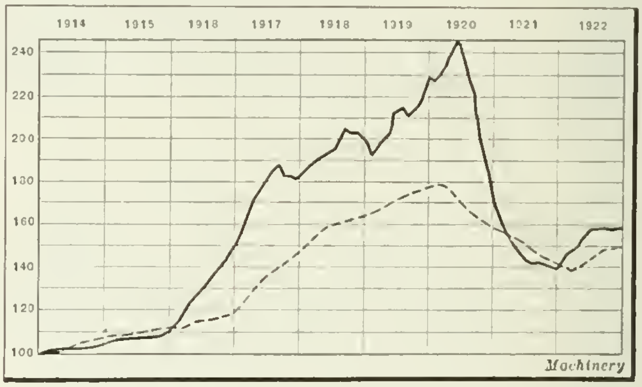


Fig. 2. Chart showing how a Line of Machine Tools increased 80 Per Cent in Price, as compared with 145 Per Cent for Commodities

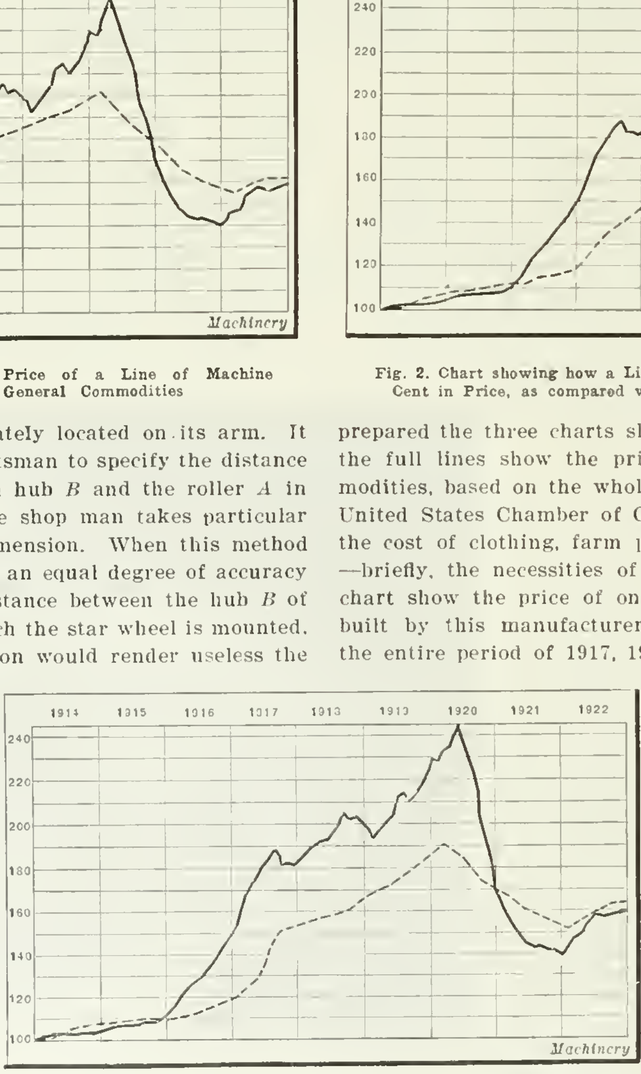
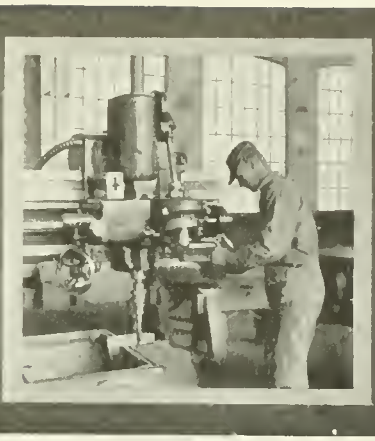


Fig. 3. Diagram showing how the Price of a Line of Machine Tools ran far behind the Average Level for Five Consecutive Years

Letters on Practical Subjects



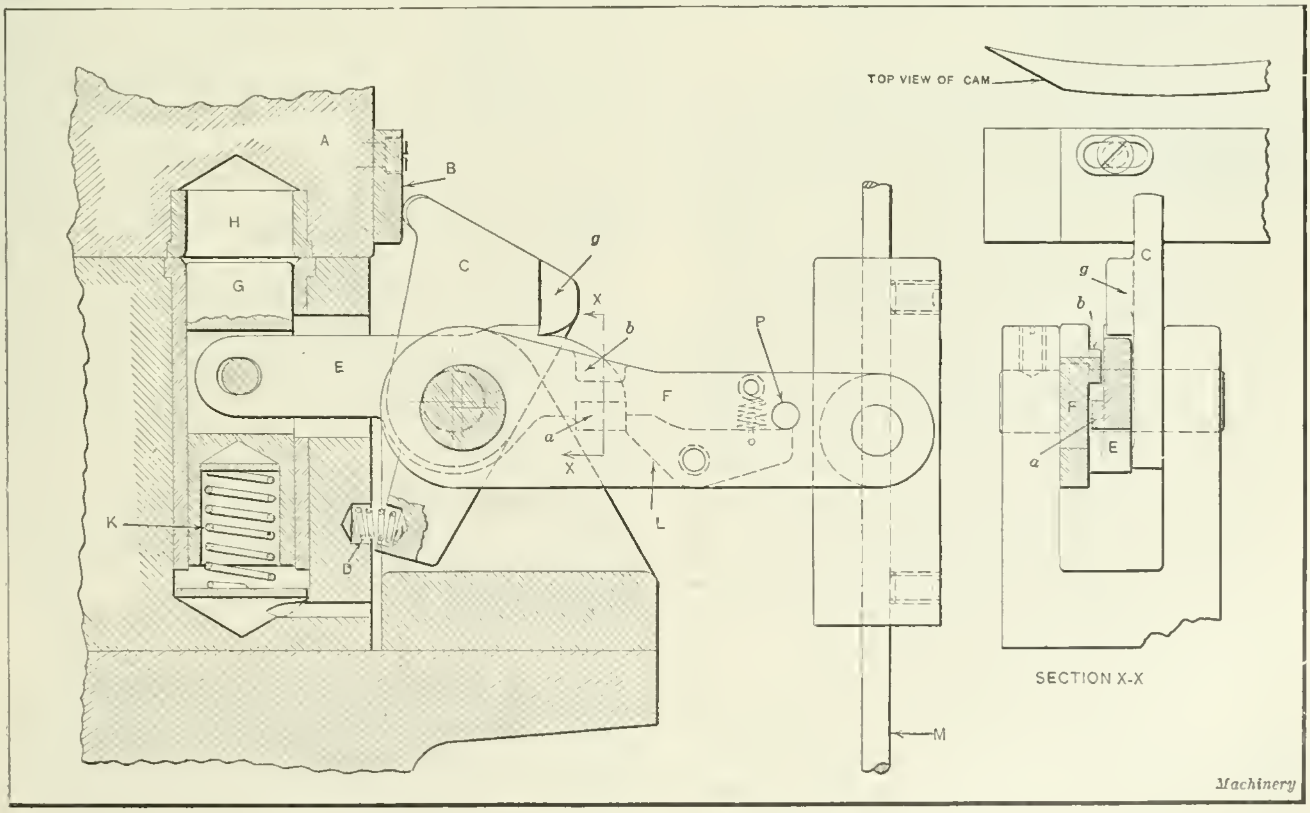
INDEXING MECHANISM FOR DIE-HOLDER

The mechanism shown in the accompanying illustration is designed to provide a safe and positive means of indexing the die-holder of a three-station upsetting die used on a large punch press. The die is hand-actuated and of the circular progressive type. In operation, the workman simply inserts the blanks (not shown in the illustration) in the rotating die-holder *A*, and trips the press. The die is then indexed one space, another blank inserted, and the press tripped again; thus the press can be kept in continuous operation. The ram is equipped with two punches. The first punch performs the work, and the second punch simply serves to push the completed part through the die, which is left open at the bottom to permit the parts to drop into a tote box. It will be evident from the preceding description that a piece is loaded into the locating die-holder, another piece upset and a third piece ejected, each time the press is tripped.

As the work is of irregular shape and is required to be held to very close limits, it is obviously necessary that the die-holder be indexed accurately and locked firmly in each position. If this is not done, the punch will not be properly aligned with the die, and either the punch or the die will be damaged or broken. Obviously it is also necessary to provide a safety device which will prevent the punch from being tripped at any time except when the die-holder is properly indexed and locked in place.

In the illustration, the safety device is shown in the position occupied when the die-plate *A* is being rotated to the succeeding station. It will be noted that the part *C* is held out or away from the die-holder *A* by the cam *B* which is attached to the die-holder. The nose of part *C* is spherical, and is kept in contact with cam *B* by means of spring *D*, so that the moment the end of cam *B* passes the spherical end of part *C*, the latter is forced in toward the die-holder, thus lifting the trigger portion *g* of part *C* out of engagement with the projecting corner of part *E*.

Part *E* has a projecting tongue *a* (see sectional view), which permits tongue *b* on part *F* to descend a limited distance. Now if part *C* is held away from the die-holder by cam *B*, the end *g* of part *C* will be held down, thus effectually locking part *E* so that its outer end cannot be moved downward. As the trip-rod *M* may be pulled down by means of a foot-pedal for about 1½ inches before actually tripping the press, it will be evident that as long as part *C* is held in the outward position by cam *B*, trip-rod *M* cannot descend far enough to trip the press, being prevented from so doing

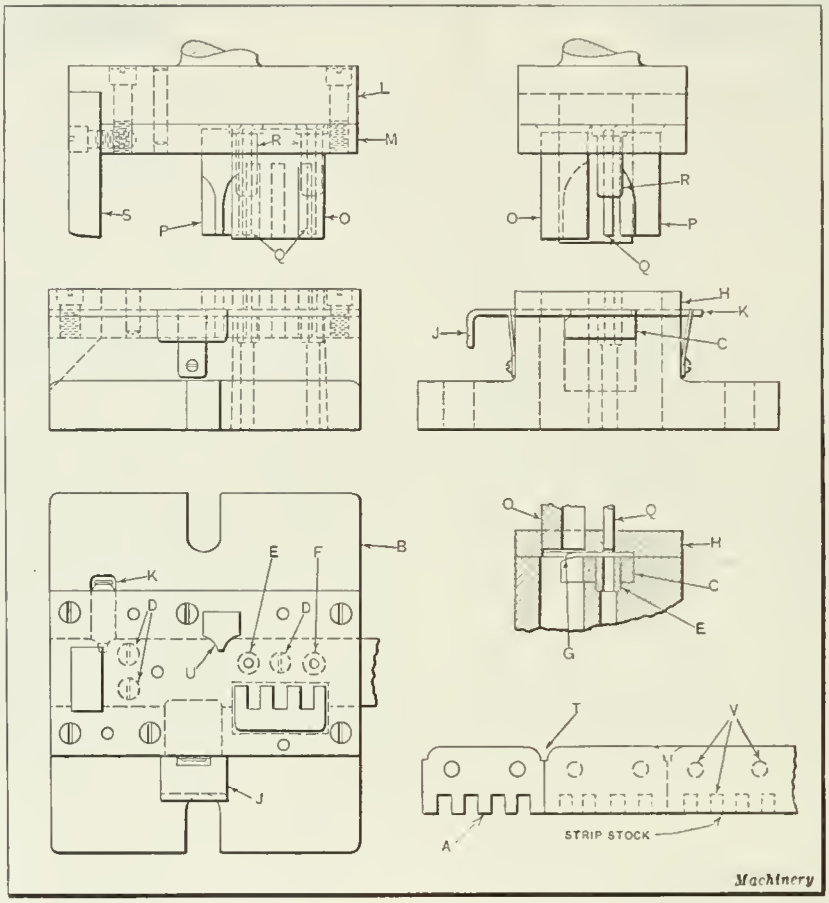


Mechanism for indexing the Die-holder of a Three-station Upsetting Die by contact of tongue *b* with tongue *a*. Cam *B* can be adjusted to permit the spherical end of part *C* to travel inward toward the die-holder *A* at exactly the proper moment, or a fraction of a second before plug *G* is brought in position opposite hole *H*.

As the end of part *C* drops or rides off the end of cam *B*, spring *D* forces the end of part *C* toward the die-holder. This action lifts the latch *g*, thus permitting spring *K* to force plug *G* upward into the indexing hole *H*. The press is then tripped, and as lever *F* descends, the dog *L* will ride over the nose of part *E*. When lever *F* has moved down a certain distance, the nose of dog *L* snaps down under the tongue *a*, due to the fact that the fulcrum of levers *E* and *F* are at different points. The opposite end of dog *L* is prevented from rising by a pin *P*, when a spring (not shown) on the end of the trip-rod *M* returns the latter member to its first position. This movement elevates lever *F*, thus raising the nose of part *E* and compressing spring *K*, as well as withdrawing the indexing plug *G* from the hole *H*. At the same time the spherical end of part *C* rides up on the beveled end of cam *B* and pushes *g* downward, so that the entire mechanism is locked in the original position shown in the illustration.

A little experimenting was necessary at first to determine the size of spring *K* which would maintain the proper balance with the trip-rod spring of the machine, but having solved this problem satisfactorily the mechanism gave excellent results.

W. R.



Die for notching, piercing and cutting off Piece shown at A

NOTCHING AND CUTTING-OFF DIE

When a worn out die is to be replaced, any weaknesses that have developed in use should be carefully considered and an effort made to eliminate them from the new die. The piece shown at *A* in the illustration was at first produced on a follow-die designed to pierce and blank the piece from the strip stock. The strip stock in this case was a little wider than the work. The whole die was composed of one block of steel and was rather expensive to make. The new die was designed to cut the pieces from strip stock the same width as the finished piece. This reduced the amount of scrap or waste, and eliminated one of the objectionable features of the follow-die. The construction of the new die will be understood from the following:

Referring to the illustration, the die-shoe *B* is grooved or slotted to receive the die *C*. This die is held in place by means of the three screws *D* and the two dies *E* and *F*, which are of the bushing type. The dies *E* and *F* are set into the die-shoe, and thus serve as dowel-pins as well as dies. The notched openings in die *C* were made with a milling cutter, and the necessary clearances filed by hand. The die after being hardened was rounded off at *G* by grinding, to give the teeth produced on the part a slight curl that is completed in another operation.

The strip stock is a loose fit in the slot milled in the stripper plate *H*, and the thrust imposed on the notching and shearing cutters is taken up by the stripper plate. The spring stops *J* and *K* are set in slots in the stripper plate. The machine-steel punch-holder *L* is provided with a punch-plate *M* in which the punches *O* and *P* are held. To prevent the punches from pulling out of plate *M*, the ends are headed over in the usual manner. The piercing punches *Q* are made of drill rod and are fitted and riveted into punch-holders *R*, which also have shoulders that prevent them from being pulled out of plate *M*. A shear blade *S*, attached to the end of the punch-holder as shown, cuts off the pierced and notched pieces.

In operation, the stock, which comes in 10-foot lengths, is fed into the die by hand until it comes up against the stop *J*. The press is then tripped, and on the down stroke of the ram, the two punches seen at *Q* pierce two holes, and the punch *O* notches the side of the stock. On the same stroke, punch *P* entering die opening *U*, notches or rounds the end of the stock. Upon the completion of the first stroke, the operator pulls back stop *J*, so that the stock can be fed up to stop *K*. The second set of notches and holes is then punched. Stop *J* now acts as a friction shoe, pressing the stock up against one side of the slot in the stripper.

Stop *J* is of the snap type, so that by pushing on the stock, the latter can be fed along to the third position, where stop *K* will snap into notch *T* previously produced by punch *P*. Here the third set of notches and holes is punched in the stock, as indicated by the dotted lines *V* in the view at the lower right-hand corner of the illustration, and the first complete piece *A* is sheared off. After the stock is started in the die, the press is run continuously at a speed of 90 revolutions per minute. The scrap or punchings cut out by punches *O*, *P*, and *Q*, pass down through the die to a scrap box, while the sheared off pieces slide down the chute at the back of the press.

Brooklyn, N. Y. S. A. McDonald

ADJUSTABLE HOLLOW-MILL

Several adjustable hollow-mills of the design shown in Fig. 1 have been in use for the last four years in the shop where the writer is employed. These tools are used for turning work up to ¾ inch in diameter. By making the tool with a tapered shank in place of the straight shank

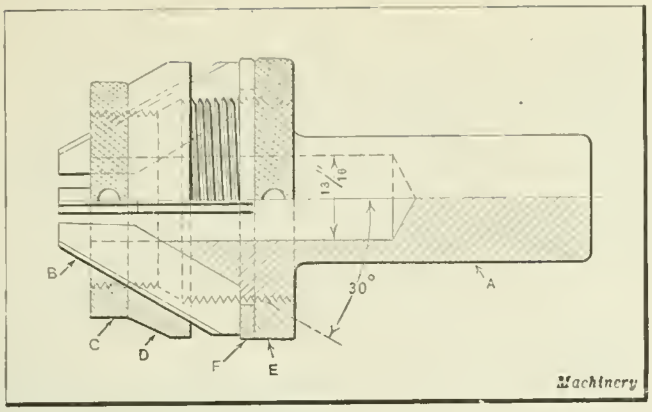


Fig. 1. Half-sectional View of Hollow-mill

shown, the hollow-mill can be used in a drill press. It is suitable for turning steel, brass, or gray iron parts.

The body *A* is made of soft steel. It has four ⅛-inch slots milled in the head end, which receive the blades, one of which is shown at *B*. The blades are made of high-speed steel, and are hardened and ground. They are rounded on one side where they bear against the collar *D*. Lock-nut *C*, when tightened against collar *D*, locks the blades *B* in position. The adjusting nut *E* which bears against washer *F* is employed in setting the blades for turning the work to the desired size. As all four blades rest on washer *F*, they are adjusted simultaneously. A spanner wrench is used to adjust the nuts *C* and *E*. The collar *D*, as well as nuts *C* and *E*, are made of soft steel, and are pack-hardened and ground. The washer *F* is also carefully hardened and ground.

A piece of screw machine stock, turned down to the exact size required, is used as a gage in setting the cutters. When nut *E* has been adjusted until all four blades are in contact with the piece of stock used as a gage, the spanner wrench is employed to tighten lock-nut *C*. The tool is then ready for a trial cut. The cutting edges of the blades are ground on a surface grinder by the use of the fixture shown in Fig. 2, which is held on a magnetic chuck.

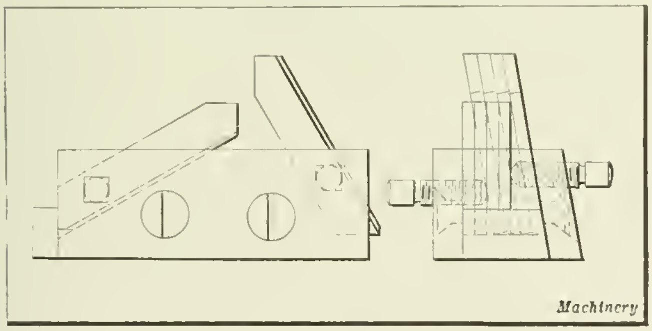


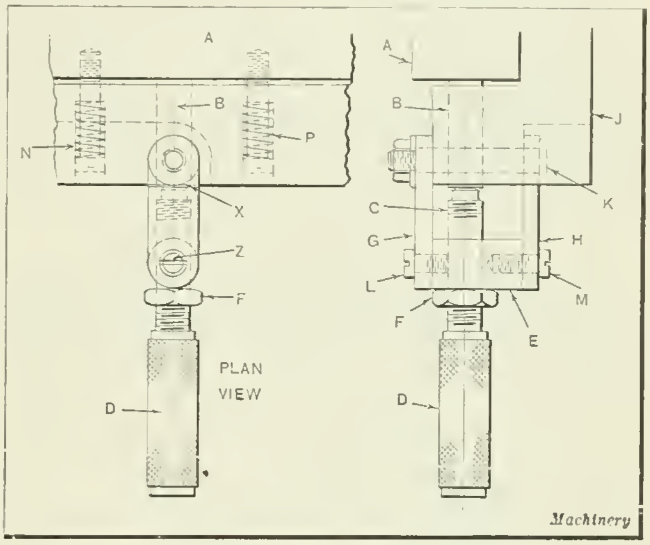
Fig. 2. Fixture used in sharpening Hollow-mill Blades on a Surface Grinder

Frankfort, Ind. Elsto Park

CLAMP FOR WORK-HOLDING FIXTURES

A powerful clamping device designed for use on work-holding fixtures is shown in the accompanying illustration. It can be operated with one hand and is particularly well adapted for use on drilling and milling fixtures, but may be used on almost any type of fixture. Referring to the illustration, *A* is a clamping block against which pin *B* operates when screw *C* is brought in contact with it by swinging handle *D* into the position shown. Screw *C* is mounted in a threaded block *E*. Nut *F* is tightened against block *E* in order to lock handle *D* securely in position after it is properly adjusted. Block *E* is supported by two links *G* and *H*, which, in turn, are held to the frame of the fixture *J* by means of a bolt *K*. It will be evident that the links *G* and *H* can be pivoted on stud *K*. The threaded block *E*, which is fastened to links *G* and *H* by screws *L* and *M*, is also free to pivot on these links.

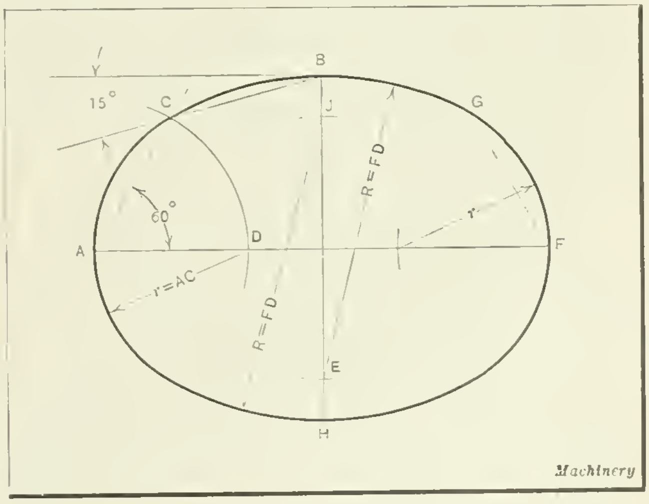
Assuming that the handle lies against the side of the fixture at approximately right angles to the position shown in the plan view, the required clamping action is obtained by pulling handle *D* over to the position shown. In doing this, the end of the screw at *X* is brought in contact with pin *B*, so that center *Z* serves as a fulcrum point. This wedges pin *B* tightly against block *A*, which, in turn, clamps the work in place. Two springs *N* and *P*, in combination with screws, serve to pull block *A* away from the work when handle *D* is moved to release pin *B*. It will be observed that the frame *J* is cut out to allow the link *H* to swing around. Two of these clamping devices may be conveniently placed on the fixture so that the operator can grip one clamping handle in each hand. F. Server



Clamping Device for Work-holding Fixtures

DRAWING AN ELLIPSE

When instruments designed for drawing accurate ellipses are not available, the draftsman usually resorts to the well-known "concentric circle" method. In many instances, however, only a close approximation of the true ellipse is required. Various short-cut methods have been devised for use in such cases, but the writer believes that the one here



Method of drawing an Ellipse

described is more accurate and quicker than the majority of those in general use.

Referring to the accompanying illustration, let it be required to draw an ellipse having a major axis equal to *AF* and a minor axis equal to *BH*. From point *A* on the major axis, draw a line upward at an angle of 60 degrees, as indicated, and from point *B* on the minor axis draw a line downward at an angle of 15 degrees which will intersect the line drawn from *A* at point *C*. Now with *A* as a center and distance *AC* as a radius, draw an arc which cuts the major axis at *D*. Using point *D* as a center and taking *r* equal to *AC* as a radius, draw the half end of the ellipse which extends from point *A* to *C*. Repeat this operation for end *F*, where point *G* corresponds to point *C*.

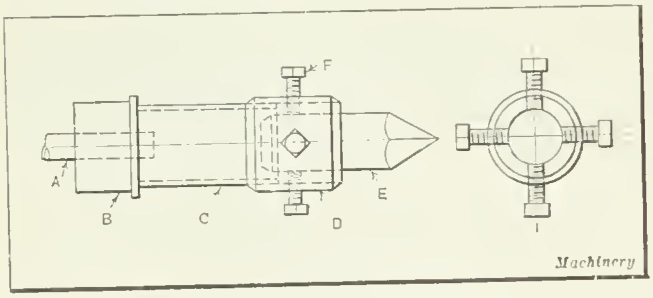
Next with *B* as a center, mark off distance $BE = FD$ on the minor axis. Now using *E* as a center and $R = FD$ as a radius, draw an arc which will connect points *G* and *C*. This completes the half side of the ellipse. The other side of the ellipse *AHF* is completed in the same manner. [For other methods of drawing an ellipse see page 258 of MACHINERY'S book "Mechanical Drawing"—EDITOR.]

Bridgeport, Conn. ARTHUR H. PONELEIT

GAS-HEATED SOLDERING IRON

The gas-heated soldering iron shown in the accompanying illustration has given excellent results in a large factory engaged in the manufacture of electric washing machines. A soldering iron of this type is economical as regards fuel consumption, because it serves as a pre-heater and soldering iron. It is well known that solder will not run freely unless applied to a heated surface. The necessary pre-heating can be readily done with a gas-heated soldering iron. The old method was to employ two soldering irons, one for pre-heating and the other for spreading or running the solder. This was rather inconvenient, however, as it necessitated frequent changing of irons.

With a gas-heated soldering iron of the type described, the necessity of changing soldering irons is eliminated; this not only means a saving of time, but also insures a uniformly soldered joint, as the joint, regardless of its length, can be soldered with one sweep of the iron. The expense involved in making a soldering iron of this type is very low, in comparison with the time and labor that it will save. The parts required to make up an outfit such as shown can be purchased at almost any hardware store.



Easily Constructed Gas-heated Soldering Iron

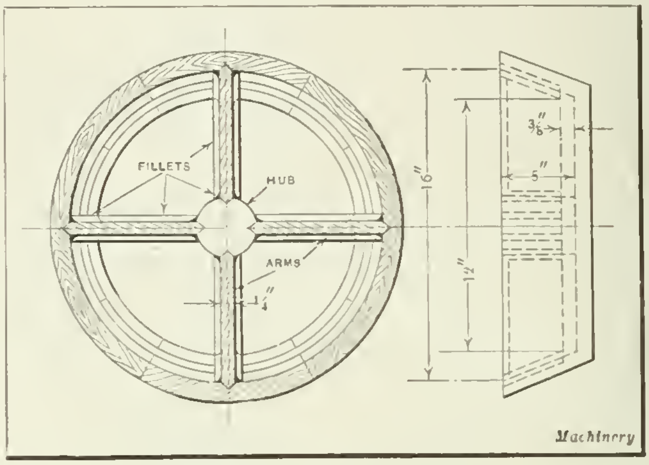
Part *A* is the end of a 3/8-inch gas blower or torch, which is provided with inlets for the gas and air pipes. Part *B* is a 1 1/4-inch iron pipe cap, part *C* a 1 1/4- by 3-inch iron pipe nipple, and part *D* a 1 1/4-inch pipe coupling. A piece of 1-inch round copper bar *E*, forged or machined to a point as shown, serves as the soldering iron. The shape of the point may be varied to meet requirements. Four 3/8- by 3/4-inch set screws *F* are required to hold the bar *E* in place. About 20 feet of rubber hose to fit the torch connections is required, 10 feet being used for the gas line and 10 feet for the air line. Before assembling the parts, a hole is drilled in the pipe cap *B* to fit the torch *A*. After this is done, parts *A* and *B* are brazed together. The next step is to drill and tap four holes in coupling *D* to receive the 3/8-inch set-screws *F*.

After the torch has been assembled and connections made to the gas and air lines, the outfit is ready for use. In setting up, the best results can be obtained by running or dropping the pipes from overhead gas and air lines and providing an ordinary hook on which to hang the outfit when it is not in use. This hook should be located high enough above the floor to clear the workman's head.

Cicero, Ill. JOHN J. BORKENHAGEN

IMPROVING CORE-BOX CONSTRUCTION

Recently the writer's attention was directed by the foreman coremaker to a mistake in the construction of a core-box. The foreman explained why it was necessary to make alterations in the core-box before a core could be made.



Core-box made with Loose Arms

He also explained the use of "white sand" in the production of the core. The core-box, as originally constructed, is shown in the accompanying illustration. The hub was fastened to the bottom of the core-box, and the four arms were located by means of slots cut in the hub and the rim, but were left loose in the pattern. Evidently the patternmaker believed that this construction would permit the arms to be withdrawn easily from the core one at a time. However, he overlooked the fact that in fastening 3/8-inch wooden fillets to the rim and hub ends of the arms, it became impossible to withdraw the arms from the tamped-in core. Before the core could be made, the eight fillets at the rim ends of the arms had to be removed. The use of fillets in such a manner that they prevent the withdrawal of loose pieces is a mistake often made by the apprentice patternmaker.

The rounding of the corners, for which the fillets were provided, was easily accomplished by the molder. It might be stated here that time is often wasted in putting in fillets on patterns and core-boxes, when only a few castings are needed, as the rounding of corners can be easily done by the molder. A better method of constructing the core-box would have been to make the hub and arms as one unit, and a loose fit in the box, so that the unit could be easily drawn from the molding sand.

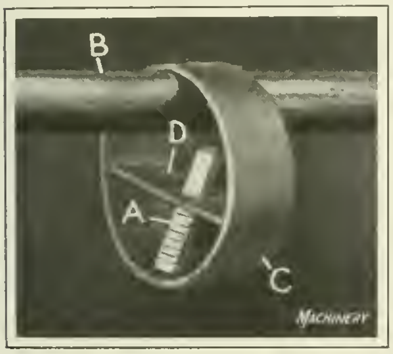
The core-box is so constructed that the sections of the core between the arms will be connected by a layer of molding sand, 3/4 inch thick. In order to prevent this thin section, as well as the sand forming the sides of the core slots from breaking or falling down when the core is rolled over on the core drying plate, the molder poured "white sand" (not molding sand) into the arm slots up to the top of the core. The "white sand" served to support the molding sand and was easily removed after the core had been properly baked.

Kenosha, Wis. M. E. DUGGAN

Shop and Drafting-room Kinks

BROACHING KINK

The little kink described in the following was employed to advantage in broaching small square holes in a lot of 7/8-inch shafts. The work consists of driving a short finishing broach *A* through the drilled hole in shaft *B* with a hammer. As the broach cuts for nearly its full length, it was necessary to use a punch when the top of the broach was flush with the work. The shafts were supported in V-blocks held in a vise.



Method of preventing Broach from falling

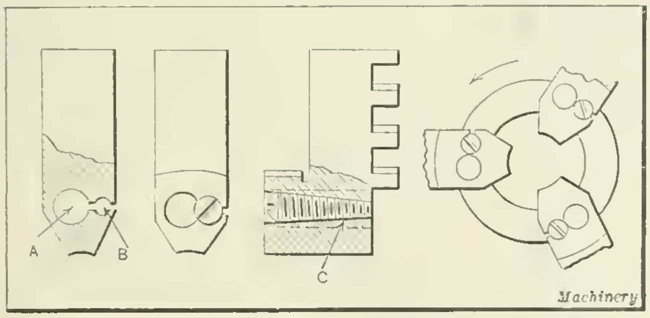
In order to prevent the broach from falling to the floor when driven through the work, a ring *C*, made from a short piece of tubing, and a piece of sheet metal *D* were arranged as shown. A hole was drilled in the ring *C* and the sheet-metal piece *D* so that when the broach was driven through the shaft it would fall into the hole in piece *D*, but would be prevented from falling to the floor by the lower part of the ring *C*. The sheet-metal piece *D* was secured to ring *C* by solder.

Rosemount, Montreal, Canada HARRY MOORE

ADJUSTING SCREWS FOR UNIVERSAL CHUCK JAWS

Trouble is sometimes experienced in making the jaws of a universal chuck center the work properly, due to wear of both the jaw and the scroll plate. Shimming with paper and thin steel is a very unsatisfactory method of eliminating the trouble. Paper shims are quickly cut through by the chuck jaws and steel shims of the right thickness are seldom available. The difficulty can be overcome, however, by the use of jaws equipped with tapered screws, as shown in the accompanying illustration. Arranged in this way, the jaws have a sufficient range of adjustment to permit the work to be properly trued up.

The process of equipping the jaws with adjusting screws consists of drilling two holes *A* and *B* in the front end of each jaw. Hole *A* provides the spring tension required to hold the adjusting screw in position, and hole *B* receives the tapered adjusting screw *C*. After the adjusting screw hole has been drilled and tapped, it is cut through as shown in the view at the extreme left-hand side of the illustration.



Jaws of Universal Chuck provided with Individual Adjustment

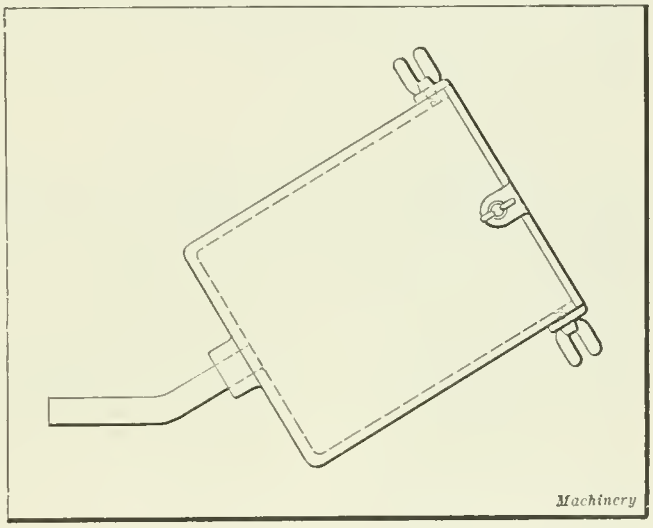
The adjusting screw should be taper-threaded on a lathe to the same taper as that of the tap. Care must be taken to have the adjusting screws located on the rear or driving sides of the jaws, as shown. After the jaws have been properly machined for the adjusting screws, they should be hardened. The adjustment required is only a few thousandths of an inch at the most, and this is readily obtainable by adjusting the screws in the three individual jaws.

Allentown, Pa. JOE V. ROMIG

TUMBLING BARREL FOR SMALL PARTS

In small jobbing shops, the use of a tumbling barrel would frequently effect a saving in the time required for polishing parts that are ordinarily buffed. However, in many cases, the number of such parts produced is not sufficiently great to warrant the purchase of a regular tumbling barrel.

A small tumbling barrel that has been used with success under such conditions is shown in the accompanying illustration. It consists of a cast-iron body with a removable sheet-steel lid secured by thumb-screws. This barrel is mounted on a short cold-rolled steel shaft which is bent at an angle of about 30 degrees with the axis of the body. In use, the end of the shaft is held in an ordinary lathe chuck. The parts to be tumbled are placed in the body together with the polishing material, which may consist of steel balls, sawdust, scraps of leather, emery, or some other polishing agent, and the lid is clamped in position by the wing-nuts. By running the lathe at a slow speed, the parts may be given a fine polish. P. R. H.



Tumbling Barrel for Small Parts

SETTING SPIRIT LEVEL GLASS

A simple method of setting a spirit level glass is to use a small piece of putty to support each end temporarily. The plastic putty can be made to hold the glass in the required position, it being an easy matter to depress either end so that it will be parallel or level with the working surface of the leveling bar. When properly leveled up in this way plaster-of-paris is poured around the supporting ends of the glass and allowed to set. The glass will then be held permanently in place.

Rochester, N. Y. J. H. BEEBEE

Questions and Answers

ROYALTIES PAID BY MANUFACTURERS OF PATENTED ARTICLES

H. E. W.—What is the customary royalty paid by manufacturers for the privilege of manufacturing and marketing patented mechanical devices?

A.—The royalty may be either a certain percentage of the selling price or a certain fixed amount for each article manufactured, but the amount varies in almost every case because of the endless variety of conditions that affect royalties. According to a prominent patent attorney, it is not feasible to give general figures, and a royalty which is too high in one case may be entirely too low in another. For instance, when the manufacturer must invest in new equipment, and when the cost of selling a product is likely to be high, it is apparent that the manufacturer should have a larger royalty than would be required if the risk assumed were less. Because of these variable factors, 5 per cent royalty might be fair to both patentee and manufacturer under given conditions, and too low under other conditions. In other words, it is not feasible to establish the royalty by considering what someone else has done, but rather to establish it on a business basis, considering the facts covering the particular case under consideration.

PROBLEM IN GAGE DESIGN

B. A. H.—In designing the gage shown in Fig. 1, a mathematical problem is involved in determining the distance x, which gives the location of the line of intersection of the spherical and conical surfaces. How can distance x be found?

ANSWERED BY WILLIAM W. JOHNSON, CLEVELAND, OHIO

With the values given in Fig. 1 substituted in Fig. 2 for a, b, r, and $E + D$, the distance x can be found as follows:

$$\text{Tan } E = \frac{a}{b} = \frac{1}{32} \div \frac{7}{32} = \frac{1}{7} = 0.14285$$

and

$$E = 8 \text{ degrees } 7 \text{ minutes } 48 \text{ seconds}$$

Then

$$\text{Angle } D = 30 \text{ degrees} - E = 21 \text{ deg. } 52 \text{ min. } 12 \text{ sec.}$$

$$c = \sqrt{a^2 + b^2} = \sqrt{(1/32)^2 + (7/32)^2} = \frac{5\sqrt{2}}{32}$$

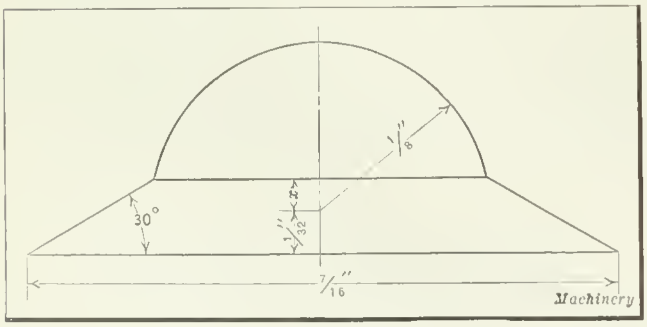


Fig. 1. Gage having Spherical Surface involving Mathematical Calculations

From the right triangle ACM, we find $AC = 2(a + x)$, since the side AC is twice the length of the side opposite the 30-degree angle.

In the oblique-angled triangle ACB, we have given two sides and the angle opposite the shorter side, to find the remaining side AC.

From trigonometry,

$$\text{Sin } X = \frac{c \sin D}{r} \text{ and } 2(a + x) = \frac{r \sin (X - D)}{\sin D}$$

Substituting the known values, we find

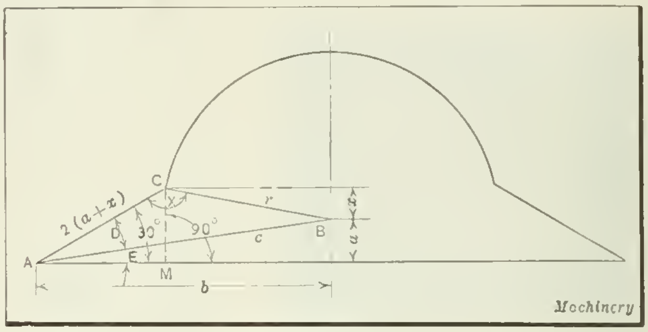


Fig. 2. Diagram used in the Solution of the Gage Problem

$$\text{Sin } X = \frac{5\sqrt{2} \sin 21 \text{ deg. } 52 \text{ min. } 12 \text{ sec.}}{4} = 0.65847$$

Then

$$X = 41 \text{ deg. } 11 \text{ min. } 7 \text{ sec. and } (X - D) = 19 \text{ deg. } 18 \text{ min. } 55 \text{ sec}$$

$$2(a + x) = \frac{\sin 19 \text{ deg. } 18 \text{ min. } 55 \text{ sec.}}{8 \times \sin 21 \text{ deg. } 52 \text{ min. } 12 \text{ sec.}} = 0.11099$$

and

$$x = \frac{0.11099 - 2a}{2} = 0.0555 - a$$

$$x = 0.0555 - 0.03125 = 0.0243 \text{ inch}$$

QUESTIONS RELATIVE TO TRADEMARKS

1. C. M. Corp.—What is the Government charge for filing an application for a trademark, and for what length of time is a trademark granted? Does a registration in the United States give any protection in foreign countries, or is it necessary to register the trademark in each country with which a concern does business and desires protection?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

The government fee on filing each application for a trademark is $10, and the term for which a trademark is registered is twenty years, unless it has been previously registered in a foreign country. In such a case, the term expires with the foreign registration, provided the latter has a shorter period than twenty years to run. A trademark may be extended indefinitely for periods of twenty years each, upon making proper application and paying a fee of $10 for each renewal.

Registration in the United States affords no protection in foreign countries, but under a convention adopted for the establishment of an International Bureau at Havana to carry into effect regulations for the protection of trademarks, the Commissioner of Patents communicates to this bureau the trademark sought to be protected. The fee is $5 to the United States Government and $50 to the International Bureau. As this protection is almost universal, it would seem advisable for those employing trademarks in their commerce with foreign countries to take advantage of it. There is an unscrupulous class ever on the lookout to pirate trademarks, and when trademarks have been registered even though wrongfully, the rightful owner loses all rights or can only regain them at considerable expense.

LAYING OUT A PATTERN FOR A FIVE-PIECE ELBOW

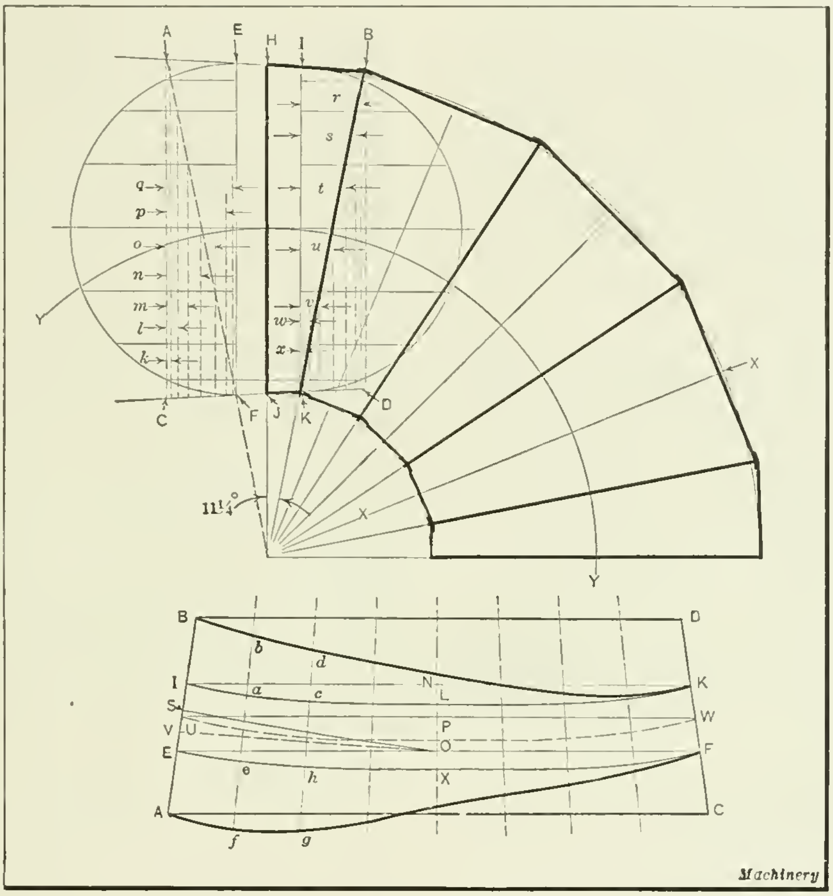
By F. WEBSTER

The procedure followed in laying out the pattern for a five-piece 90-degree sheet-metal elbow is described in the following: The diameter of the elbow is 54 inches and the metal used is ¼ inch thick. With this type of elbow it is necessary that the sections be tapered so as to form slip joints. This necessitates the crimping or forming of the ends of the sections so as to conform with the angle at the joints. It will be evident that an elbow of this kind should be laid out in eight segments of 11¼ degrees each.

The first step in making the lay-out is to draw an arc Y–Y to represent the center line of the elbow. The cross-section outlines at the ends of the elbow and at the middle of the three large sections, as taken on line X–X for instance, are true circles, while those at the joints are elliptical. The taper of the sections should be such that, when taken with the diameter of 54 inches at the middle, the outside diameter of the small end will be equal to the inside diameter of the large end.

In order to lay out the pattern for the sections, it is necessary to use a number of construction lines. The construction lines are applied to the portion of a cone that is formed by the outlines of one of the sections, as shown in the accompanying illustration. The line *HJ* represents the diameter at the circular end of the elbow, and the line *IK* represents the diameter as measured at point *K* at the inside or small end of the joint. The line *EF* is a construction line drawn parallel to line *IK* from point *F*, and represents the diameter at the large end of the tapered section *EIKF*. The first step consists of developing the pattern for this section. The extensions that form the sections represented by *AEF* and *BIK* are then developed as additions to the pattern for the section *EIKF*.

In laying out the pattern for the latter section, first draw the line *IK* on the pattern plate, as shown in the lower view, making this line equal in length to one-half the circumference of the outside of the section at the small end. As the sides of this section are symmetrical, it is only necessary to lay out the pattern for one-half of the section. The length of the line *IK*, as shown in the lower view, is equal to (54 × 3.1416) ÷ 2, and the length of the line *EF* is equal to (54½ × 3.1416) ÷ 2. These equations give the semicircumference at the small and large ends, respectively, of the section *IKFE*. The distance *NO* between the lines *IK* and *EF* is made equal to the distance between the lines of the section. The end lines *IE* and *KF* are next drawn in, after which the camber lines are developed.



Development of a Pattern for a Five-piece Elbow

In order to determine the amount of camber on the pattern for the conical surface, which has a very slight taper, a line *OS* is drawn perpendicular to the line *AB* from center *O*. The angle *SOE* is then bisected by line *OV*. The dimension *VE* represents the camber which is to be laid off on the center line, as indicated by *OX*. A curve is then drawn through the points *E*, *X*, and *F*, thus forming the edge of the pattern, which corresponds to a section on line *EF* of the upper view.

The lines *IK* and *EF* of the lower view are next divided into eight equal parts, as shown by the dotted radial lines. Points are then located on each of these radial lines at a distance from curve *EXF* equal to the dimension *IE*. Through these points is drawn the upper camber curve *ILK*. The resulting pattern *ILKFXE* is that required for the part of the elbow represented by the section *IKFE* in the upper view. In addition to this pattern, it is necessary to add the extensions represented by the triangles *AEF* and *BIK*, as shown in the upper view.

The next step in the construction is to draw semicircles on each end (*IK* and *EF*) of the taper section *IKFE*, in the upper view, as shown, and divide each of these semicircles into eight parts. Then draw horizontal lines through these eight division points at right angles to the vertical center line of the semicircles. Where these division lines cross lines representing the joints *BK* and *AF*, draw lines to meet the lines *CF* and *KD*. Finally, lay off on the pattern in the lower view, the extension *IBDK*, and the extension *EACF*. Next make distance *ab* equal to distance *r*, distance *cd* equal to *s*, etc. Likewise, make *ef* equal to *q*, *gh* equal to *p*, etc. Then draw the curves *BK* and *AF* in the pattern lay-out. The pattern for a complete half section is represented by the lay-out *ABKF* in the lower view. The pattern for an end section is represented by the part of the full section pattern enclosed by the lines *AUWF*. The amount required for lap at the joints must, of course, be added to the pattern lay-out thus obtained.

The pattern curves are usually shown to a very small scale in printed illustrations. Hence, they are considerably distorted from their true form at the working size.

* * *

Complete electrification of the Swiss Federal State Railways has been decided upon by the Swiss Government. Present plans call for the completion of this electrification by 1928. The cost will involve an expenditure of from 75,000,000 to 80,000,000 francs annually until the electrification is completed. Switzerland, being only about the size of Massachusetts, the total length of the railroads involved is but 1000 miles.

The Machine-building Industries

THERE has been no important change in conditions in the machine tool industry during the past month. As a whole, the industry is booking orders averaging from 40 to 50 per cent of capacity. Some of the larger and best known plants building standard lines of machine tools operate at about 60 per cent capacity, and a few of the plants engaged in building special types are having all the business they can handle. In a few instances plant operation is limited not by lack of prospective business but by a scarcity of skilled labor.

Radial drilling machines and planers have been in greater demand of late than most other types of standard tools, although lathes also find a steady market. Several price advances have been made, and as long as buyers expect as much free engineering service as they do at present, coupled with higher labor and material costs, further price advances may be expected. One prominent machine tool builder states that with the amount of free engineering service demanded by some of the machine tool buyers—service that should be paid for as a separate and distinct item—prices of machine tools must continue to advance. This service, he finds, is a more important item in increasing costs than either increased material or labor charges. Among more recent price advances is a line of open-side planers which has been increased 10 per cent; a line of grinding machines in which price increases vary from 10 to 40 per cent, according to size and type of machine; and a well-known make of milling machines that has advanced 10 per cent.

The demand for heavy power presses is good, and one of the leading makers states that his output is limited only by the available supply of labor. The pressed-steel shops in the Detroit and Toledo districts are fully occupied, one plant in which 60 per cent of the output is for automobile purposes and 40 per cent for general industrial purposes, employing a night force to take care of the constantly increasing volume of business.

In the gear-cutting shops, 100 per cent activity is in evidence wherever automobile gears are produced. Jobbing shops in the Philadelphia, Pittsburg, and Cleveland districts are operating at about 75 to 100 per cent of capacity, gears being in demand for practically all industrial fields, steel mills, mines, paper mills, electric railway cars, and grain elevators. The demand for tractor gears, for which some of the gear-cutting shops are well equipped, is still very small.

The Small Tool Industry

The volume of sales in the small tool field is increasing at a steady pace and may be considered close to what may now be called "normal." The moderate price increases in small tools merely bring the price levels for products in this field more nearly up to par with prices for other commodities.

The demand for cutters, reamers and gear hobs keeps many of the plants in these fields fully occupied. The market for broaches is fair, with an increasing demand for broaching machines. Several hacksaw manufacturers state that their plants are fully occupied. There has been a slight increase in hacksaw prices, but they are still low compared with other metal products. Production methods in the manufacture of hacksaws have, however, been considerably improved in many instances, enabling manufacturers to sell at a price that is not far above the pre-war level. The demand for hacksaw machinery and power cutting-off machines is stated by various makers to vary from 50 to 100 per cent of normal. The volume of business in pneumatic tools is greater than before the war, but as the facilities for manufacturing these tools were enormously increased during the war, manufacturers in this field are still far from capacity output.

The Iron and Steel Industry

Production in the iron and steel field has now reached over 93 per cent of the theoretical capacity, but as a matter of fact, this is about as high a rate of output as the industry has ever been able to attain. The present output is limited only by the labor supply, and conditions in the steel market are now much the same as in 1920 just before the unprecedented rise in prices took place. The accumulated orders mount higher week by week, as shipments fall behind demand. Decided price advances have been made in spite of the fact that costs are reduced by the present activity in production. It is believed that those who control prices in the iron and steel field will not permit basic prices to go any higher, lest there should be a recurrence of the experience in 1920; but premiums for immediate delivery are beginning to be more common, and the scarcity of steel is felt in some localities. The rise in prices, instead of discouraging buyers, has brought them into the market.

Eighteen additional blast furnaces were being blown in during March, tube and rail mills are fully occupied, and the exports of iron and steel products is beginning to increase. March broke all pig iron production records with an output of over 3,521,000 tons, passing the peak production reached during the war—in October, 1916. On April 1, altogether 293 blast furnaces were in action, producing nearly 3000 tons of pig iron a day in excess of the highest average peak production during the war. The great activity in the iron and steel field is also indicated by the demand for electric furnaces in both steel mills and foundries, and for heat-treating purposes.

The Automobile Industry

The production of automobiles is increasing. While complete figures are not yet available for the month of March, figures for February show that in spite of the shorter month the total number of cars produced was the largest in the history of the automobile industry with the exception of June, 1922. The number of cars produced per working day was greater than ever before, aggregating over 11,000. From March 1, 1922, until February 28, 1923, 2,600,000 passenger cars were produced, representing an average of 217,000 per month, or 40 per cent above the 1920 monthly average, which was the high peak up to that time. The output of the trucks averaged 21,000 per month. The total February production was 271,000 cars, the production of Ford cars being nearly one-half of this, or 130,000 cars.

The higher priced cars are now in greater demand than they were last year. The Pierce-Arrow Motor Car Co. announces that the sales this year have been over 225 per cent greater than for the corresponding period a year ago. If the present demand is maintained, the sales of this company's cars will exceed that of any previous year.

Some of the automobile manufacturers are hampered in their output by the steel shortage, and may have to curtail production because of the longer deliveries now prevailing. On the whole, the industry is more conservative than in 1920, and materials, tools, and equipment are ordered only as they are definitely needed to take care of present production, while in 1920 orders were placed in anticipation of future production that never materialized.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Cincinnati Simplified Gear-hobbing Machine. Cincinnati Gear Cutting Machine Co., Elam St. and Garrard Ave., Cincinnati, Ohio ... 733
Gardner Automatic Double-disk Grinding Machine. Gardner Machine Co., 414 E. Gardner St., Beloit, Wis ... 735
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American Vertical Broaching Press. American Broach & Machine Co., Ann Arbor, Mich ... 738
Hanna 150-Ton Pneumatic Riveter. Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill ... 739
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Harris Full-automatic Hob Grinding Machine. Harris Engineering Co., Bridgeport, Conn ... 745
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Hand-feed Levers on Bullard "Maxi-Mill." Bullard Machine Tool Co., Bridgeport, Conn. ... 746

Cincinnati Simplified Gear-Hobbing Machine

CONTINUOUS production of high-class gears, without the necessity of repeated and inconvenient adjustments, is the chief claim made for a recently developed gear-hobbing machine, which, when supplied to a customer, is arranged for cutting gears of only one pitch and one number of teeth. However, provision is made for easily adapting the machine to cutting gears of any other pitch and number of teeth within its range. This machine is known as the "Cincinnati simplified gear-hobber," and is built by the Cincinnati Gear Cutting Machine Co., Elam St. and Garrard Ave., Cincinnati, Ohio. The chief improvement in construction made by designing the machine for the quantity manufacture of gears of one pitch and one number of teeth, is in the simplicity of the indexing mechanism. The reduced number of parts in this mechanism lessens lost motion and wear, and increases the rigidity of the machine, which, in turn, increases its accuracy.

This machine is designed with a view to maintaining unusual accuracy in quantity production, and may be applied both to producing finished gears or gears that must be ground later. To produce an accurate gear by grinding, it is highly desirable that the blank be cut as nearly perfect as possible in order that the stock to be removed by grinding will be reduced to the minimum. Tests have shown all measurable mechanical errors in the tooth space and form to be eliminated in the finished product, this accuracy being attributed to the simple indexing mechanism and the rigidity of the machine. Subsequent grinding is said to be necessary only for correcting inaccuracies resulting from hardening. The machine has a capacity for cutting steel

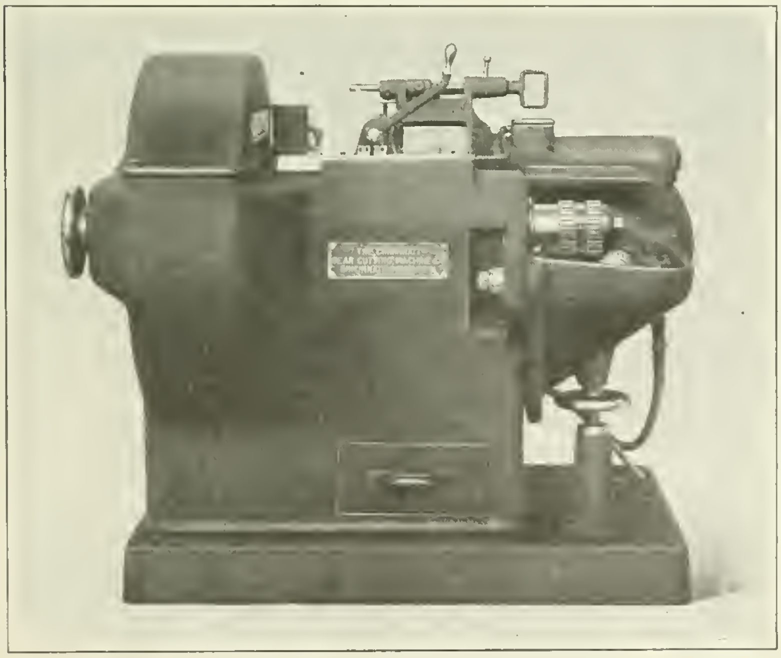

Fig. 1. Cincinnati Simplified Gear-hobbing Machine

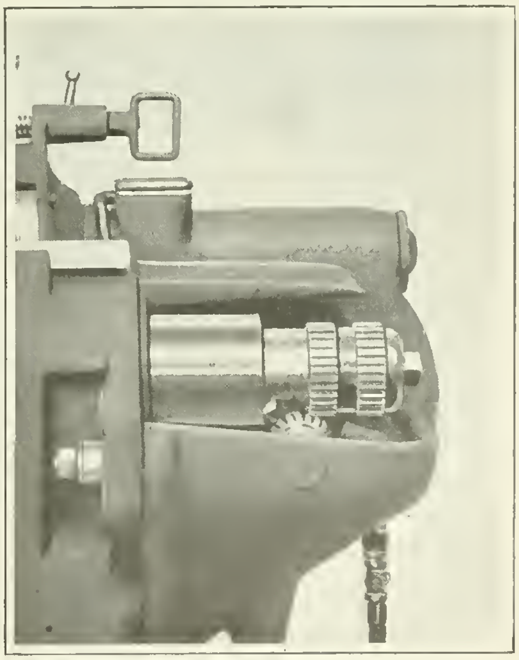

Fig. 2. Positions of Hob and Work at End of Operation

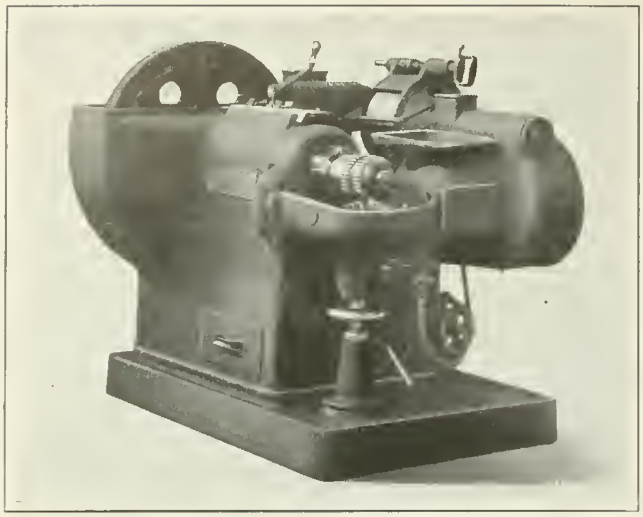

Fig. 3. View of Machine from Right-hand End, showing the Hob-spindle Housing and Micrometer Jack

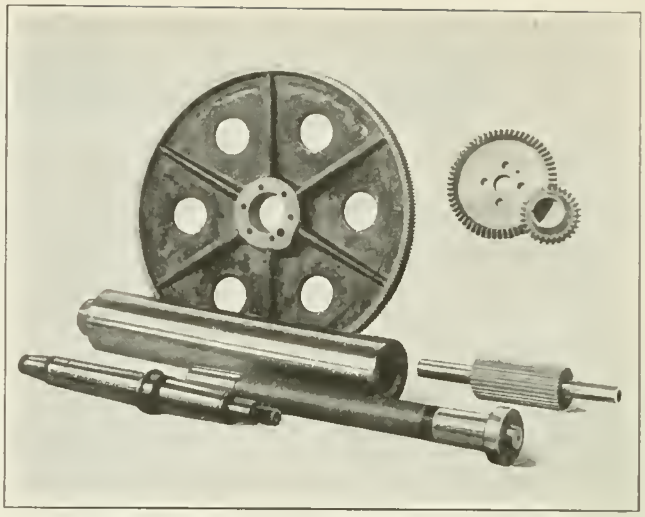

Fig. 4. Seven Parts, including the Hob- and Work-spindles, which constitute the Entire Indexing Train

gears up to 7 inches in diameter, 4½ inches face width, and 4 diametral pitch.

The Hob-spindle and Housing

The front view of this gear-hobbing machine, illustrated in Fig. 1, shows the relative positions of the hob- and work-spindles when the work-spindle is in the loading position, while Fig. 2 shows the position of the work-spindle at the completion of the operation. Referring to the sectional view, Fig. 5, it will be seen that the hob-spindle *C* is driven by flywheel *A*, the teeth *B* of the flywheel engaging an eight-thread worm on the driving shaft. The flywheel is mounted directly on the hob-spindle, so that the momentum and balancing effect resulting from its weight of 300 pounds is carried directly to the hob. The hob-spindle is hardened and ground, and is provided with two opposed taper bearings, which are adjustable. There is a thrust collar *D* between the two bearings to insure that an adjustment of one bearing will not affect that of the other.

The hob-spindle housing is bored from the solid to suit the angle of the hob. The hob is set for the proper depth of cut and adjusted to suit the diameter of the gears through a radial movement imparted to the hob-spindle housing by the micrometer jack located below the chip pan, as seen in Fig. 3. This radial movement of the housing centers about driving shaft *J* of the indexing mechanism. Clamping bolts prevent a change in the position of the spindle housing after a setting has been made. The machine is furnished with a hob-spindle housing bored to the proper angle for cutting gears of any one pitch, but the housings are made interchangeable so that a machine equipped for cutting gears of one pitch can be quickly converted by the user to adapt it for cutting gears of any other pitch desired. No provision is made in the machine itself for changing the speed of the hob, and so the desired speed must be obtained through the ratio of the driving pulleys on the machine and the lineshaft. While any diameter or bore of hob can be used in the machine, a 4-inch diameter hob with a narrow face and a

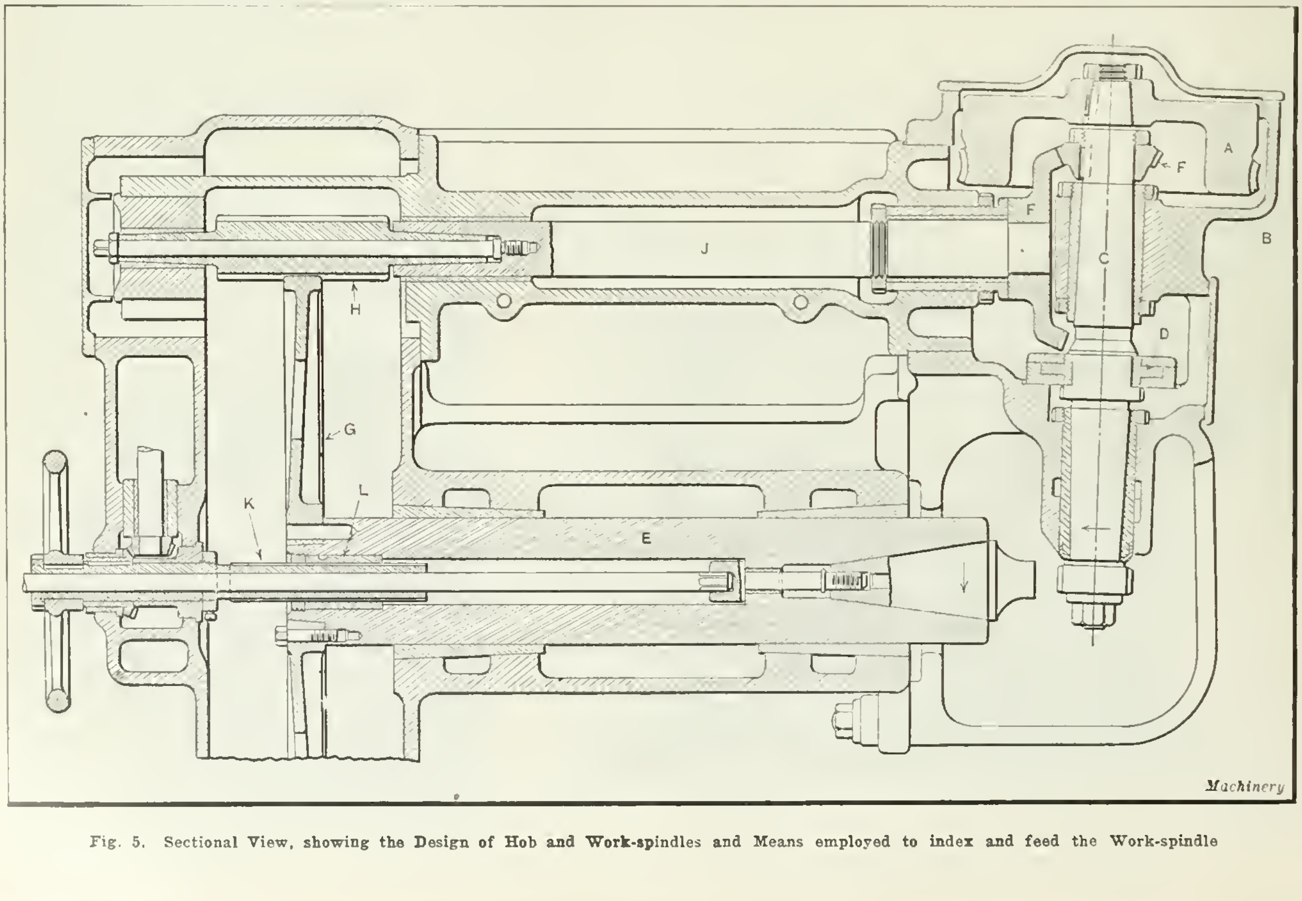

Fig. 5. Sectional View, showing the Design of Hob and Work-spindles and Means employed to index and feed the Work-spindle

2-inch bore is recommended. Such a sized hob has resulted in more accurate gears than smaller hobs. The large diameter directly reduces the depth of the feed marks.

Work-spindle and Indexing Mechanism

Work-spindle *E*, Fig. 5, is 6¾ inches in diameter, hardened, ground, and lapped. Like the hob-spindle, it is mounted in adjustable bronze bearings, but these are tapered on the outside. The size of the work-spindle and the design of its bearings (as is also the case with the hob-spindle) eliminates the necessity of outer supports. Attention has already been called to the simplicity of the machine, as emphasized in the indexing mechanism; the entire train consists only of the seven parts illustrated in Fig. 4, which include both the hob- and work-spindles. The proper relative rotation of the hob- and work-spindles is obtained through only four gears and the index driving shaft.

Referring again to Fig. 5, it will be seen that power for the indexing mechanism is transmitted from the hob-spindle through bevel gears *F*, and delivered through shaft *J* to the wide-faced pinion *H*. This pinion drives the index master gear *G*, which is mounted directly on the left-hand end of the work-spindle. The spur gears are accurately cut, and any error that might in time be produced by wear, becomes insignificant when transmitted to the work because of the comparative sizes of the master gear and the work, the former being approximately 34 inches in diameter. The machine can be adapted for cutting gears of different numbers of teeth by changing master gear *G* and pinion *H*.

The work is fed past the hob by lead-screw *K* running in nut *L*, the latter being mounted inside the work-spindle. Thus the rotation of the work-spindle in indexing also results in its being advanced according to the lead of screw *K*. Different feeds may be obtained by changing the lead-screw and nut. The work-spindle is returned to the starting position by revolving the lead-screw. Another unusual feature for machines of this class is the provision of intermittent feeds, by means of which the work is advanced rapidly to the hob, then fed at the proper rate until the teeth have been cut and finally stopped automatically at the end of the operation. After the work has been removed, the machine is tripped by the operator to throw into motion a quick return of the spindle to the loading position.

The compact and simple design of the machine, the heavily proportioned members, and the ample bearing surfaces are said to insure gears in which a constant tooth form and spacing is maintained around the periphery of any one gear and of all gears cut by the same hob. Increased production is claimed because of the elimination of shut-downs for making adjustments, repairs, or frequent changes of hobs, the use of increased feeds, the quick reloading facilities made possible because of the absence of outer supports for the hob- and work-spindles, the automatic quick traverse, and the reduction of rejections in the inspection department. Automatic oiling is provided for all parts of the machine.

GARDNER AUTOMATIC DOUBLE-DISK GRINDING MACHINE

The rapid grinding of parts having two opposite parallel sides of approximately equal area, such as piston-rings, ball- and roller-bearing races, gear blanks, solid dies, and adding machine parts, can be accomplished on the No. 2 automatic double-disk grinding machine now being built by the Gardner Machine Co., 414 E. Gardner St., Beloit, Wis. This machine is fully automatic when equipped with a continuous feeding magazine, but it may also be fed by hand, in which case its operation is semi-automatic. The most unique feature is that the grinding heads are mounted on offset spindles, so that the grinding operation is performed by the back face of one wheel and the front of the other. This arrangement of the heads permits quick and accurate dressing of the grinding disks, without altering the set-up, and on piston-rings, thrust collars, and other circular work the arrangement causes the piece to revolve rapidly during the grinding, which results in a high degree of accuracy in the finished part.

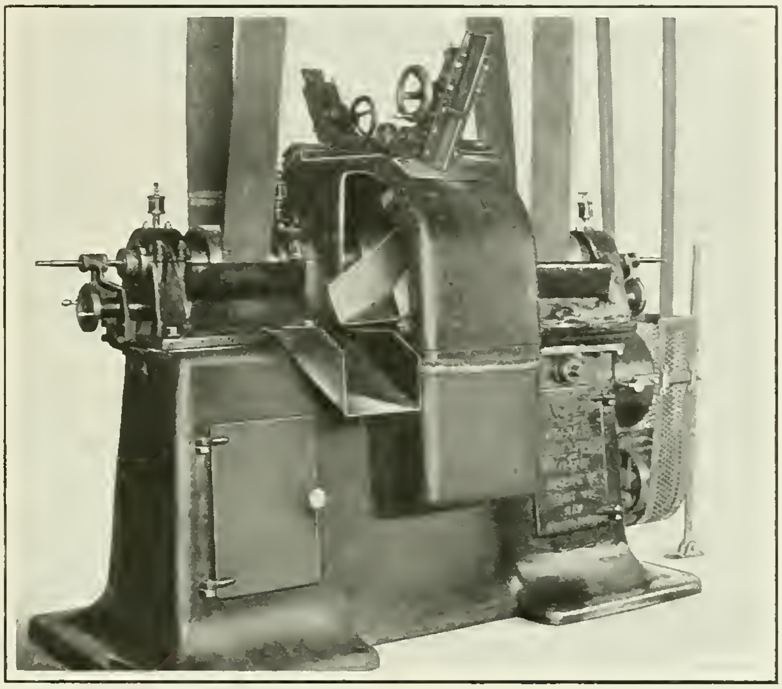

Fig. 1. Gardner Automatic Double-disk Grinding Machine for Parts having Two Parallel Sides of about Equal Area

The grinding members, when the work is to be ground dry, consist regularly of 18-inch diameter steel disk wheels, faced with heavy-type abrasive disks. However, when the work requires a coolant, 18-inch diameter ring-wheels are furnished, which are carried in chucks designed especially for this type of machine. The parts to be ground are conveyed to the grinding position by a carrier which passes between the grinding disks. In order to accommodate a considerable variety of work, including pieces having a large surface on which much stock is to be removed, as well as pieces with a small area over which only a light cut is necessary, this carrier is provided with a range of feeds varying from fifteen to sixty pieces per minute. The rate of feed may be further reduced to from four to fifteen pieces per minute by changing a pulley on the countershaft.

From six to twelve openings are cut in the carrier as shown in Fig. 2, to receive the work. These openings may be made to conform to the shape of practically any piece for which the machine is adapted, and by means of inserts one carrier can often be used for several sizes of similar parts. Special carriers can be made for operations in which the machine attendant loads and unloads the work. As the work approaches the grinding position, the right-hand disk automatically advances until it reaches a positive stop. This disk is applied to the work under an adjustable spring pressure governed by a cam, and consequently it advances only as rapidly as the stock is removed, giving a constant pressure against the work. The disk is returned to the open position by the action of the same cam, while the work is automatically unloaded as it passes out from the wheels.

Construction of the Grinding Head

The spindles are made of heat-treated alloy steel and are equipped with bronze bearings of special design. The bearings are tapered on the outside and are fitted into correspondingly tapered cast-iron sleeves having means for drawing the bearings into the sleeves to compensate for wear. End thrust on the spindles is carried by hardened and ground steel collars, which bear directly on the spindle bearings, adjustment for thrust being provided by means of a nut and lock-nut on the spindle at the opposite end of the bearing. All bearings are adequately protected from dirt or dust, and they are thoroughly lubricated.

The grinding heads are heavy, rigid, one-piece castings, weighing about 275 pounds each. They are mounted on sub-bases, on which they are adjustable by means of a hand-wheel-operated micrometer screw graduated to 0.001 inch. This adjustment permits quick, accurate setting of the grinding disk or ring-wheels to compensate for wear. The sub-bases are also adjustable along the main base of the machine, for convenience in setting up a job requiring greater distance between the grinding disks than is obtainable through the screw adjustment. In its lateral movement the right-hand head slides on ways which are planed and scraped, amply lubricated, and guarded against dirt.

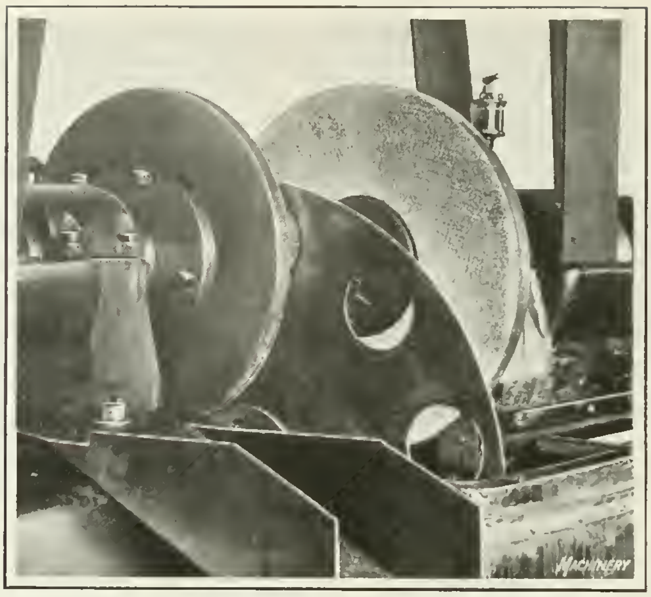
Fig. 2. View showing the Offset Relation of the Grinding Wheels and also the Work-carrier

Design of the Grinding Disks

A backing plate fills the center hole of each grinding wheel so that it is impossible for work to fall into this opening. The plate is part of a hollow shaft which extends the entire length of the spindle, and it is so arranged that no adjustment is necessary after the first set-up. In other words, the adjustment of the backing plate is entirely separate from the adjustment for wear of the grinding wheel. The hollow shaft carries coolant to the disks when wet grinding is being done. The flanges, on which the grinding wheels are mounted, are of large diameter so as to provide a support well out toward the periphery of the wheel.

A cast-iron hood guards the grinding disks, and when the machine is equipped with standard shields and attached to an exhaust system, all dust produced in grinding is removed. Naturally, to produce flat work of uniform thickness, the alignment of the spindles must be carefully maintained, and therefore an adjustment is provided to permit aligning the spindles in the event of wear of their bearings or other surfaces.

The Dressing Device

In grinding machines, an efficient truing device is one of the essentials in the production of accurate work. In this machine, two truing devices form an integral part of it. As shown in Fig. 3, these dressers are mounted on rigid slides, carried by the cast-iron hood previously referred to. Lateral adjustment to compensate for wear of the grinding wheels is obtained by means of a screw. In truing the wheels, the dressers are traversed on the vertical slide by rotating a handwheel, the drive being transmitted to the dresser through a rack and pinion.

When the machine is equipped for wet grinding, a tube for carrying the coolant to the work passes through each hollow spindle. This tube is connected at the outer end with a pump, and the inner end terminates in the backing plate of the grinding disk. Each tube has a number of holes at a point just behind the backing plate through which the coolant is ejected, thus being delivered to the center of the grinding disk and insuring flushing of the entire wheel face, as well as flooding of the work.

Automatic Feeding Device

Automatic feeding of such work as piston-rings thrust washers and ball races into the work-carrier is accomplished by means of the device illustrated in Fig. 4. This mechanism presents the work to the carrier one piece at a time,

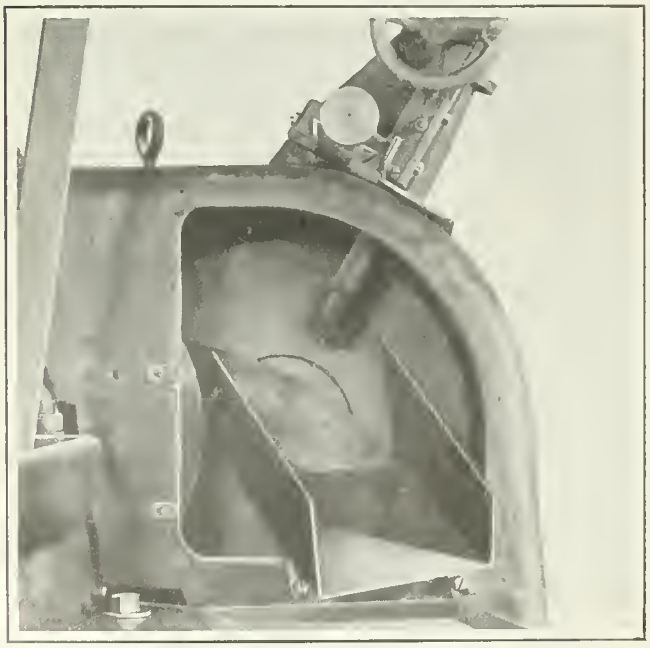
Fig. 3. Close-up View of One of the Devices provided for truing the Grinding Disks

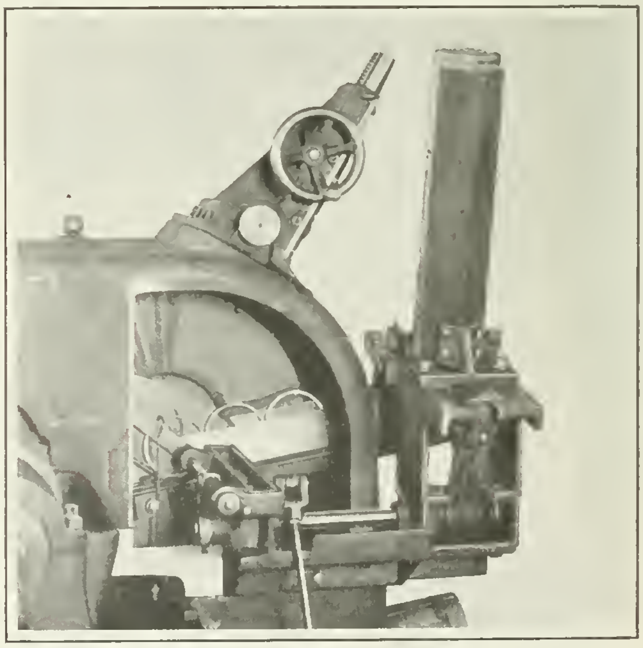
Fig. 4. Automatic Feeding Device for conveying Work from a Magazine to the Revolving Work-carrier

and because of the pieces being delivered by a mechanical means, the last piece in the magazine is fed just as efficiently as if the hopper were full. Larger work than mentioned, or irregularly shaped pieces, are preferably fed by hand or by means of a trough arrangement, with which the machine may be readily provided.

Some of the principal specifications of this machine are as follows: Maximum distance between disk wheels, 12 inches; maximum distance between new ring-wheels, 6 inches; diameter of hole in abrasive disks and ring wheels, 7 inches; height of spindles from floor, 40 inches; spindle speeds, 1400 revolutions per minute; countershaft speed, 560 revolutions per minute; power required for maximum duty, 15 horsepower; floor space required, 4 by 8 feet, and weight for domestic shipment, 4250 pounds. This machine is furnished for belt drive only.

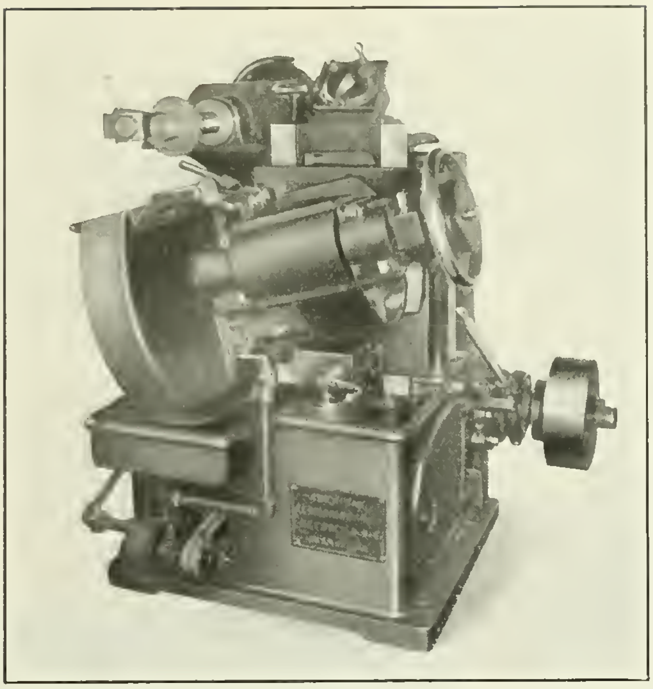
Fig. 1. Machine for grinding the Teeth of Spur Gears to obtain Accurate Tooth Form and Spacing, and Concentricity of the Pitch Circle

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AMERICAN SPUR GEAR GRINDING MACHINE

For grinding the teeth of spur gears to obtain accurate tooth contour, tooth spacing, and concentricity of the pitch circle with the bore, so that the gears will be quiet, smooth-running and durable, the American Gear Grinder Co., 6534 Benson St., Detroit, Mich., has brought out a grinding machine having a number of interesting features. The special field of application of this machine is the production of hardened steel gears for automobile transmissions. Close working limits for the tooth form and tooth spacing may be eliminated in cutting the soft gear, thus doing away with fine finishing cuts, burnishing, etc. It is said that in many cases the total grinding time is less than the time required for the finish-cutting operation.

The action of the carriage relative to the grinding wheel generates a true involute curve on the gear teeth; however, this curve may be varied so that any desired tooth contour and dimensions within reasonable limits can be obtained. The machine is adapted for grinding the teeth of spur gears with pressure angles up to 25 degrees, of any diametral pitch from 12 to 3, of any pitch diameter from 1½ to 8 inches, and up to 1½ inches face width.

Construction of the Machine

The relation of the grinding wheel to the work-carrying mechanism may be clearly seen in Fig. 2, the guards having been removed in this view. The work-arbor seats in a large taper hole in a spindle mounted in a sliding carriage, the latter being actuated by means of a drum cam in the bed of the machine. On the opposite end of the work-spindle from that on which the work is mounted, there is a cylinder of approximately the same diameter as the pitch diameter of the gear to be ground. From Fig. 3 it will be seen that wound around this cylinder are two pairs of thin steel tapes, which are anchored both to the cylinder and to a rigid bracket. Thus as the work-carriage slides back and forth, the work-spindle is oscillated by the tapes winding and unwinding on the cylinder, the action being the same as that of rolling a perfect gear in a perfect rack. By this arrangement the gear tooth is rolled against the face of the grinding wheel. The bracket to which the tapes are anchored can be adjusted for height to accommodate various sizes of gears, and there is an adjustment to compensate for the corresponding difference in tape length.

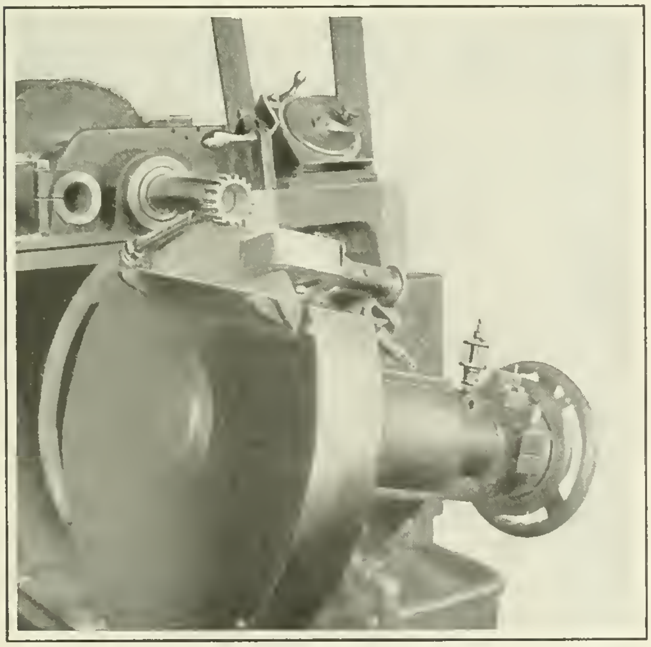


Fig. 2. Close-up View, showing the Method of rolling the Gear Teeth over the Grinding Wheel

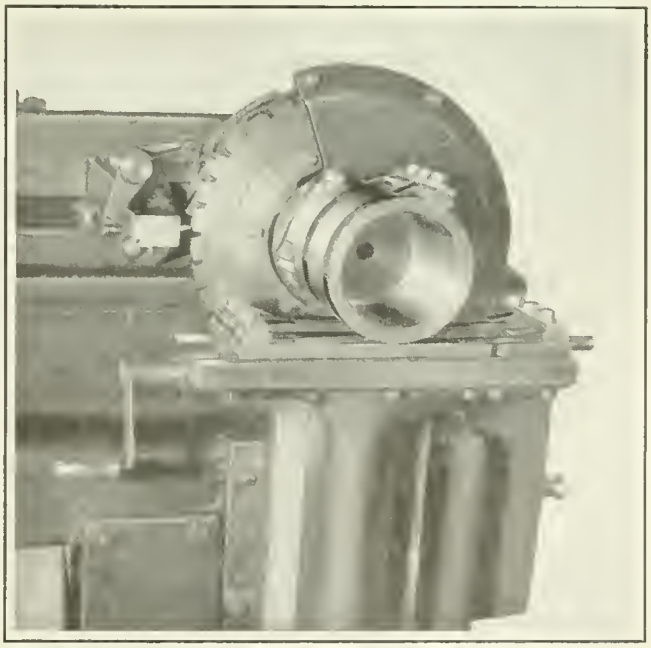


Fig. 3. Mechanism for indexing the Gear and imparting an Oscillating Movement to the Work-spindle

All control levers are within easy reach of the operator, and the heavy and high-speed units are mounted low, while the work-arbor and its slow-moving carriage is located above the grinding wheel. Other features include an automatic stop for the work-carriage; a reversible wheel-head which can be set either side of the center to the desired grinding angle for grinding both sides of a tooth; a centrifugal water pump, and a removable tank. The machine is self-contained, and so can be driven by belt directly from a line or countershaft or from a motor which may be located in the base. All parts are sturdily constructed with a view to eliminating vibration and producing practically perfect gears.

Carriage Drive and Automatic Stop

Only four gears are used in the entire machine; these are contained in the carriage cam drive, two of them being speed-change gears. The drum cam provides a positive reversal of the carriage and a ready means of cutting down the grinding time per tooth. The latter is accomplished by moving the carriage rapidly during the indexing and at a moderate speed when a gear tooth is in mesh with the grinding wheel. Change-gears provide for grinding one side of a gear tooth at the rate of four, five or six seconds, and means are incorporated within the bed of the machine to change the length of the carriage travel and its position. The carriage is controlled by an automatic stop mechanism on top of the wheel column, as shown in Figs. 1 and 2, which may be set to grind from one to sixty teeth. After the last tooth has been ground, the carriage is stopped with the gear free from the grinding wheel and in the proper reloading position. There is a device for locating the work in the proper relation to the grinding wheel.

Indexing Mechanism and Grinding Wheel Mounting

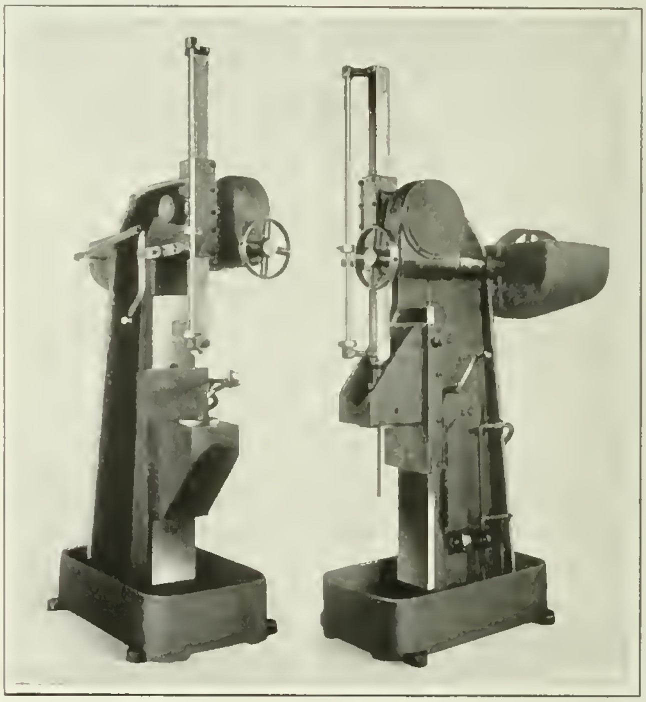
Proper spacing of the gear teeth being ground is obtained by utilizing the natural roll of the work-spindle for indexing the slotted disk, seen in Fig. 3, which controls the spacing. After the gear has been rolled to the right, out of the grinding wheel, a cam lifts the index-finger out of the index-plate slot that it happens to occupy. Simultaneously, a secondary plunger enters the same slot and holds the disk until the index-finger travels on the periphery of the disk to the next slot, drops into it, and again starts rotating the disk, at which time the secondary plunger is released. Less than one second is required to index a gear one tooth with this mechanism, and during the production grinding of 32-tooth gears of 6–8 pitch, the total accumulated error over eight teeth is said to have been only 0.0005 inch, while with stem gears of 16 teeth, 6–8 pitch, the total accumulated error over four teeth was but 0.0003 inch. The entire mechanism runs in a bath of oil, the oil pan and cover having been removed when the photographs were taken.

The grinding wheel is mounted on a 3-inch alloy steel spindle which is hardened, ground, and lapped, and which rotates in bearings made of Lumen bronze. These bearings are tapered on the outside to provide adjustment for wear. Horizontal adjustment of the wheel is obtained by rotating a handwheel graduated in thousandths of an inch, which is located at the right of the wheel-head, as shown in Fig. 1. A positive wheel-stop and a worm-driven wheel-truing device are provided. There is an elevating mechanism for the wheel-head, and the head can be swiveled either side of the center to any angle up to 25 degrees, as will be apparent from Figs. 1 and 2. An ordinary spur gear can be reversed in order to grind both sides of the teeth, but in the case of a gear that is integral with a shaft or cannot be reversed for some other reason, both sides of the teeth may be ground by swiveling the wheel-head in the opposite direction to that occupied in grinding one side, and reversing the setting of the grinding wheel on its spindle. The same work-holding arbors can be utilized.

One grinding cut is sufficient to provide a satisfactory finish on the average gear, but in cases of bad distortion, two cuts are necessary. When two cuts are taken, from 0.003 to 0.005 inch of stock is removed in the first cut, and 0.001 inch in the second. The heaviest cut that has been taken in tests conducted on this machine was on a 32-tooth, 6–8 pitch, ¾-inch face, casehardened gear. This cut was 0.010 inch on all teeth, and the grinding time was three minutes. The gear tooth is ground by a perpendicular face of the wheel, ⅜ inch wide, the wheel being 24 inches in diameter. The shape of the wheel allows for over one inch of face wear, which should be sufficient, with careful truing, for grinding over 1000 gears of 32 teeth.

AMERICAN VERTICAL BROACHING PRESS

Both push- and pull-broaching, as well as assembly work, can be performed on a vertical broaching press equipped with a reversible knee, which has been brought out by the American Broach & Machine Co., Ann Arbor, Mich. This machine is designated as the "V-20." That the machine is not limited to broaching is due to the fact that it is provided with a pair of friction clutches, which furnishes a flexible control for the drive. From the driving shaft, power is transmitted through a hardened steel worm and a bronze worm-gear, in a similar manner to the method used on the rack-operated horizontal broaching machine built by this company, the final drive to the steel ram being through a hardened pinion. The ram is 2½ inches square, and is provided at the lower or working end with a 2-inch tapped hole having eight threads per inch, to receive pull-bushings which are standard equipment for the horizontal machine. The new vertical machine has a pressure varying from 8 to 10 tons. Automatic stops facilitate the operation of this machine, and an oil-pump delivers lubricant to the broach from an oil reservoir formed by the deep base of the machine.



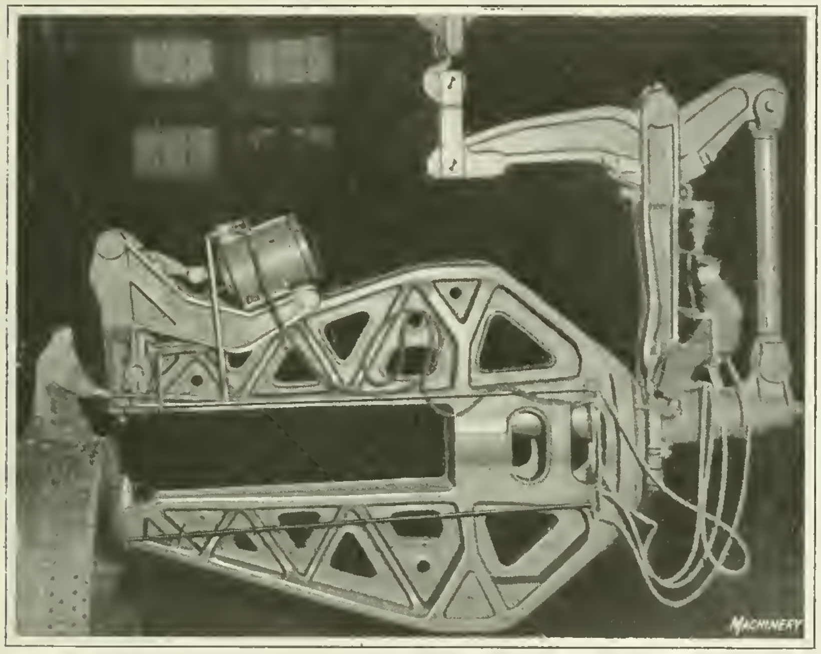
American Vertical Press for Pull- and Push-broaching and Assembling

The reversible knee, previously referred to, pivots at the center of its slide so that the knee may be conveniently reversed to bring it into position for either push- or pull-broaching. At the left in the accompanying illustration, the knee is shown in position for push-broaching, while at the right it is set for a pull-broaching operation. In order to adapt the machine for pull-broaching when it is arranged for push-broaching, it is only necessary to change the direction of the driving belts and reverse the links on the operating handle at the left-hand side of the machine. This alteration causes the power or cutting stroke to be made at a slow speed and the reverse stroke at a fast speed. The knee and slide are bored and bushed at the pivotal point, and in this bushing is placed a removable steel pinion of large size, which is used to lock the knee and slide to the face of the column. The latter is provided with a number of holes to permit locating the slide at different heights, and the slide is raised and lowered on the column to register with any of these holes by rotating the crank on the right-hand side of the machine, which actuates a pinion.

This machine is especially suitable for pull-broaching round holes, because the broach hangs in a perpendicular plane, which allows it to center itself in the work. The handwheel near the top of the machine is used for setting the ram and operating it by hand. Normally the handwheel "coasts" when the machine is in operation, but when it is desired to use it, a slight pressure endwise will cause it to engage a positive clutch. This machine receives broaches of the push type up to 20 inches in length, and pull-broaches up to 28 inches in length. The knee is bored 5 inches in diameter, with the bore located in line with the tapped hole of the ram. The machine weighs approximately 2200 pounds.

HANNA 150-TON PNEUMATIC RIVETER

A 150-ton portable pneumatic riveter having a reach of 118 inches and a 30-inch gap constitutes the latest achievement of the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill., in the development of riveting equipment. This riveter is built primarily for fabricating the plates forming the volute of the casing and the penstock for a 70,000 horsepower hydraulic turbine built for the Niagara Falls Power Co. The greatest distance across the volute is 48 feet, and the diameter for the entrance of water is 15 feet. The plates vary in thickness from 1¼ inches at the entrance to ⅞ inch at the end, and rivets varying in diameter from 1 to 1½ inches are used. The longest grip of the 1½-inch rivets is approximately 5 inches. The penstock is approximately 18 feet in diameter, 110 feet long, and is constructed of 1½-inch plates. The total weight of the machine is approximately 57,750 pounds and, obviously, mechanical power is necessary to move the equipment into the operating positions.



Hanna Portable Pneumatic Riveter of Massive Proportions

The riveter is so designed that the spindle may be tilted and the frame swiveled into the necessary angular positions. The illustration shows the spindle approximately horizontal and the frame in a vertical plane with the riveting mechanism above. However, the frame may be revolved on the spindle into a horizontal plane and tilted upward 30 degrees from the horizontal or downward a similar amount. It may also be brought into a vertical position with the riveting equipment on the lower side.

The supporting mechanism is so designed that when the frame is revolved on the spindle or tilted upward or downward from the horizontal, the center of gravity of all the parts hanging from the crane hook is neither raised nor lowered. This is accomplished through the suspension beam at the top, two vertical links, the spindle housing, and the spindle, which form a parallelogram with an overhung support at the crane hook directly above the center of gravity of the entire machine. With this arrangement, the friction of the bearings and inertia are the only forces to be overcome. Power for the revolving and tilting movements is obtained from two reversible air-drill motors of approximately 2 horsepower which are manufactured by the Chicago Pneumatic Tool Co.

The motor for tilting is mounted on the inner vertical link and drives a worm that engages a worm-gear segment on the suspension beam, while the motor for rotating the frame is mounted on the spindle housing, and drives a full worm-gear on the frame. This construction makes it possible to set the frame at any angular position around the spindle. Incorporated in this driving arrangement is a means for absorbing the shock of stopping the massive frame, and roller and ball bearings are furnished at all points of rotation. The frame is mounted on the spindle on two radial roller bearings, and is restrained from longitudinal movement by two roller thrust bearings. All moving parts are lubricated by oil baths and a grease system.

The riveting mechanism is a combination of toggles, which merge into a lever action, developing a predetermined maximum uniform pressure during the lever action, which is obtained with the last half of the piston stroke, this being also the last inch of die travel. This insures the driving of absolutely tight rivets without the necessity of adjusting the die screw to compensate for ordinary variations in the length of rivets, thickness of plates, diameter of holes, etc. Complete manipulation of this machine is possible from one position at the head or dies, three valve-operating handles being located at that point for operating the riveting, rotating, and tilting mechanisms. The rotating and tilting motor valves may also be manipulated from a seat provided near the rear of the machine. In the latter case, use is made of standard reversing valves built into the motors.

COATS UNIVERSAL ANGLE-PLATE

Milling, drilling, and other operations in which the work must be placed in one or more angular or radial positions may be facilitated by the use of a universal angle-plate which has been placed on the market by the Coats Machine Tool Co., Inc., 112 W. 40th St., New York City. As will be apparent from Fig. 1, this device has a faceplate provided with T-slots for attaching work or special fixtures, and with an accurately machined hole at the center which receives plugs for centering the work on the faceplate. The faceplate is 6 inches in diameter, and the hole ¾ inch.

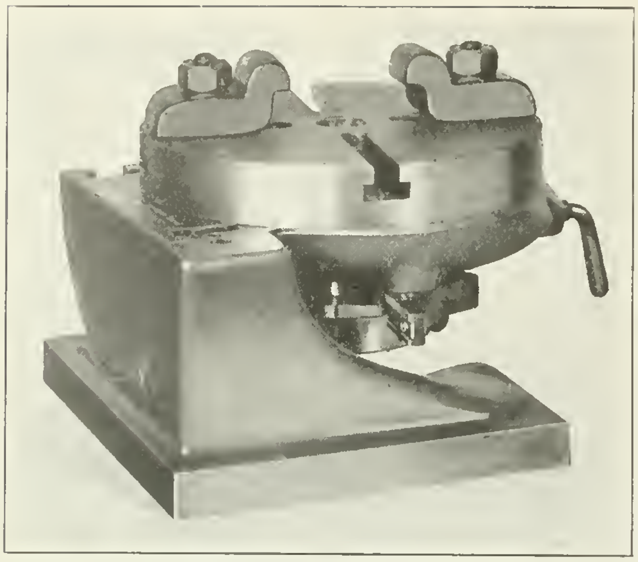


Fig. 1. Coats Universal Angle-plate for obtaining any Radial or Angular Position of Work

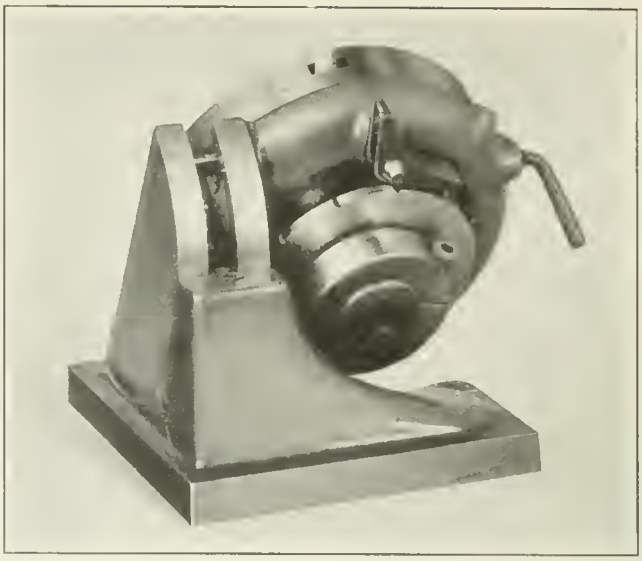


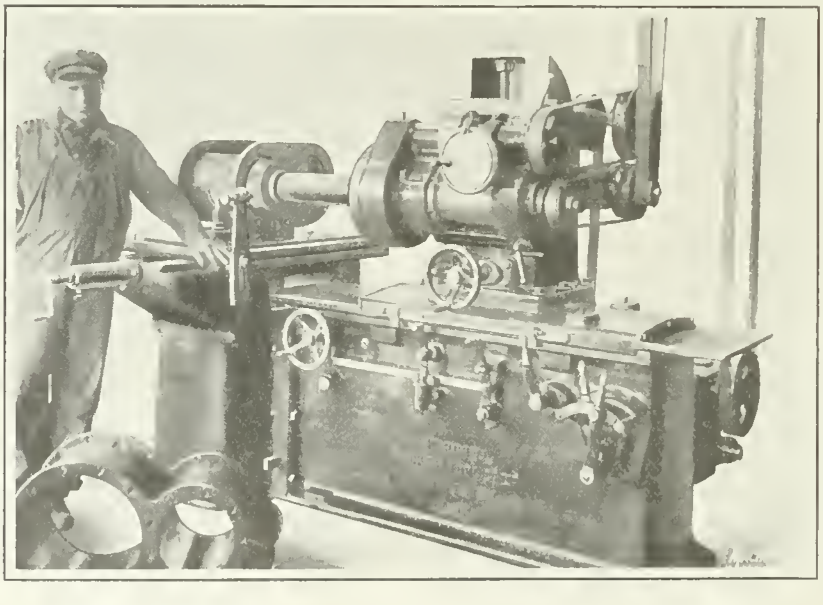
Fig. 2. View showing the Faceplate swiveled to a Position between the Horizontal and the Vertical

Accurate setting of the faceplate to any radial position is readily accomplished, graduations in degrees being provided around the periphery of the plate for this purpose. It will be seen from Fig. 2 that the faceplate may also be swiveled to any angular position from the horizontal to the vertical, and means are furnished for locking the faceplate in position.

Accurate indexing of the work is accomplished through an interchangeable index-plate and a hardened steel pawl beneath the faceplate. There are six index-plates which provide for indexing from 12 to 360 divisions about a circle. These index-plates are guaranteed to be accurate within 5 minutes. The clamps shown on the faceplate and bolts are supplied for securing this angle-plate to the table of the machine tool on which it is to be used, the bottom of the base being machined to insure a rigid set-up. The base, bracket and faceplate are chilled iron castings.

CHURCHILL CYLINDER GRINDING MACHINES

One class of work for which the cylinder grinding machines built by the Churchill Machine Tool Co., Ltd., Manchester, England, have been found especially suitable ls grinding the cylinders of braking equipment of locomotives. These machines are designed for grinding holes in parts that, owing to their shape, cannot be rotated as required in grinding machines of the internal type. One of the machines is shown in the accompanying illustration. As the work may be of irregular outline or have overhanging projections, the machine is arranged so that it may be equipped with one of several tables. The table is mounted on a separate bed, which reaches to the floor and is bolted on one side to the bed proper of the machine. This method of assembly makes it convenient to equip the machine with a larger or smaller table as desired, or to substitute a baseplate for the table. The table has a cross adjustment which is used only in positioning the work, the table remaining stationary during the actual grinding.



Churchill Grinding Machine for finishing Holes in Parts of Irregular Shape

The grinding wheel spindle is carried in a head which is adjustable vertically on the column, the column being mounted on a slide which has an automatic longitudinal movement on the bed, controlled by reversing dogs. These dogs are adjustable to permit of varying the stroke of the spindle to suit the length of the hole being ground. The column slide is provided with various speed changes, and on two of the machines it has a quick traverse obtained independently of the reversing dogs. This quick traverse can be operated automatically for feeding the wheel at a high rate of speed over relieved or cored portions of long holes. The main spindle in which the grinding wheel spindle is mounted also has various speed changes which are independent of the table speed changes. The wheel-spindle is easily detached from the main spindle, so that larger or smaller wheel-spindles can be substituted in a few minutes. A full range of spindles may be furnished to adapt the machine to grinding all holes within its capacity.

On two of the machines, an adjustment of the planetary motion of the grinding wheel is obtained through double eccentric spindles, which are controlled by means of a differential mechanism, while in the larger sizes, this adjustment is obtained directly by means of a slide located at right angles to the main spindle and operated through a screw and differential motion. This construction provides a wide range of adjustment, so that wheels considerably smaller in diameter than the holes to be ground may be used. Under such a condition the arc of contact between the wheel and the work is reduced. The cross

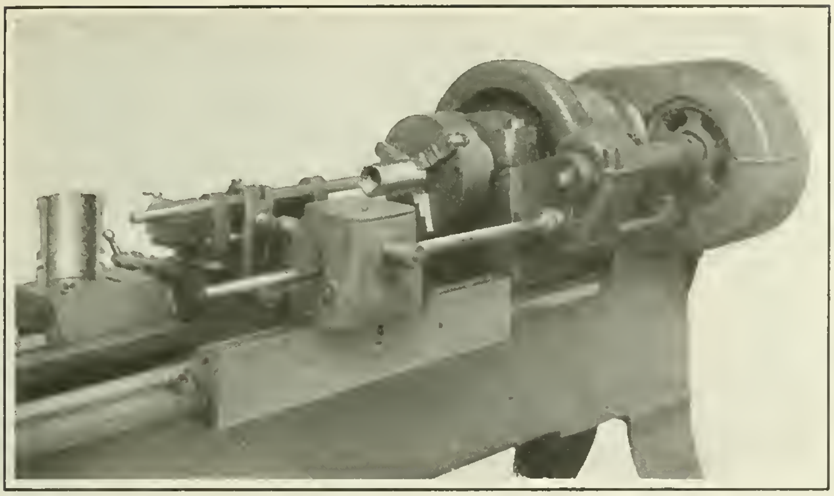


Fig. 1. Mueller Lathe Attachment for cutting Oil-grooves in Bearings or Shafts

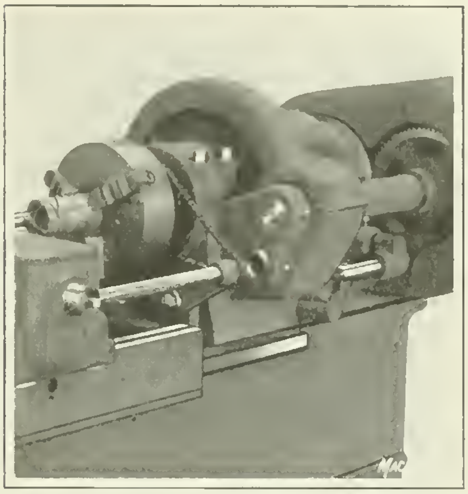


Fig. 2. Chain Drive for Oil-grooving Attachment

adjustment of the table and the vertical adjustment of the spindle make it possible to grind a number of holes in the work without disturbing the set-up. The machine may be driven from a countershaft or by a constant-speed motor.

MUELLER OIL-GROOVING ATTACHMENT

An oil-grooving attachment applicable to bearings or shafts of any size or shape that can be revolved in a lathe has been brought out by the Mueller Machine Tool Co., Cincinnati, Ohio. This attachment may be applied both to the lathes built by this company and to those of other makes. With it oil-grooves can be cut either single or double figure-eight style without rechucking the piece. The cutter-bar of the attachment has a double-pointed cutting tool, so as to groove consecutively on opposite sides of the hole in a bearing, the cutter-bar being fed longitudinally along the machine during the operation. The lathe spindle makes two revolutions to each complete stroke of the cutter-bar.

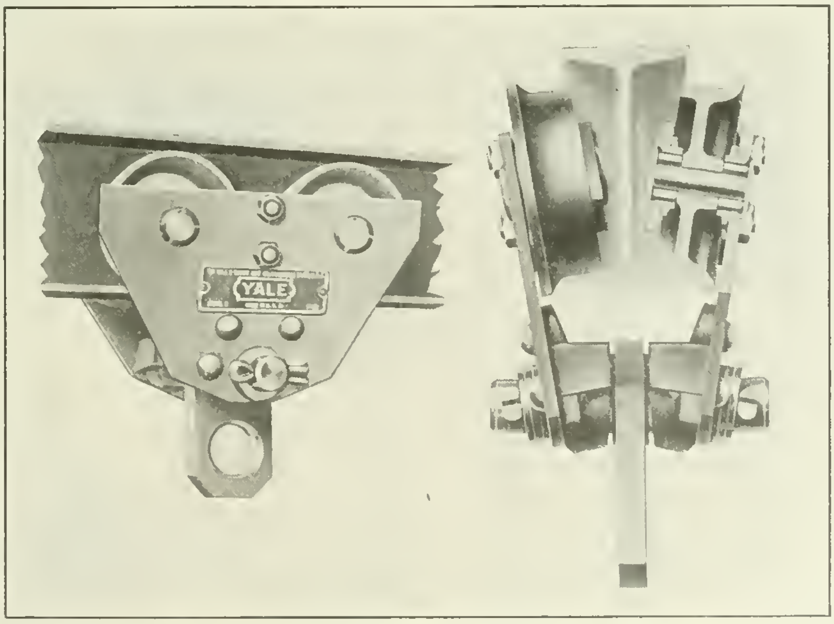
On engine lathes built by the Mueller Machine Tool Co., the driving shaft of the attachment enters the lathe head directly below the back-gear pinion, as shown in Fig. 1. The drive is transmitted through a rawhide pinion on the forward end of the driving shaft of the attachment, which meshes with the face gear on the lathe spindle. For other makes of lathes, a chain drive is furnished, as may be seen in Fig. 2. The sprocket gear on the nose of the lathe spindle is assembled before the chuck, a chain connecting this gear with a sprocket pinion which is fastened on the splined driving shaft of the attachment.

The driving shaft of the attachment is supported by an adjustable bearing made to suit any lathe, and it passes through a driving box bolted or clamped on the lathe carriage. This driving box contains a worm and worm-wheel, which transmit power to a splined shaft above, running at right angles to the driving shaft. At the front end of this upper shaft there is an adjustable graduated cross-bar, functioning like a crank, which traverses the cross-head that carries the cutter-bar. Any required stroke within a range of 1½ to 6 inches may be obtained through the adjustment. The cross-head traverses the cutter-bar back and forth in a support bolted on top of the compound rest. The cutting tool can be brought to any desired position while the lathe is in operation, and the cutter-bar can be raised or lowered to suit the center line of lathes of different swing. The sliding block in the cross-head has a ball-and-socket bearing, which enables the compound rest to be swiveled for grooving tapered holes and shafts.

YALE ROLLER-BEARING TROLLEY

A reserve strength of seven times its rated capacity and an unusual degree of flexibility are the main features claimed for a steel-plate trolley equipped with roller bearings, which has been brought out by the Yale & Towne Mfg. Co., Stamford, Conn. It is said that in a test the 2-ton size was loaded with a weight of 28,000 pounds, and although the standard I-beam on which the trolley was mounted broke under the load, the trolley was undamaged. The non-rigid construction of the trolley is such that the 1-ton size can be easily run around a track curve having a radius of only 21 inches.

The sectional view in the accompanying illustration shows the mounting of the wheels on the roller bearings, and the method of attaching the wheels to the side plates. The side plates, in turn, are connected by a single equalizing pin, which supports the shackle plate. Spreader castings riveted to each side plate give large bearing surfaces for the equalizing pin. These castings are shaped

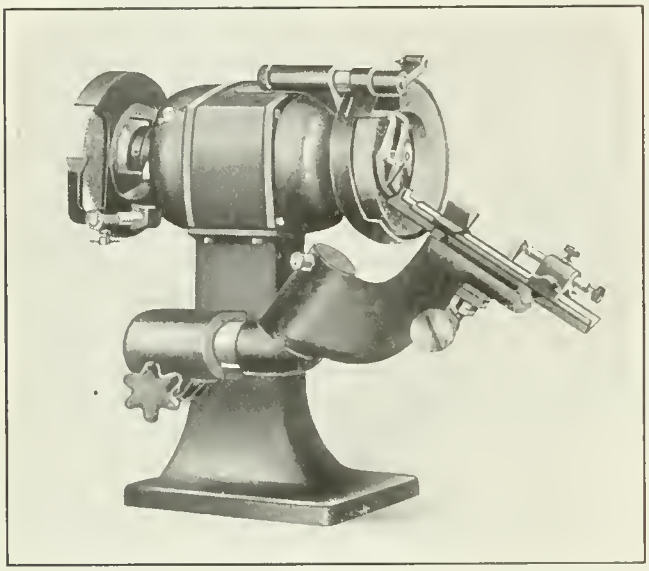


Yale Roller-bearing Trolley

to protect the trolley and act as a bumper for contacting the stop on the lower flange at the ends of the I-beam track. The roller-bearings are heat-treated, and hardened and ground. They assure easy lateral motion, and are provided with grease chambers. Each axle is set parallel to the upper surface of the lower I-beam flange, pressed into its wheel hub, and supported by an inner bearing plate. The wheels have chilled iron treads, designed to suit the shape of the I-beam flange on which they run. The equalizing pin is made of cold-rolled steel, and supports a shackle, eye, or clevis.

GALLMEYER & LIVINGSTON DRILL GRINDERS

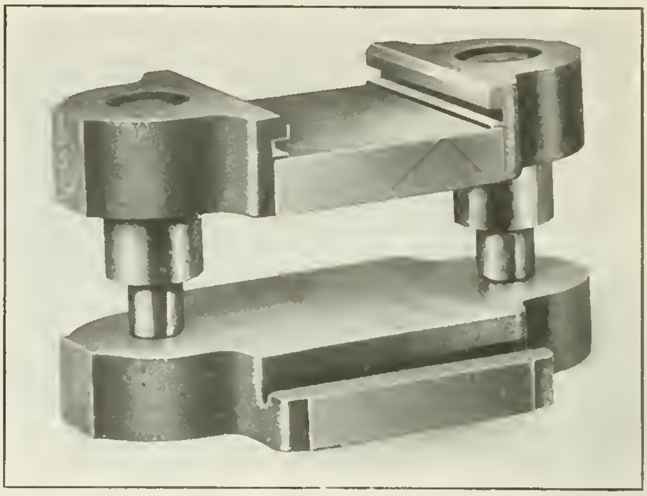
Two motor-driven bench drill grinders, which are now being placed on the market by Gallmeyer & Livingston Co., successor to the Grand Rapids Grinding Machine Co., 14 Campau Ave., N. W., Grand Rapids, Mich., have a built-in motor, which may be connected with any lighting or power circuit. The ½-horsepower size carries an 8½-inch cup grinding wheel, and the ¼-horsepower size a 5-inch cup-wheel. The machine equipped with the ½-horsepower motor is made in two sizes, one for grinding drills from No. 52 to ¾ inch, and the other for drills from ⅛ inch to 1½ inches. The machine with the ¼-horsepower motor is believed to be the smallest drill grinder ever placed on the market. It is suitable for grinding drills from No. 60 to ⅜ inch. Both machines are equipped throughout with ball bearings, and are supplied with a wheel-truing diamond. These grinders are similar to the floor-type machine described in July, 1918, MACHINERY.



Gallmeyer & Livingston Motor-driven Bench Drill Grinder

DANLY STANDARD DIE SET

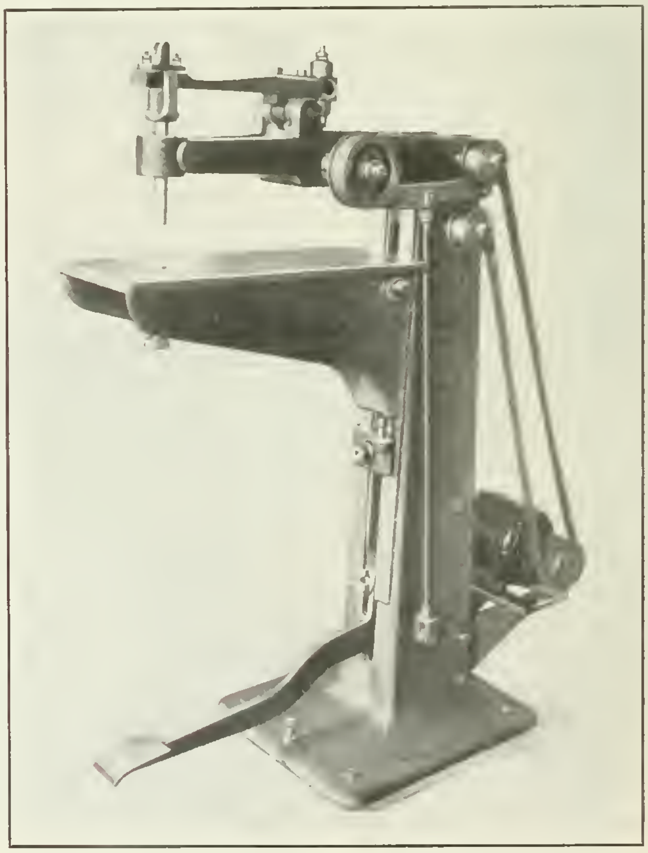
Another addition has been made to the line of standardized die sets and component parts manufactured by the Danly Machine Specialties, Inc., 4911 Lincoln Ave., Chicago, Ill., in the type Z die set, here illustrated. This set is especially suited for the production of adding machine, typewriter, and similar stampings, which must be accurately made. A floating punch shank relieves the dies from all strains due to play in the ram of the press or other faults in the machine. The punch-holder is guided into the die by extra long, hardened, ground, and lapped bushings, which never leave the leader or pilot pins. Adapters that take the place of the punch shank can be made up by the user in either solid or swiveling types, and arranged for either a spring or a positive knock-out. A particular feature of the adapters is that they need not be removed from the ram when the dies are changed, it being only necessary to remove clamps from the shoe to permit sliding the die set from the adapters. Obviously, this feature provides for making set-ups quickly. The die-set parts are made of semi-steel and accurately machined. A complete range of stock sizes of this set accommodates dies from 4 to 10⅜ inches square.



Danly Type Z Standard Die Set for Power Presses

GRANT ROTARY VIBRATING RIVETER

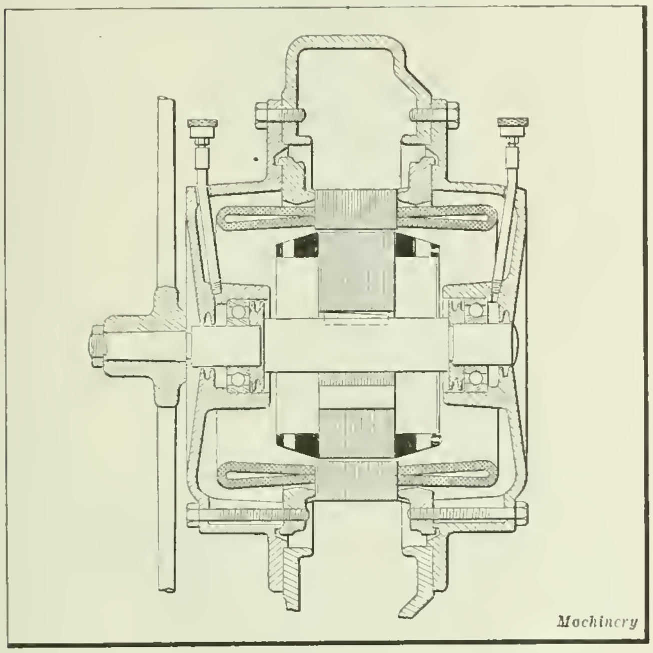
Sufficient depth of throat to permit handling a large variety of work is one of the features of the No. 4 rotary vibrating riveter recently brought out by the Grant Mfg. & Machine Co., N. W. Station, Bridgeport, Conn. This machine, which is shown in the accompanying illustration is designed to head rivets up to and including 5/16 inch in diameter. The riveter has a throat depth of 18½ inches, which provides for heading rivets at the center of a 36-inch circle. It is also built in a style arranged for belt drive, and fitted with a horn support used in riveting circular drums, such as fire extinguishers and other cylindrical articles.



Grant New Type Rotary Vibrating Riveter

OLIVER MOTOR-DRIVEN BAND SAW

The No. 16 band-sawing machine built by the Oliver Machinery Co., Grand Rapids, Mich., may now be equipped with a motor drive in which the rotor is mounted and keyed directly on the lower wheel-shaft within the column of the machine, as illustrated. Two ball bearings, supported by end bells reduce the friction of the shaft. The end bells have finished concentric tongues which accurately fit inside finished rings on the band-saw frame and on the stator, this construction insuring alignment and providing for easy accessibility. A two- or three-phase alternating-current motor running at 600 revolutions per minute is recommended for this type of drive. The machine is equipped with 36-inch wheels and accommodates work up to 36 inches wide between the saw and the column, and up to 16 inches high under the guide. The table tilts 45 degrees to the right and 5 degrees to the left.

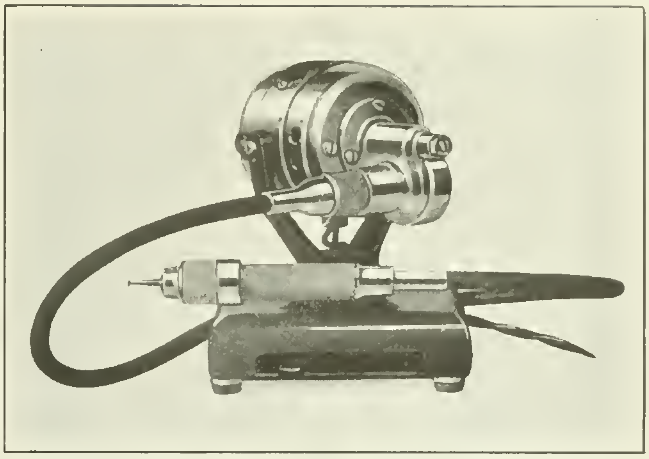


Sectional View of Novel Motor Drive on Oliver Band Saw

DUMORE UTILITY TOOL AND IMPROVED DRILL

To facilitate small-hole drilling, engraving, and die-sinking operations, especially in places that may be inaccessible with other types of equipment, the Wisconsin Electric Co., 2559 Sixteenth St., Racine, Wis., is bringing out the geared utility tool here illustrated. This tool is driven by a nickel-plated universal motor, which may be operated on either alternating or direct current, the motor being balanced dynamically to obviate vibration. The motor drives, through worm-gearing, one end of a flexible shaft, at the opposite end of which is mounted an aluminum hand-piece and a No. 0 Jacobs chuck. Convenient operation of the tool is provided for by having the motor pivotally mounted on the base. Chuck speeds from 500 to 2000 revolutions per minute are obtainable by means of a five-speed rheostat in the base; however a foot-control rheostat can also be supplied. The chuck takes tools from ⅛ inch diameter down to a No. 80 drill.

Attention is called to the Aluminum hand-piece, which is knurled and fitted with a double-row S K F ball bearing to take both end thrust and radial load. This construction is said to result in a smooth-running chuck and to prevent the hand-piece from becoming hot. A chuck guard permits the hand-piece to be held close to the work. This guard is made of brass and is removable from the hand-piece by giving it a single turn. An S. S. White No. 7 hand-piece may also be furnished with this equipment, together with a special adapter and a coupling.

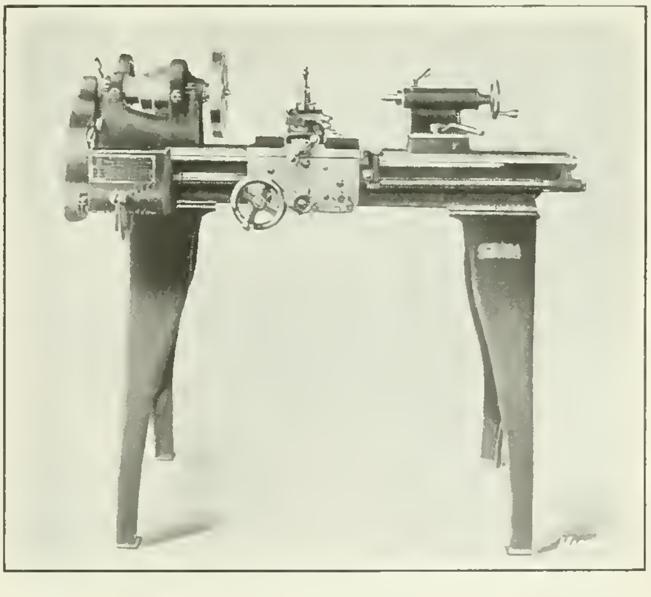


Dumore Utility Tool for Difficult Drilling, Engraving, and Die-sinking

The same company is also introducing to the trade an improved type A sensitive high-speed drilling machine for use in jewelry manufacture and similar work, where a machine designed for light work is required. This machine is similar in appearance to the one described in May, 1918, MACHINERY; but it is equipped with a universal dynamically balanced motor for operation on either alternating or direct current, the same as the utility tool. The drilling machine is equipped with a No. 0 Jacobs chuck, and a foot-controlled rheostat provides for regulating the spindle speed to meet the requirements of each job. This machine has a capacity for drilling holes up to 1/16 inch in diameter in steel.

MYERS SMALL-SIZE ENGINE LATHE

A 10-inch engine lathe equipped with a quick-change gear-box is the latest addition to the line of products manufactured by the Myers Machine Tool Corporation, Columbia, Pa. The machine has a maximum distance between centers of 24 inches, and is built both in floor and bench styles. The simplicity of its construction and convenience of operation will be apparent by reference to the accompanying illustration. The gear-box provides for cutting twenty-five threads, ranging from 6 to 52 per inch. For convenience in thread-cutting, the apron is equipped with a thread dial at the right-hand end, which makes it unnecessary to use a



Myers 10-inch Engine Lathe equipped with a Quick-change Gear-box backing belt or a reversing motor in operations of this sort. The thread dial can be readily disengaged from the lead-screw when not in use, and the lead-screw is only used in thread-cutting, a rack on the bed and a pinion in the apron being used to feed the carriage longitudinally in other operations.

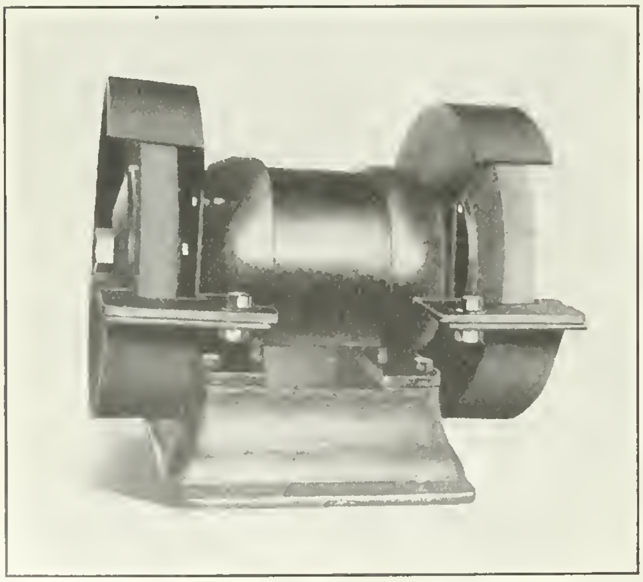
The compound rest is graduated in degrees, and the cross-feed is equipped with a micrometer nut. Clamping bolts provide for holding the compound rest in the desired setting. The swing over the rest is 6½ inches. The tail-stock is of the set-over type and does not interfere with swinging the compound rest at right angles to the cross-slide. The headstock spindle is made of open-hearth high-carbon steel, bored from solid metal and ground. The spindle socket is bored to a No. 3 Morse taper, and bushed for a No. 2 Morse taper. The hole through the spindle is 25/32 inch in diameter. The countershaft is provided with forward and reverse friction pulleys.

All gears on the lathe are adequately covered with guards, the guard for the change-gears at the left-hand end of the machine being of the swinging type so that they are readily accessible. Various attachments, such as a draw-in collet chuck and a taper attachment, may be furnished, and the lathe may be equipped with short legs in place of those shown, for installation on a bench. The weight of the floor and the bench type is approximately 400 and 360 pounds, respectively.

FORBES & MYERS TOOL GRINDER

A model No. 102 tool grinder, which differs principally from other grinders of this class made by Forbes & Myers, 178 Union St. Worcester, Mass., in that it is equipped with welded steel guards and rests, is now being introduced to the trade by this concern. Originally, this machine was supplied to a purchaser without either guards or rests, so that he might equip it as desired. Because welded steel guards and rests have proved satisfactory, the standard machine is now being furnished with them.

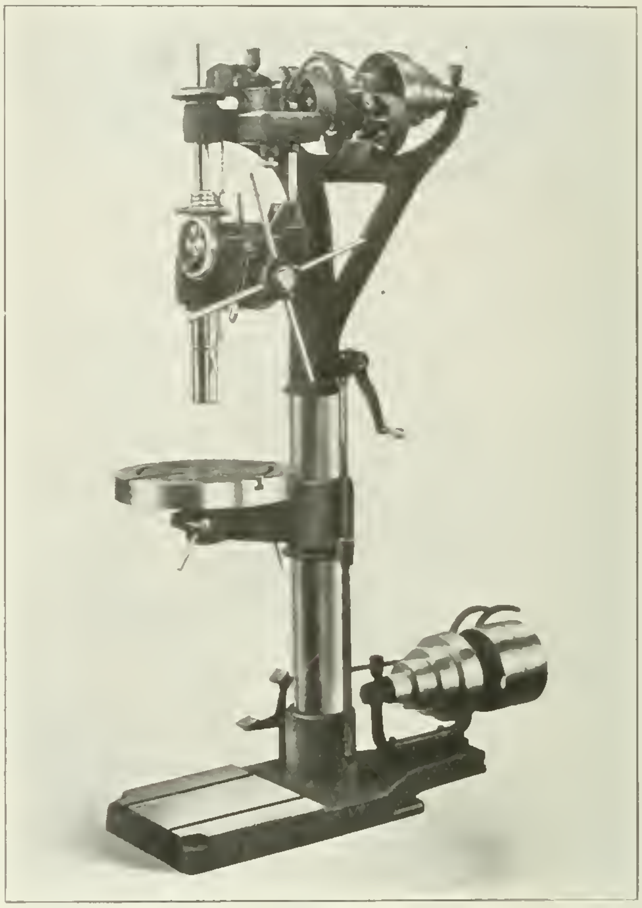
The motor is of the squirrel-cage induction type, fully enclosed, and equipped with "Norma" bearings. The standard wheels are 10 by 1 inch, and run at a speed of 1800 revolutions per minute; however, wheels of different widths and grades can be furnished when specified. The welded guards and rests are attached to the motor frame by four nuts, which are screwed on stud extensions. This grinder is ordinarily supplied for 220-, 440-, or 550-volt, two- or three-phase, 60-cycle current, but for cases where 60-cycle current is not available, a special model is furnished.



Forbes & Myers Tool Grinder equipped with Welded Guards and Rests

SUPERIOR VERTICAL-SPINDLE DRILLING MACHINE

The 20-inch drilling machine made by the Superior Machine Tool Co., Kokomo, Ind., has been redesigned to adapt it for light manufacturing work, and for use in vocational training schools, garages, etc. This machine is made in six styles, the type B-1, shown in the illustration, being back-geared and provided with geared wheel and pilot feeds. The other types differ in the drive, feed, or both. All parts of the machine are made by an interchangeable system, which enables the machine to be readily converted or reassembled to meet requirements. Housings for the bearings are bored standard, so that worn bushings may be easily replaced and accurate alignment maintained.



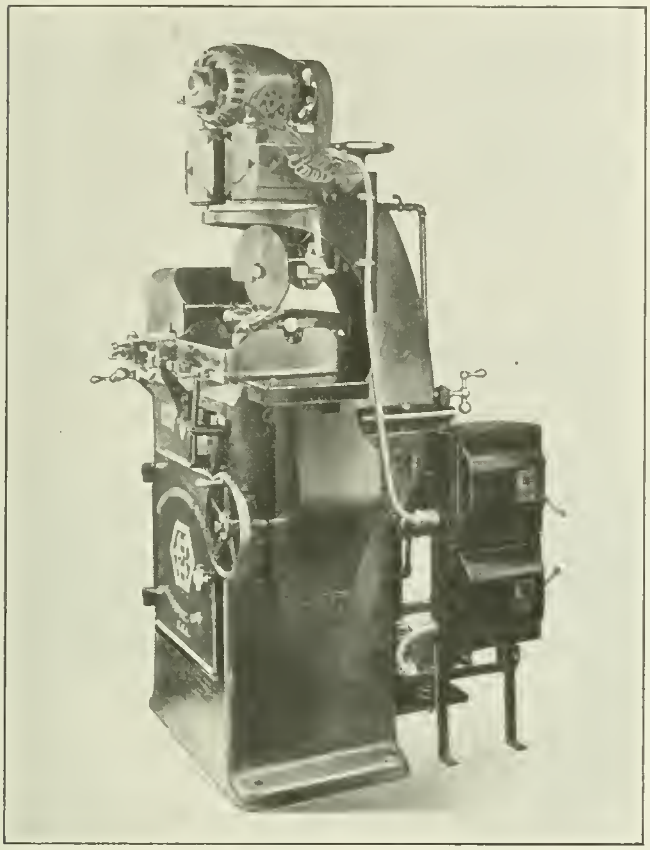
Superior Redesigned Vertical-spindle Drilling Machine

The spindle has a No. 3 Morse taper hole, and is provided with a ball thrust bearing. The drift slot for the taper hole is located in the shoulder of the spindle, where it is exposed at all times. The spindle sleeve is made of cast iron, bronze-bushed, and graduated the full length of its travel. The rack is made of steel, and secured between shoulders. The rack-pinion shaft is operated through worm-gearing, which is permanently in mesh and runs in an oil bath. The feed gears in the feed-box are made of steel and are heat-treated. The speed reduction is obtained through worm-gearing, three feeds are obtained by shifting a key in the feed-box, and three additional feeds by sliding a gear.

The base of the machine is provided with standard T-slots for securing work, and the table has a large supporting shoulder on the hub to provide additional stiffness when work is being drilled close to the edge of the table. A geared motor drive is applicable to all types of this machine, motor speeds varying from 750 to 1800 revolutions per minute being suitable. Some of the principal dimensions of the machine are as follows: Maximum distance from base to spindle, 41½ inches; maximum distance from table to spindle, 26 inches; traverse of spindle sleeve, 8½ inches; and traverse of table, 23¼ inches. The machine drills to the center of a 20¼-inch circle, and the style illustrated weighs approximately 790 pounds.

HARRIS FULL-AUTOMATIC HOB GRINDING MACHINE

To meet the demands for a fully automatic hob grinding machine smaller than its No. 815 machine, the Harris Engineering Co., Bridgeport, Conn., has developed the No. 415 machine here illustrated. Its rated capacity is for hobs up to 4 inches in diameter by 5 inches long, although hobs somewhat larger can be accommodated, especially if the teeth are fine. The machine will grind straight-fluted and either right- or left-hand spiral-fluted hobs, indexing automatically and feeding the hob rotatively against the wheel by means of an automatic mechanism. This mechanism is so designed that it does not require setting for different numbers of flutes in the hobs, being controlled by each complete revolution of the hob-spindle.



Harris Automatic Hob Grinding Machine for Hobs up to 4 Inches in Diameter by 5 Inches Long

The grinding wheel is driven from an overhead motor through an endless open belt. By means of an overhead turntable, which is graduated in degrees to suit hobs having spiral flutes, the wheel-head is swiveled with the wheel, when the angular position of the latter is changed. Vertical adjustment of the wheel-head is obtained by revolving a handwheel at the top of the column, and lateral adjustment of the wheel is obtained by turning a ball-crank handle. The wheel-head is equipped with a truing diamond, and all moving parts are amply lubricated by means of oil wells, cups, and tubes. As much as 2 inches of belt slack may be taken up by means of adjustable wedge blocks beneath the motor.

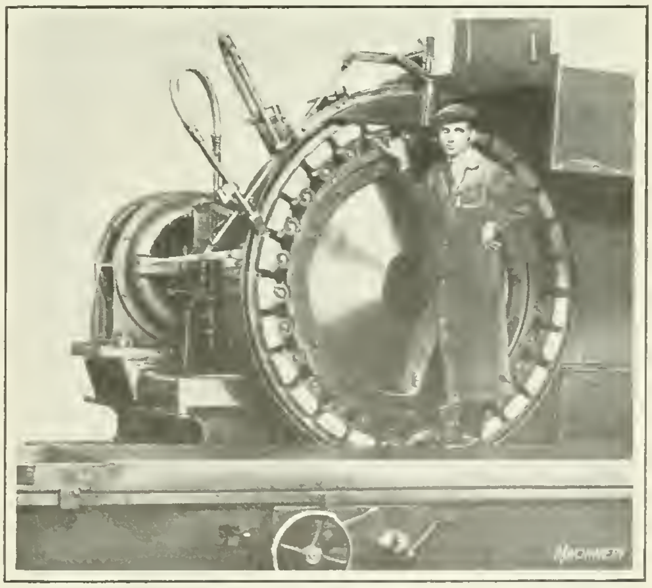
The table reversing spiral, generating, indexing, and hob-feeding mechanisms are driven automatically by a motor mounted on brackets at the rear of the base. The same motor drives the pump through an open belt. Enclosed safety-type starting switches for the motors are located at the back of the machine where they do not interfere with the attendant or the operation of the machine. A safety device is also provided to prevent damage to the mechanisms in case of accident. This machine is also furnished with a belt drive; however, the motor-driven type is recommended if a machine practically free from vibration is desired.

DIAMOND FACE GRINDING MACHINE

What is believed to be the largest grinding wheel ever provided on a face grinding machine was furnished on a machine of this class recently built by the Diamond Machine Co., Providence, R. I., for grinding large work, such as boiler sections having a height of 60 inches. An idea of the wheel dimensions may be obtained from the illustration. The wheel has an outside diameter of 66 inches, and is composed of twenty-eight separate blocks having a face width of 2 inches and a depth of 7¼ inches. Each block is held rigidly in a chuck of special design which allows the use of about 90 per cent of the abrasive material in the block before it becomes necessary to replace it. A wheel dresser built on the machine may be used while an operation is in process, without interfering with production.

The construction of the machine itself is similar to a heavy-duty face grinding machine introduced to the trade by the Diamond Machine Co., three years ago, and described in August, 1920, MACHINERY. The drive is obtained from a 75-horsepower motor which delivers power to the grinding wheel through sprockets and a silent chain. The speed of the wheel-spindle is 180 revolutions per minute. A large cutting power is available at the wheel face, due not only to the power delivered from the motor, but also to the kinetic energy stored in the rotating wheel, chuck, and spindle. The wheel-spindle is provided with bearings to reduce friction in rotation and to take up end thrust.

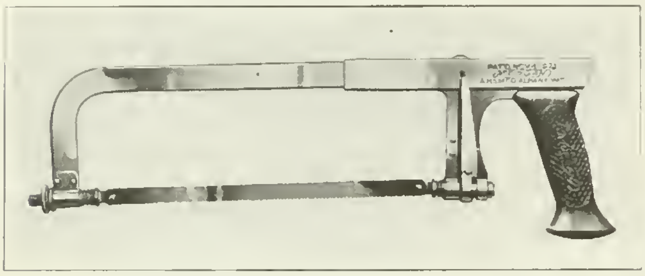
An automatic system provides for pumping cutting solution or water from a 140-gallon tank at the rear of the machine, collecting it after the solution flows from the wheel, and settling out the solid material before the solution is again circulated. The solution is delivered to the wheel through two nozzles by means of which the supply may be conveniently regulated. Sheet-metal guards prevent splashing of the solution and protect the bearings of the machine. The table platen measures 36 by 110 inches, and has a speed of 22 feet per minute. It is provided with slots for attaching the work and fixture. The table motion may be controlled from the front of the machine and also from the position



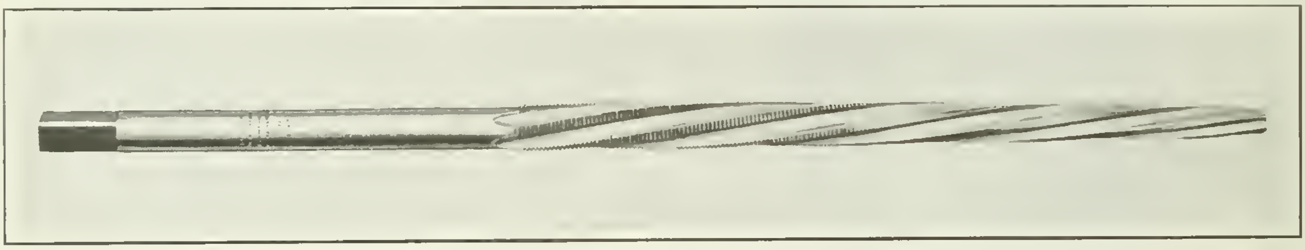
Sectional Wheel 66 Inches in Diameter provided on a Diamond Face Grinding Machine of the operator behind the table. A patented arrangement of belts and pulleys within the bed practically eliminates shocks when the table movement is reversed. The weight of this machine is over 40,000 pounds.

MORGAN HACKSAW FRAME

Among the features claimed for the Morgan hacksaw frame, which has been placed on the market by the Albany Hardware Specialty Mfg. Co., Albany, Wis., are a means for quickly releasing and tightening the blades; quick adjustment to suit various lengths of blades; and a quick method of setting the blades in any of four positions. The lever on the side of the frame just in front of the handle is attached to a cam, which releases the tension on the saw blade when the lever is pulled away from the frame. The frame is held in the desired position for a given blade by means of a spring stop-pin, which is seen in the illustration projecting through a hole just above the tension lever.


Morgan Hacksaw Frame of Improved Design

Adjustment of the tension on the blade is accomplished by means of the knurled thumb-nut at the left-hand end, the spring on the adjusting bolt doing away with the necessity of using a check-nut. In setting the blade at right angles to the frame, it is only necessary to push back a pin which holds the blade in position and then turn the blade until the spring again seats locating keys. The handle is made of hard rubber.


Bruhaker Patented Spiral-fluted Staybolt Tap

BRUBAKER SPIRAL-FLUTED STAYBOLT TAP

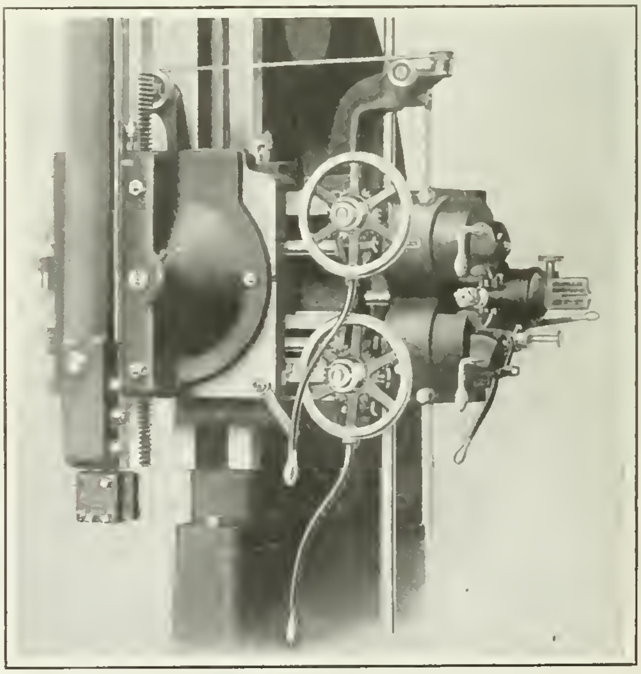
In tapping staybolt holes it is important to use taps that are not only free-cutting, but also designed to distribute the work of cutting properly in order to obtain clean threads, eliminate vibration, and consume a minimum amount of power in driving. The patented spiral-fluted staybolt tap recently introduced on the market by W. L. Brubaker & Bros. Co., Millersburg, Pa., is designed to meet these requirements. After developing this tap, tests were run for over three years in leading shops, the object being to determine whether or not the tap was a success under working conditions. According to these extensive tests, the tap has six distinct features that make it superior to any tap previously manufactured by this company.

In the first place, the taper, which varies for each size, is such that it insures a uniform distribution of the work along the entire length of the tap. The tests showed that this resulted in an average increased life of about 20 per cent. Another advantage claimed for this tap is the elimination of practically all vibration, which is usually the direct cause of tap breakage. The smoothness of operation at high speeds permits a reduction in tapping time, and consequently the production of more tapped holes per day per man. On account of the fact that the tap has a free cutting edge, it has been found possible to run the driving motor at unusually high speeds without injuring the tap. Difficulties have been experienced with some staybolt taps because of excessive friction causing the tap to soften and become dull in the heated spots, the dulling action continuing until the tool was practically ruined.

Considerable experimenting in relieving the tap was resorted to in order to eliminate chatter and obtain a method of relieving all taps uniformly; finally, it was decided that a "compound relief" was the most satisfactory. This was produced by machine relieving in conjunction with a special machining operation. To insure durability, a steel of special analysis is used in making the tap. In order to insure that the tap would be within the specified lead tolerance after the various machining operations it was found advisable to give it a special temper. With the tempering process employed the lead variation is within close limits, and at the same time the tap is given a soft center, thus combining toughness with good cutting qualities. This staybolt tap is made in all styles and sizes required in boiler building and repairing.

HAND-FEED LEVERS ON BULLARD "MAXI-MILL"

There are many classes of work handled on turning and boring mills, for which it is desirable from the viewpoint of both quality and quantity production, to feed the tool


Right-hand End of Cross-rail on Bullard "Maxi-mill," showing Arrangement of the Hand-feed Levers

by hand in taking heavy cuts. A job of this kind is the machining of automobile tire molds. In this work, it is standard practice to feed the tool by hand in roughing out the form. In order to facilitate hand-feeding of the tools, the Bullard Machine Tool Co., Bridgeport, Conn., has equipped its "Maxi-Mill" with special levers, as here illustrated. When using these hand-feed levers, the operator stands in a position from which he can closely observe the cut, and the greater leverage obtained through their use is of considerable advantage in holding the tool in contact with the work when cutting through tough scale and into chilled cast iron or cast steel. When a form templet and pointer attached to the tool-slide are used, the operator can watch them closely, and guide the tool with ease and accuracy by the use of the levers.

These hand-feed levers are provided at both ends of the cross-rail. They are pivoted on a free swinging collar, mounted on the "hammer" handwheel supporting bracket. Hardened steel clutch teeth on the hub of the handwheel and on the hand-lever are engaged by imparting a slight forward movement to the lever. A safety device provides for automatically disengaging the levers when they are not actually held in engagement.

* * *

NEW MACHINERY AND TOOLS NOTES

Stainless Steel Rule: Brown & Sharpe Mfg. Co., Providence, R. I. A new 12-inch stainless steel rule, known as style No. 350, which is similar to the 6-inch rule described in March MACHINERY. The rule is rustproof, and will not stain or discolor. It is made of high-grade stainless steel, and is hardened and tempered. These rules are graduated in eighths, sixteenths, thirty-seconds and sixty-fourths of an inch.

Open-side Crank Planer: Whipp Machine Tool Co., Sidney, Ohio. A redesigned and improved crank shaper of the open-side type, suitable for work requiring either a planer or a shaper and hence especially adaptable to tool-rooms and vocational training schools where the installation of both a shaper and a planer is not warranted. The table stroke is adjustable by means of the shaper-type stroke-adjusting mechanism. The table drive is through a heavy crank operated by a bull wheel. The crank-arm is mounted on a bearing pin at the bottom of the bed, and its upper end and the table-adjusting nut are connected through heavy links. The table may be operated at from 7 to 70 strokes per minute. The feed-control mechanism is like that used on planers. This machine weighs about 4600 pounds.

Spot-welding Machine: Thompson Spot Welder Co., 161 Pleasant St., Lynn, Mass. A power-driven automatic spot-welding machine for such work as disk wheels and crankcases. Its normal capacity is for welding two 3/16-inch iron or steel plates. A maximum pressure of 2000 pounds per square inch is delivered on the die points. The machine is provided with means of elevating the upper welding head or electrodes 1¾ inches, to facilitate the insertion or removal of work having flanges, ribs, etc. The machine may be operated in cycles of one spot or continuously. Automatic make-and-break switches can be set to suit the gage of stock to be welded or the amount of indentation desired. The driving pulley runs at a normal speed of about 100 revolutions per minute, which operates the machine at the rate of 20 spots per minute.

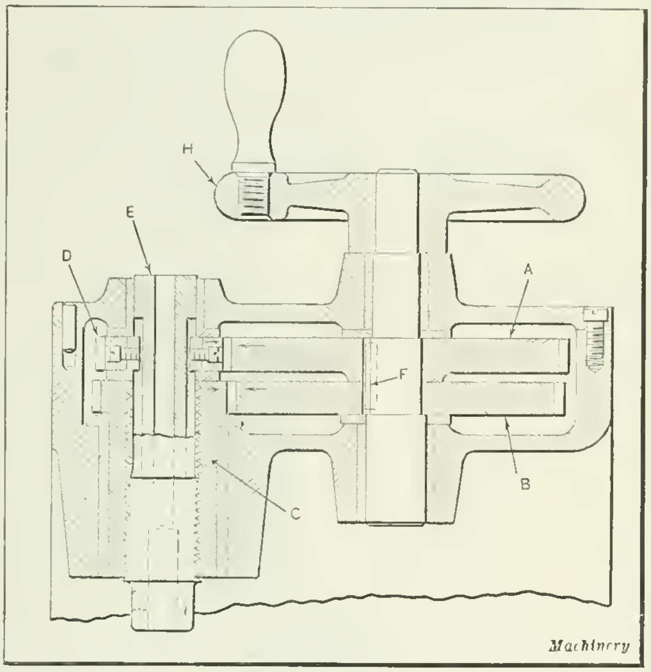
Assembling and Straightening Press: General Mfg. Co., 255 Meldrum Ave., Detroit, Mich. A power-driven assembling and straightening press, capable of exerting pressures varying from a few pounds up to twenty tons, which is intended for use as a single-purpose heavy-duty machine. This press is of the three-post type, and has a maximum ram stroke of 12 inches. The ram is driven at a constant speed in one direction through worm-gearing and spline keys. A nut revolves with the ram until pressure is applied on a foot-pedal, to tighten a brake and stop the nut. The ram then advances through the nut until the pressure is released from the foot-pedal, at which time a spring connected by a cable to the top of the ram returns it to the raised position. The maximum height between the table and the ram nose on the standard machine is 18 inches, but this dimension may be changed to meet requirements.

* * *

HAND-OPERATED BORING TOOL

A certain automobile repair part, which is regularly sent out with a nominal sized hole, must, on account of the particularly close limits required, be bored at the service station during the assembling operation. As many service stations are not equipped with machine tools adapted for this work, a special fixture (the driving mechanism of which is shown in the accompanying illustration) was designed for their use. The fixture holds the part securely, and drives a small piloted boring tool through the hole at an extremely fine rate of feed.

The operation is merely to set up the part (not shown), insert the boring-bar, and turn the handwheel *H*. It will be noted that two gears are mounted on the handwheel shaft, and held in place by a key *F*. Gear *A* has 80 teeth of 16 pitch, and gear *B* has 79 teeth of 16 pitch. gear *A* drives gear *D*, which has 30 teeth, turning it in the direction indicated by the arrow at a speed ratio of 8 to 3 or 2.666. Also gear *B* turns gear *C*, the ratio between these gears being 2.548. Gear *C* will therefore make 0.882 revolution while *D* is making one revolution.

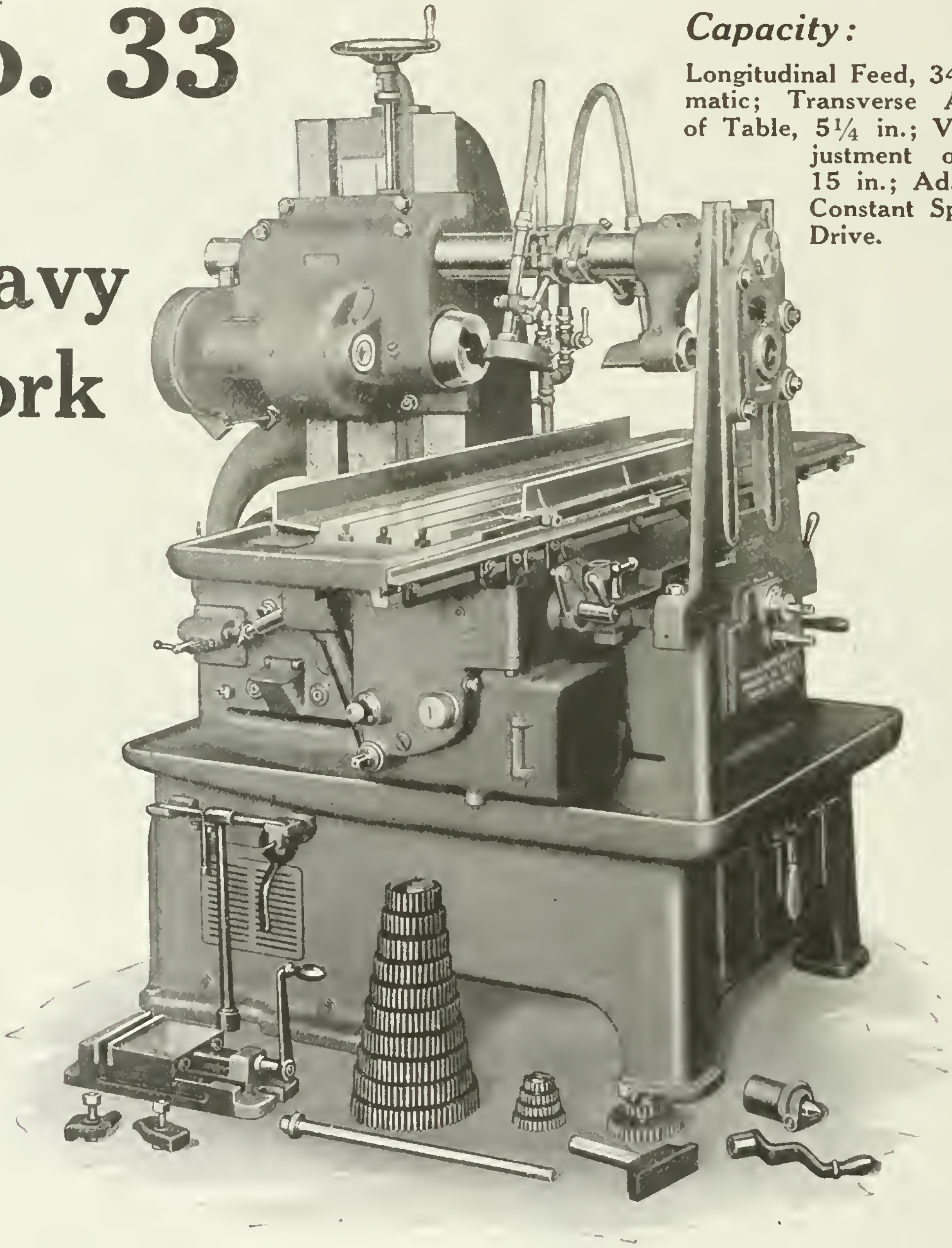


Hand-operated Boring Tool used in assembling Automobile Repair Part

Gear *D* is provided with two splines which are a sliding fit in keyways cut in spindle *E*. A 16-pitch thread is cut the entire length of the hole through gear *C*. Now as the splines drive spindle *E* at a different speed from that of the threaded gear *C*, the resultant action will be a feeding movement of shaft *E* in a downward direction. The amount of feed per revolution of the spindle is found by multiplying the differential ratio by the exact pitch of the thread in gear *C*. In this case, the tool feed for each revolution of the spindle or boring-bar would be equal to 0.118 × 0.0625 or about 0.0073 inch. The boring-bar makes about 2 2/3 revolutions for each complete revolution of the handwheel. The feed per revolution of the handwheel is about 0.019 inch. The holes bored by the use of this attachment are accurate and free from tool marks. W. R.

Another BROWN &

No. 33 for Heavy Work

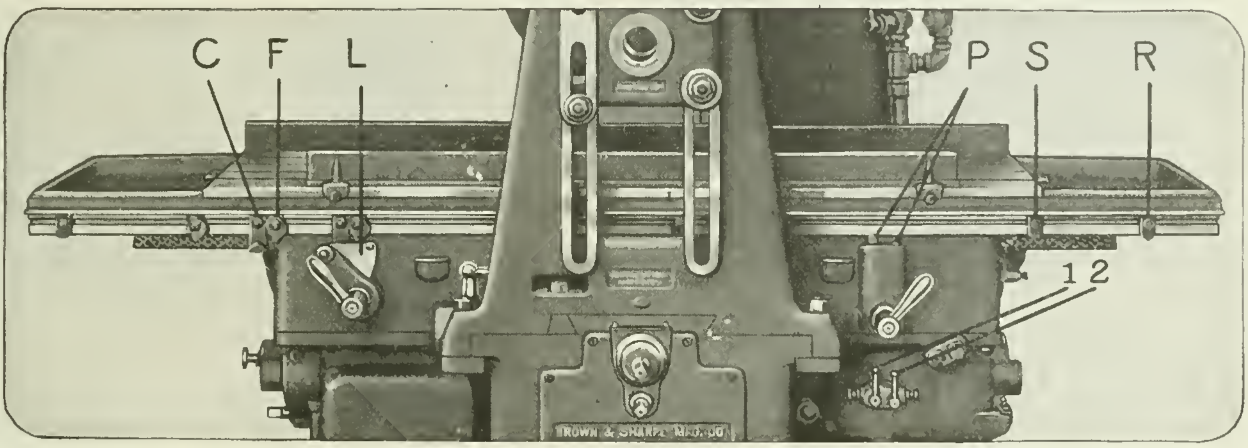


Capacity:

Longitudinal Feed, 34 in., Automatic; Transverse Adjustment of Table, 5¼ in.; Vertical Adjustment of Spindle, 15 in.; Adapted to a Constant Speed Motor Drive.

This rugged, sturdy machine is a development of the manufacturing type of milling machine. Fully automatic control of table and spindle adapt it to the milling of duplicate parts in large quantities. Box construction with internal bracing of heavy webs throughout the machine gives ample strength for substantial cuts on large pieces. Additional support for heavy cuts is found in the long saddle, clearly shown on the next page. Other features of this machine are the Constant Speed Drive, making the spindle speeds and table feeds entirely independent of each other—the Taper Nose Spindle, a well-known advantage of Brown & Sharpe Milling Machines—and the automatic lubrication of all rotating parts within the frame. The Automatic Control of the Table and Spindle is described on the next page and is similar in principle to that used on our No. 21 Automatic Milling Machine.

SHARPE Automatic Milling Machine



Dogs control all movements of Table and Spindle

All the automatic controls of this machine are operated by four styles of table dogs.

Dogs "C" and "F" acting on gear sector "L" control the Constant Fast Travel and Variable Cutting Feed of the table, respectively, and may be set to act in either direction.

Dogs "R" and "S" acting on plungers "P" control the reversing and stopping of the table. These dogs in conjunction with levers "1" and "2" may be set to secure continuous, intermittent or semi-automatic milling.

The Spindle can be set to start, stop or reverse automatically or it can be set to run continuously in either direction. The Spindle reverse is controlled by dogs similar to "C" and "F" placed on the rear of the table at the right.

When working in conjunction with the table, the Spindle starts whenever the variable cutting feed is engaged and stops whenever the table stops, reverses or moves at its constant fast travel.

Write for Specifications.

BROWN & SHARPE MFG. CO.
Providence, R.I., U.S.A.

PERSONALS

Fred C. Stiening, formerly chief engineer of the Thomas Spacing Machine Co., Pittsburg, Pa., is no longer connected with that concern. Mr. Stiening's plans for the future have not yet been announced.

Fred E. Lampe, until recently associated with the Powers Accounting Machine Corporation, has become connected with the Wales Adding Machine Co., Wilkes-Barre, Pa., in the capacity of production engineer.

Albert Schaffner, formerly with the United States Navy Yard at Philadelphia, has become associated with the H. B. Underwood Corporation, 1015 Hamilton St., Philadelphia, Pa., manufacturer of portable tools for industrial plants, marine shops, and railroad shops..

E. H. Rhynearson, for five years with the Millholland Machine Co., Indianapolis, Ind., and also for five years with the E. A. Kinsey Co., machinery dealer, Cincinnati, Ohio, has been placed in charge of the used machinery department of the Vonnegut Machinery Co., of Indianapolis, Ind.

R. L. Morgan, of the Greenfield Tap & Die Corporation, Greenfield, Mass., will terminate his connection with that concern on June 1. Mr. Morgan developed the "Hydroil" internal grinder manufactured by the company. His address after June 1 will be 393 Main St., Worcester, Mass.

Louis W. Williams, who has been in charge of the New York office and warehouse of the Union Drawn Steel Co., Beaver Falls, Pa., serving in the capacity of eastern sales agent, has been succeeded by J. P. Barnum, late assistant sales agent, and for many years office manager at New York.

W. H. Marshall, chairman of the board of the Consolidated Machine Tool Corporation of America, builder of machine tools, railroad and shipyard equipment, 17 E. 42nd St., New York City, has been elected president of the company to fill the vacancy caused by the sudden death of C. K. Lassiter on March 3.

Arthur H. Adams, consulting engineer, of 41 Park Row, New York City, specializing on design, development, and production problems in light and especially delicate mechanical and electro-mechanical devices, has recently become assistant to the superintendent of development of the Hawthorne, Ill., works of the Western Electric Co., Inc.

L. B. Augustine has been appointed export sales manager of the Wisconsin Electric Co. with offices at the factory in Racine, Wis. The company is undertaking a vigorous campaign to develop its export business in "Dumore" toolpost grinders, drills, motors, and electrical appliances. H. A. Schultz has been appointed advertising manager of the company.

John C. Cotter, formerly with the J. H. Williams & Co., at Buffalo, N. Y., has become associated with the Western Drop Forge Co., Marion, Ind. Mr. Cotter was connected with J. H. Williams & Co. for a number of years, having served as works manager of the Brooklyn factory, Buffalo district sales manager, and general sales manager of the special forgings department.

H. E. Witham has been appointed manager of the Chicago office of the Kearney & Trecker Corporation, Milwaukee, Wis., to take the place of W. H. Allen who has been promoted to the position of sales manager. Mr. Witham was previously connected with the Warner & Swasey Co., Cleveland, Ohio, serving in various capacities, principally with the sales department, and eventually being placed in charge of the Chicago office.

S. P. Rockwell, 65 Highland St., Hartford, Conn., was appointed by the American Gear Manufacturers' Association at its seventh annual convention, held in Cleveland, April 19 to 21, consulting metallurgist of the association. In this capacity, any of the members of the association may call on Mr. Rockwell for consulting work, when any problems arise in which they may be aided by Mr. Rockwell's experience in the metallurgical and heat-treating field.

W. H. Allen has been promoted to the position of sales manager of the Kearney & Trecker Corporation, Milwaukee, Wis., and will assume his new duties in that capacity at once. From 1906 to 1915 he was employed as a salesman for the Charles H. Besly Co., of Chicago, and subsequently became Chicago sales representative of the Fellows Gear Shaper Co. In 1918 he associated himself with the Kearney & Trecker Corporation in the capacity of manager of the Chicago office, which position he has held up to the present time.

Clifford F. Messinger, for the last three years general sales manager of the Chain Belt Co., Milwaukee, Wis., manufacturer of "Rex" conveying and transmission chains, concrete mixers, conveying machinery, and traveling water screens, has been elected second vice-president. Mr. Messinger entered the employ of the Chain Belt Co. in 1911, and has held the positions of advertising manager, manager of concrete mixer sales, and general sales manager. He is also a director of the Chain Belt Co., and a director of the Interstate Drop Forge Co. of Milwaukee.

Reginald Clark has become associated with the Western Drop Forge Co., Marion, Ind. Mr. Clark sailed for England on March 24, to investigate foreign forge practices in the interest of the company, and upon his return to the United States will reside and take up his work in Marion. He was previously connected with J. H. Williams & Co., and for many years with the Rolls-Royce Co. in Derby, England. During the war he was sent by the latter company to the United States to supervise the production, testing, and all elements in connection with forgings used in the Rolls-Royce battle plane motor.

Henry Dreses, president and general manager of the Dreses Machine Tool Co., who recently retired from active business. after fifty-four years' service in the machine tool industry, was tendered a farewell dinner by the radial drilling machine manufacturers of Cincinnati on the evening of April 4 at the Business Men's Club. August H. Tuechter acted as toastmaster, and presented Mr. Dreses, on behalf of his former associates, with a beautiful Rookwood vase, as an expression of their respect and esteem. The following were present: J. B. Doan, American Tool Works Co.; J. C. Carlton Machine Tool Co.; Oscar W. Mueller, Mueller Machine Tool Co.: Norman B. Chace, Fosdick Machine Tool Co.; George M. Morris and Arthur C. Pletz, Morris Machine Tool Co.; William Gilbert, Charles Gilbert and Walter Hudson, Dreses Machine Tool Co.; George P. Gradolf and August H. Tuechter, Cincinnati Bickford Tool Co.

* * *

THE AMERICAN MANAGEMENT ASSOCIATION

The American Management Association was formed at a recent meeting in New York City, at which were present nearly 200 executives representing industrial and commercial enterprises in various parts of the country. The new organization takes the place of the National Personnel Association, and will be devoted exclusively to the consideration of the human factor in commerce and industry. The association recognizes that personnel work is an inseparable part of management, and is interwoven in all the efforts and activities of the production and sales departments. It cannot be segregated as an isolated function, and must be dealt with by management with the same care as production and sales problems. The human factor in industry must be handled in a more intelligent manner than it has in the past, if the best results as regards industrial harmony and cooperation are to be obtained. Among the men at the meeting who expressed themselves strongly along these lines was Charles R. Hook of Middletown, Ohio, vice-president and general manager of the American Rolling Mill Co., who declared that the leaders of American industry must carry to the rank and file of the workers a clear and simple explanation of the problems of business as they relate to the particular work in which any one industrial enterprise is engaged.

* * *

THE INDUSTRIAL OUTLOOK

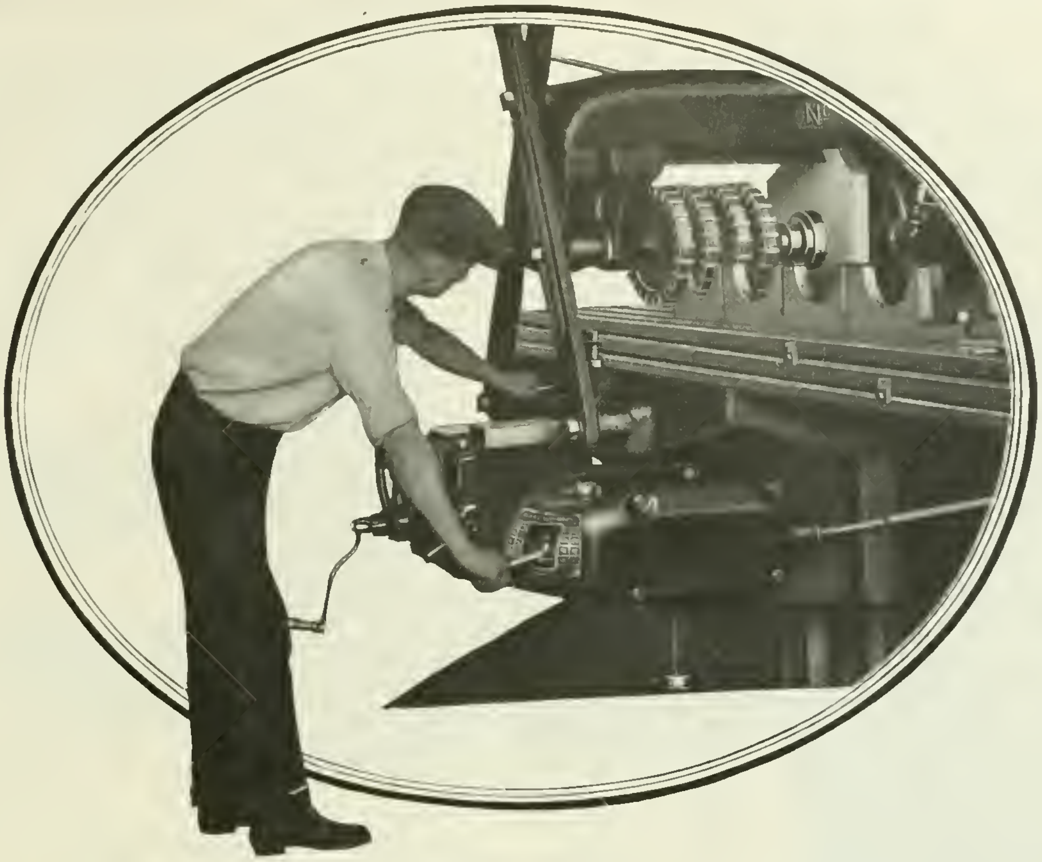
As summarized by W. F. Gephart, vice-president of the First National Bank of St. Louis, the outstanding factors in the industrial situation today are as follows:

The present tendency of business is upward, but further increases above the existing physical volume of trade are handicapped by the lack of adequate transportation facilities.

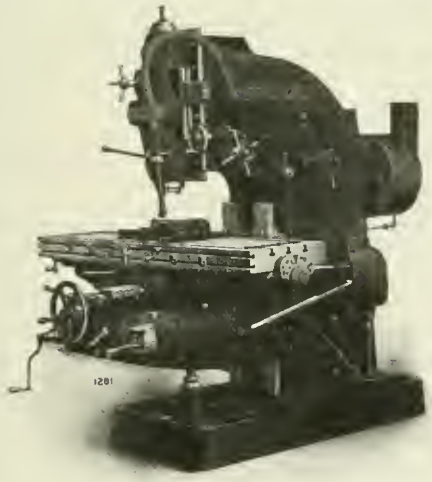
The upward movement of prices may continue in the case of some classes of commodities, but there will probably be a marked resistance to too rapid and too great advances in the case of consumers' goods. One of the unfortunate effects of the transportation situation is that it may produce a temporary "place scarcity" of some commodities, with the result that some unhealthy price advances may occur.

Wages, like prices, will probably reach higher levels in some lines of business. This, coupled with higher raw material costs, in the face of a resisting market, will probably tend to restrict industrial profits, even though business activity continues at a relatively high level.

While the Federal Government has been making some progress in reducing expenses, there is no sound basis for assuming that any material reduction in taxes can be expected in the near future. As a matter of fact, if some of the plans that are now under consideration are put into force, taxes may tend higher rather than lower.



INSTANTLY!



No. 4 VERTICAL HIGH POWER

All 4 and 5 High Power Millers have patented features that will speed your production. It will pay to know all about them.

From *one* position at the *front* of the knee, a *single* lever by a *direct* movement gives any desired rate of feed.

Easier control means more profitable operation. That is why No. 4 and No. 5 High Power Cincinnati Millers are designed to bring all elements of control to the operator at this one centralized position.

Other equally distinctive patented features are described in a special booklet "Cincinnati Millers Nos. 4 and 5." Send for it.

The Cincinnati Milling Machine Company
CINCINNATI, OHIO

CINCINNATI MILLERS

OBITUARIES

WINSLOW BLANCHARD

Winslow Blanchard, president of The Blanchard Machine Co. of Cambridge, Mass., and widely known in the machine tool industry, died at his home in Waban, Mass., April 7, after an illness of some months. He was born in Dorchester, Mass., September 24, 1865, the son of John W. and Harriet Blanchard. A graduate of the Institute of Technology in the class of 1888, in his early professional life he served on the engineering staffs of the Boston Heating Co., and the Metropolitan Sewerage Commission, but for more than twenty years had been associated with The Blanchard Machine Co., of which he was the head. Mr. Blanchard held all the chief executive offices of the Boston Branch of the National Metal Trades Association, and was treasurer of the Associated Industries of Massachusetts, first vice-president of the National Machine Tool Builders' Association, one of the Board of Governors of the Massachusetts Charitable Mechanics' Association, a member of the Employers' Association of Eastern Massachusetts, the Engineers' Club of Boston, the Machinery Club of New York, the Wellesley Country Club and the Waban Neighborhood Club.

Mr. Blanchard was responsible for bringing out a line of grinding machines so original in design that the type was generally referred to as Blanchard grinders. These machines have greatly widened the field for the grinding of flat surfaces and many parts that formerly it was not considered practicable to grind.

Mr. Blanchard is survived by his wife, two brothers and a sister.

Fred S. Martin, staff superintendent of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., died recently in the West Penn Hospital, Pittsburg, following an operation. Mr. Martin was born in Claverick, N. Y., February 12, 1863. He graduated from the Staustead Wesleyan College, Staustead, Canada, in 1878, with a commercial degree. After completing his college education, he took up the machinist trade at the Franklin Foundry & Machine Co., Providence, R. I. Upon completing his training, he became superintendent of the Brown & Sharpe Mfg. Co., which position he held for eight years. Later he became foreman of the Edison General Electric Co. in Schenectady, and in November, 1906, entered the employ of the R. D. Nuttall Co., Pittsburg. Subsequently he was employed by the Westinghouse Electric & Mfg. Co., and served as superintendent of the large industrial motor department for a period of eleven years. In 1918 he was appointed staff superintendent and held that position until the time of his death. He was a member of the American Society of Mechanical Engineers. Mr. Martin is survived by his wife, three sons, and one daughter.

Frederick M. Stevens, for the last twelve years production manager of John Chatillon & Sons, died in New York City on April 8, in his seventy-second year. Mr. Stevens was born in Danbury, Conn., and after finishing public school, attended the Gloversville Military Academy. He then entered Cornell University, where he studied mechanical engineering. After completing his education, he spent fourteen years in production work with Mathews & Willard, of Waterbury, Conn. He left Waterbury to take charge of the production of the Manhattan Screw & Stamping Co. in New York City. During the last twelve years of his life, Mr. Stevens served as production manager of John Chatillon & Sons. During this time he made many notable changes in production methods and practice, developing and improving many types of scales and cutlery. Mr. Stevens is survived by a widow and three daughters.

Walter H. Gilliland, architect for the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., died on April 1 at his residence in Pittsburg, aged fifty years. Mr. Gilliland became connected with the Westinghouse company in 1904. At the time of his death he held the position of works architect, and had charge of the designing of buildings for the company not only at East Pittsburg but throughout the United States. He is survived by his wife, a daughter, and two sons.

Ernest Mills, vice-president and production manager of the Smith & Mills Co., Cincinnati, Ohio, manufacturer of shapers, died at his home in Cincinnati on April 4, after an illness of about three months. Mr. Mills was forty-nine years old at the time of his death, and had spent thirty-five years in the business. He leaves a widow, one son, two daughters and a brother, James Mills, who is president of the Smith & Mills Co. He was a Scottish Rite mason.

M. C. Townley, president of the Walcott Lathe Co., Jackson, Mich., died on April 3.

MEETING OF AMERICAN WELDING SOCIETY

The annual meeting of the American Welding Society was held in the Engineering Societies' Building, 29 W. 39th St., New York City, April 24 to 27. The first day was devoted to committee meetings on the training of operators, resistance welding, electric arc welding, and the welding of storage tanks. The committee on specifications for steel to be welded, met Thursday, April 26, and in the evening of the same day the technical session of the society was held, when papers were read on "Welding of Unfired Pressure Vessels," by H. L. Whittemore, and on "Training of Welding Operators," by J. C. Wright. During the last day of the meeting the gas welding committee outlined plans for future activities.

The committee on training of operators outlined courses for training both gas and electric welders; the resistance welding committee considered a research program and assigned specific problems to appropriate laboratories and individuals. The electric arc welding committee dealt with standardization of arc welding apparatus, cast iron welding, applications of arc welding to ship construction, and welding of non-ferrous metals and manganese steel. Recent developments in the electric arc welding field were reviewed. The committee on specifications for steel to be welded made plans for such investigations as are necessary to enable the committee to draw up specifications for steel.

* * *

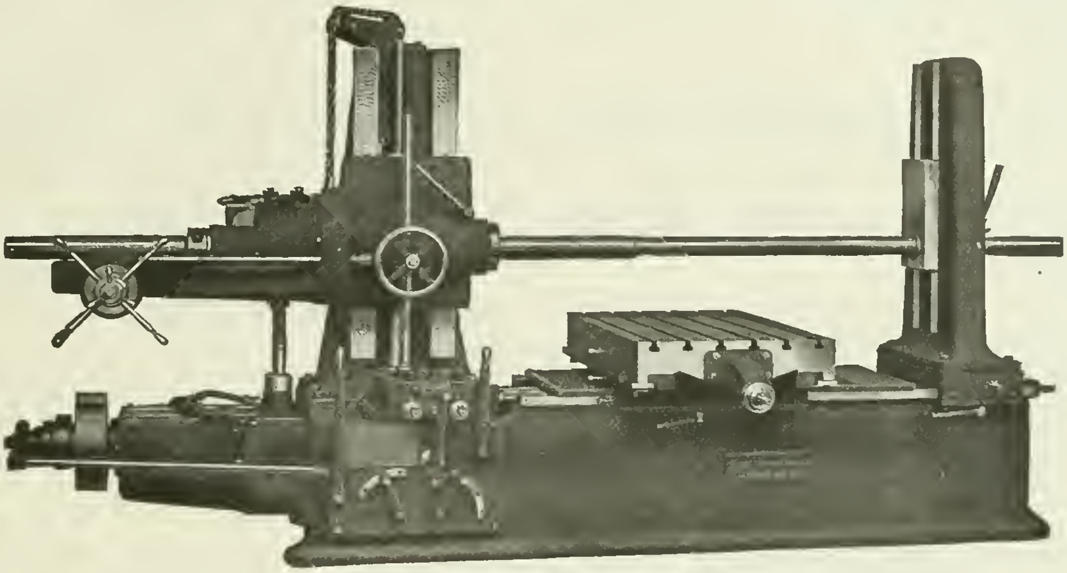
SWISS FIRM RECEIVES FRANKLIN INSTITUTE MEDAL

The Franklin Institute, Philadelphia, Pa., at its meeting Wednesday, April 18, conferred the Edward Longstreth medal upon the Societe Genevoise d'Instruments de Physique of Geneva, Switzerland, for that company's universal measuring machine. R. Y. Ferner, of 1410 H St., N. W., Washington, D. C., the American representative of the company, received the medal on behalf of the Geneva firm. This medal is awarded for unusual developments and inventions pertaining to mechanical processes. The universal measuring machine, for which the medal was awarded, is a machine adapted to the measurement of gages of all types used in machine shops for inspection or working purposes, including plug, disk, plate, snap, ring, and thread gages.

* * *

The British Engineering Standards Association has recently published a conveniently arranged glossary of the terms employed in aeronautical work. The glossary is divided into sections covering general aeronautics, airplanes, airships, aircraft engines, and instruments. In each section the terms employed are logically arranged and clearly defined. Illustrations are given in many cases to assist the user, and a complete general index is also included, so that any particular term can be readily located. The number of the publication is 185—1239, and it is obtainable from the offices of the association at 28 Victoria St., London, S. W. 1, price 1s 5d.

"A ship is a ship only when she's sailing"—
And so a boring machine is a boring machine only when she's boring; and the same with a drilling or a milling machine.

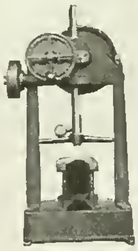


When the

"PRECISION"

Boring, Drilling and MILLING MACHINE

is not doing one thing she is doing another, and often does all three at one setting of the work, therefore *Never Stands Idle.*



WE ALSO MAKE THE
LUCAS POWER
Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo. Aux Forges de Vulcain, Paris. Benson Bros., Sydney, Melbourne.

TRADE NOTES

Bridgeport Brass Co., Bridgeport, Conn., has moved its Chicago district sales office from the State Lake Building to the Wrigley Building.

American Grinding Co., Philadelphia, Pa., is erecting a new building at 1527 Fairmount Ave. The company plans to increase its range of work and will install some additional special machinery.

LaPorte Machine & Tool Co., Inc., LaPorte, Ind., has acquired the manufacturing rights to the J. & B. filing and sawing machine formerly built by the Johnson & Biddle Tool Co., Elkhart, Ind.

Williams, White & Co., Moline, Ill., have opened an office at 623-625 Majestic Bldg., Detroit, Mich., for the accommodation of their customers in that territory. C. G. d'Ugglas is in charge of the new office.

John Steptoe Co., Cincinnati, Ohio, manufacturer of shapers, milling machines, and lathes, has made arrangements to build the die-slotting machine previously made by the Peters-Bossert Co., which was described in February, 1922, Machinery.

Peter A. Frasse & Co., Inc., 417 Canal St., New York City, have purchased the entire stock of seamless steel tubes of the U. T. Hungerford Brass & Copper Co., New York, the latter company having discontinued the handling and sale of seamless steel tubes.

Cutler-Hammer Mfg. Co., Milwaukee, Wis., has made an agency arrangement with O. T. Jenkins, 1002 Pacific Ave., Dallas, Tex., for the sale of wiring devices, radio apparatus, and standard industrial heating apparatus. The territory covered is Texas and Oklahoma.

Oilgear Co., Milwaukee, Wis., manufacturer of hydraulic presses, broaching machines, variable delivery pumps, and variable-speed drives, has appointed the Cleveland Duplex Machinery Co. Inc., 1224 W. 6th St., Cleveland, Ohio, as its representative in the northern Ohio district.

Rockford Milling Machine Co., Rockford, Ill., has appointed Manning Maxwell & Moore, Inc., its exclusive representative in the Atlanta, Ga., territory with offices at Atlanta. The company will represent the Rockford Tool Co., as well as the Rockford Milling Machine Co.

Triplex Machine Tool Corporation, 50 Church St., New York City, has appointed the firm of Neff, Kohlbusch & Bissell, 1045 W. Washington Blvd., Chicago, Ill., exclusive agent for the sale of the Triplex combination bench lathe, milling and drilling machine in the Chicago territory.

Walter A. Zelnicker Supply Co., St. Louis, Mo., has moved from 325 Locust St., where it has been located for the last twenty years, to new offices in the Chamber of Commerce Bldg., 511 Locust St. The main plant and yards of the company in East St. Louis now cover fourteen acres.

Rockford Machine Tool Co., Rockford, Ill., has given the following dealers exclusive sales rights in their respective territories for Rockford planers, shapers, and drilling machines: C. A. Thumm, 125 Light St., Baltimore, Md.; Milwaukee Machinery Co., 93 W. Water St., Milwaukee, Wis.

Cutler-Hammer Mfg. Co., Milwaukee, Wis., moved its Pittsburg office on May 1 from the Farmers Bank Building to Rooms 950-953 Century Building, located on Seventh St., between Penn Ave. and Duquesne Way. A. G. Pierce is manager of the central district with headquarters in Pittsburg.

Camden Mfg. Co., Camden, N. J., has been taken over by William T. J. Purnell, president of the Palmyra National Bank, and Jacob M. Noll, formerly general manager of the Nelson Valve Co. The company will be known as the Camden Die Mfg. Co., and will continue to manufacture the "Camco" dies.

Dwight P. Robinson & Co., 125 E. 46th St., New York City, engineers and constructors, have opened a Philadelphia office which will be under the direction of Carl A. Baer, a consulting engineer in the design of industrial textile and power plants, recently connected with the firm of Baer, Cook & Co., engineers.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder and precision thread lead variator, announces the following newly elected officers: President and general manager, A. T. Doud; vice-president and chief engineer, W. H. Frick; treasurer, F. V. Doud; and secretary, W. C. Greger.

Cleveland Abrasive Wheel Co., Cleveland, Ohio, has recently added to its plant and equipment, and is now in a position to supply vitrified and shellac wheels, as well as those manufactured by the silicate process. This company started by manufacturing only silicate wheels, but has widened its scope, so that it now meets all grinding wheel requirements.

Bickett Machine & Mfg. Co., Cincinnati, Ohio, has been reorganized and is now doing business at 650 Evans St., Cincinnati, under the name of Bickett Miller Co. The company will continue to manufacture the Bickett line of bench milling machines, and will also design and build special machinery and tools and do general contract work. C. A. Bickett is president and general manager.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., has opened a direct factory branch at 66 Forsythe St., Atlanta, Ga. The new branch will be under the management of Ben L. Willingham and Brad Hodges, both of whom have had broad experience in the belting field. At the new branch the company will carry a complete stock of "Reliance" and "Sea Lion" leather belting, as well as a complete line of belting accessories.

Griswold Mfg. Co., Rock Island, Ill., has sold its entire assets to C. P. Thomas, of Rock Island, and the business will be operated in the future under the firm name of the Thomas-Kerns Co. (not incorporated). The Thomas-Kerns Co. is entering the light metal specialty engineering field, and in addition to stampings, will produce jigs, tools, dies, wood and metal patterns, models, etc. It will also undertake plating, enameling and spot-welding.

Midwestern Tool Co., 5215 Ravenswood Ave., Chicago, Ill., has recently been formed for the purpose of manufacturing hobs, milling cutters, jigs, fixtures, dies, gages, and special tools. S. R. Swenson, who has been chiefly active in forming the new company, will act as general manager. Mr. Swenson has had extensive experience in the field covered by the new company, having formerly been connected with the Barber-Colman Co., the Illinois Tool Works, and the Goddard Tool Co.

American Metal Products Co., Milwaukee, Wis., manufacturer of "Ampco," a copper aluminum steel alloy of high tensile strength and acid-resisting properties, reports an increase of 400 per cent in its business over the previous year. The company has just installed a Detroit electric rocking type furnace to take care of its increasing business in ingots and castings. Other new equipment is being installed, and the installation of a wire-drawing equipment is contemplated.

Combustion Engineering Corporation, Limited, and the Uehling Instrument Co., Paterson, N. J., have entered into an agreement whereby Uehling interests in Canada and Newfoundland will be handled exclusively by the Combustion Engineering Corporation, Ltd., with principal offices located in Toronto, Montreal, Winnipeg and Vancouver. The Uehling line includes CO_2 recorders, SO_2 recorders, draft recorders, combined barometer and vacuum recorders, absolute pressure indicators, etc.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., is erecting a twenty-three story bank and office building at Broadway and Liberty St., New York City, which will be known as the Westinghouse Building. All the space above the eleventh floor will be occupied by the Westinghouse Electric & Mfg. Co., Westinghouse Electric International Co., Westinghouse Lamp Co., Westinghouse Air Brake Co., and allied organizations. The building is expected to be ready for occupancy on May 1, 1924.

Marf Machine & Die Casting Co., Inc., Brooklyn, N. Y., manufacturer of die-castings in aluminum, zinc, tin, and lead alloys, has opened a New England office at 51 Harrison Ave., Room 222, Springfield, Mass., of which John C. Bennett is manager. Mr. Bennett has been secretary, and for the past year president of the Purchasing Agents' Association of western Massachusetts, and was previously connected with the Stevens-Duryea Automobile Co., the Fisk Rubber Co., and the Hampden Grinding Wheel Co.

Whitman & Barnes Co., Akron, Ohio, transferred its New York City office and warehouse on May 1 from 64 Reade St. to new and more commodious quarters at 99 Chambers St., corner of Church. This location will afford increased accommodations and facilities for the carrying of larger stocks of W & B twist drills and reamers, thereby enabling the company to render a complete service in the eastern district. Frank W. Oliver, manager in charge, with a corps of salesmen, will represent the company's interests as heretofore.

Rolled Thread Die Co., 28 Cherry St., Worcester, Mass., has been formed for the purpose of manufacturing rolled thread dies. The company has been formed by E. Howard Reed and M. Clifton Nelson, who have had extensive experience in practical thread rolling. The new company expects to embody in its method of design and manufacture of thread rolling dies some new principles discovered through an exhaustive study of the problems involved in thread rolling, and expects to place on the market dies that will produce a high grade of rolled thread.

AJAX

(Trade Mark Registered)

Upsetting Stock for ½" Eye Rod Ends—

Production:—200 per Hour

This 1½" Ajax New Model Upsetter with one operator and one heater is making record productions on these ½" eye rod upsets at the Joslyn Mfg. & Supply Co., Chicago.

It takes four operations to gather the 9" of ½" working stock into this egg shaped upset from which the eye is afterward drop forged.

The machine on which the piece was formerly made required three die and tool set-ups and three heats to complete the forging, but this NEW MODEL Ajax with its *great vertical die height* and *ample stock gather* accommodates all operations in one pair of dies and makes possible the completion of the forging at one heat.

Extra die set-ups and heats add materially to forging costs. Let us show you how Ajax Machines will *reduce your costs* and *increase your profits.*

The Ajax Manufacturing Company

621 Marquette Building
Chicago, Ill.

1369 Hudson Terminal
New York City

CLEVELAND, OHIO

COMING EVENTS

May 2-4—Tenth National Foreign Trade Convention in New Orleans, La. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 3-5—Semi-annual meeting of the American Electro-chemical Society at Hotel Commodore, New York City. Secretary, Colin G. Fink, 327 S. La Salle St., Chicago, Ill.

May 7-10—Eleventh annual meeting of the National Chamber of Commerce in New York City at the Waldorf-Astoria Hotel. Secretary, D. A. Skinner, Mills Bldg., Washington, D. C.

May 15-18—Annual convention of the National Association of Purchasing Agents at Cleveland, Ohio. Secretary, O. H. R. Heydon, 19 Park Place, New York City.

May 17-19—Joint convention of the National Supply & Machinery Dealer's Association, Southern Supply & Machinery Dealers' Association, and American Supply & Machinery Dealers' Association in Cincinnati, Ohio. Secretary, F. D. Mitchell, 1819 Broadway, New York City.

May 28-31—Spring meeting of the American Society of Mechanical Engineers at Montreal, Canada. Calvin W. Rice, 29 W. 39th St., New York City, secretary.

June 11-14—Annual meeting of the Electric Power Club in Hot Springs, Va.; headquarters, Hotel Homestead. Executive secretary, S. N. Clarkson, Kirby Bldg., Cleveland, Ohio.

June 14-15—Eastern sectional meeting of the American Society for Steel Treating in Bethlehem, Pa. National secretary, W. H. Eisenman. Hotel reservations made through George O. Lilly, superintendent of heat-treatment, Bethlehem Steel Co., Bethlehem, Pa.

June 19-23—Summer meeting of the Society of Automotive Engineers at Spring Lake, N. J. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

June 25-29—Annual convention of the American Institute of Electrical Engineers at Swampscott, Mass. For further information, address the secretary's office, 29 W. 39th St., New York City.

June 25-30—Twenty-sixth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa., secretary.

October 8-12—Annual convention of the American Society for Steel Treating to be held in Pittsburg, Pa., in connection with an international steel exposition. W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio, national secretary.

October 25-26—Production meeting of the Society of Automotive Engineers at Cleveland, Ohio. Further information may be obtained from the society's headquarters, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

Testing of Barometers and Altimeters. 22 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 46 of the Bureau of Standards. Price, 10 cents.

Business Cycles and Unemployment. 30 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C. Price, 5 cents.

This little pamphlet contains a digest of the report and recommendations of a committee on the President's Conference of Unemployment which met in Washington in September, 1921. The foreword is written by Herbert Hoover. The book gives the suggestions made by the committee for controlling business cycles.

Patents—Law and Practice, 56 pages, 6 by 9 inches. Published by Richards & Geier, patent and trademark attorneys, 277 Broadway, New York City.

This little booklet is designed to serve as a convenient handbook on patent law and practice, presenting in concise form for ready reference, the information required by lawyers, manufacturers, and inventors. It contains a digest of United States law and practice as well as the practice in foreign countries. The book is distributed without charge to those interested in the subject.

Machine Tools and Their Operation—Part II. By Fred H. Colvin and Frank A. Stanley. 409 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $4.

This is the second volume of a work published in two parts on the construction and operation of machine tools. This part takes up planers, shapers, slotters, broaching machines, milling machines, gear cutting machines and grinders. The aim has been to show examples of the uses of the various machines so as to give a thorough understanding of the principles involved. Section I, dealing with planers, describes methods of holding the work; fixtures, gages and tools; different kinds of work; belting speed and power. Section II treats of the shaper and its uses, and describes tools and fixtures for special work. The section on milling machines discusses general types; spindle driving and feed mechanism; the dividing head and some of its uses; cutting spirals; attachments; cutters and their uses; setting cutters and work; and typical milling operations. The grinding section describes types of grinding machines; cylindrical grinding; surface grinding; grinding wheels; safeguards in grinding; various grinding operations; buffing and polishing; and the magnetic chuck.

NEW CATALOGUES AND CIRCULARS

Wellman-Seaver-Morgan Co., Cleveland, Ohio. Bulletin 77, illustrating and describing the W-S-M type L gas producer for making producer gas from coal.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa. Folder containing information on precision cold-set diamonds for truing grinding wheels.

Niles-Bement-Pond Co., 111 Broadway, New York City. Leaflets illustrating Maag gears, pointing out their advantages, and showing different positions of the cutter in generating this type of gear.

Magnus Electric Co., Inc., 451 Greenwich St., New York City. Catalogue 922, of wireless accessories, including vario-couplers, condensers, rheostats, crystal detectors and holders, vacuum tube sockets, tuning coils, etc.

Uehling Instrument Co., Paterson, N. J. Circular illustrating Uehling carbon dioxide recorders. The pamphlet also contains data on the Uehling combined barometer and vacuum recorder for low-pressure turbine and condensing plants.

Racine Tool & Machine Co., 1433 Junction Ave., Racine, Wis. Leaflet illustrating the Racine high-speed metal-cutting machine, showing a pile of one-inch square steel bars cut in nine hours by this machine with one blade at a blade cost of six cents.

A. D. Granger, 15 Park Row, New York City. Bulletin 2, descriptive of the Oswego internally fired water-tube boiler, illustrating the latest improved features. Tables giving dimensions, ratings, and other data for both high- and low-pressure boilers are included.

Whiting Corporation, Harvey, Ill. Catalogue 165, illustrating and describing the Whiting line of cranes, which includes electric travelling cranes, bucket-handling cranes, Gantry cranes, transfer cranes, hand-power cranes, jib cranes, and pillar and bracket cranes.

Oliver Machinery Co., Grand Rapids, Mich. Bulletin 7, on portable woodworking machinery, including saw benches, hand saws, jointers, sanders, wood trimmers, oilstone grinders, tool grinders, vises, and glue heaters. Copies will be sent to those interested, upon request.

Walter A. Zelnicker Supply Co., 511 Locust St., St. Louis, Mo. Bulletin 300, listing track material, rails, cross-ties, switches, turntables, locomotives, cars, cranes, steam shovels, machine tools, air compressors, boilers, motors, generators, etc., carried in stock by the company.

Ingersoll Milling Machine Co., Rockford, Ill. Circular showing typical jobs handled on Ingersoll continuous milling machines, and giving production data for each. The circular also illustrates the Ingersoll type R inserted-tooth milling cutter designed for general-purpose milling.

Hisey-Wolf Machine Co., Cincinnati, Ohio. Bulletin 106, descriptive of Hisey portable electric drills and reamers. The various features of these tools are outlined, and illustrations and complete specifications are given for the different styles. A detailed line illustration makes the construction clear.

Stark Tool Co., Waltham, Mass. New catalogue covering the line of bench milling machines, precision bench lathes and attachments, and fine tools made by this concern. The catalogue illustrates the various tools, and gives complete specifications of each. A detailed description of the Stark lathe attachments is included.

Louis Allis Co. Milwaukee, Wis. Bulletin on the Watson multi-speed motor, which operates on polyphase alternating current circuits and is designed to parallel the performance of direct-current motors having adjustable speed through field control. Attention is called to the large field for the multi-speed motor in the machine shop.

Myers Machine Tool Corporation, Columbia, Pa. Circular descriptive of the new Myers 10-inch engine lathe, equipped with quick-change gears. In designing this lathe particular attention was given to the features of simplicity, convenience, and economy. The circular describes the machine in detail, and illustrates the various parts and attachments.

Triplex Machine Tool Corporation, 50 Church St., New York City. Circular descriptive of the Triplex combination machine for turning, boring, milling, drilling and thread cutting. The illustrations show the machine in operation on the different classes of work for which it is adapted. The machine is also shown equipped with a combined floor stand and chip pan, which can be furnished if desired.

Fellows Gear Shaper Co., Springfield, Vt. Catalogue entitled "A New Development in Gear Cutting," describing the principles involved in the design of the No. 7 type gear shaper, which is intended for the rapid production of accurate gears. In addition to the general description, information is also included on the correct method of setting up and operating the machine. This is the second edition of the catalogue.

Geometric Tool Co., New Haven, Conn. Booklet treating of Geometric collapsing and solid adjustable taps. The advantages of the collapsing feature are pointed out, and the principle of operation is explained. These taps are made in two classes, the standard class NL type, and the type known as class P, which is intended for special work; both of these types are fully described. Instructions for operating are also given.

Brown & Sharpe Mfg. Co., Providence, R. I. Booklet entitled, "New Tools by Brown & Sharpe," describing and illustrating tools for the machinist, toolmaker, and garage mechanic, which have been added to the Brown & Sharpe line. Among the tools shown are micrometer calipers, micrometer cases, stainless steel rules, micrometer depth gages, thickness gages, dial test indicator attachments, and speed indicators.

United States Drill Head Co., Cincinnati, Ohio. Circular illustrating and giving general specifications of the U. S. patented adjustable multiple-spindle drill head, which is regularly furnished with any number of spindles from two to six. The standard heads are made in five different sizes. The No. 4 head is built especially for drilling pipe, fittings, flanges, and similar parts in which holes are equally spaced and in multiples of four.

Bristol Co., Waterbury, Conn. Catalogue 1006, containing 84 pages covering the complete line of Bristol recording gages for pressure and vacuum. The charts reproduced show that the gages are adapted to practically every application where pressures of liquids, gases, steam or air are required to be measured. Illustrations and descriptive matter relating to the various types are included, as well as list prices and directions for ordering.

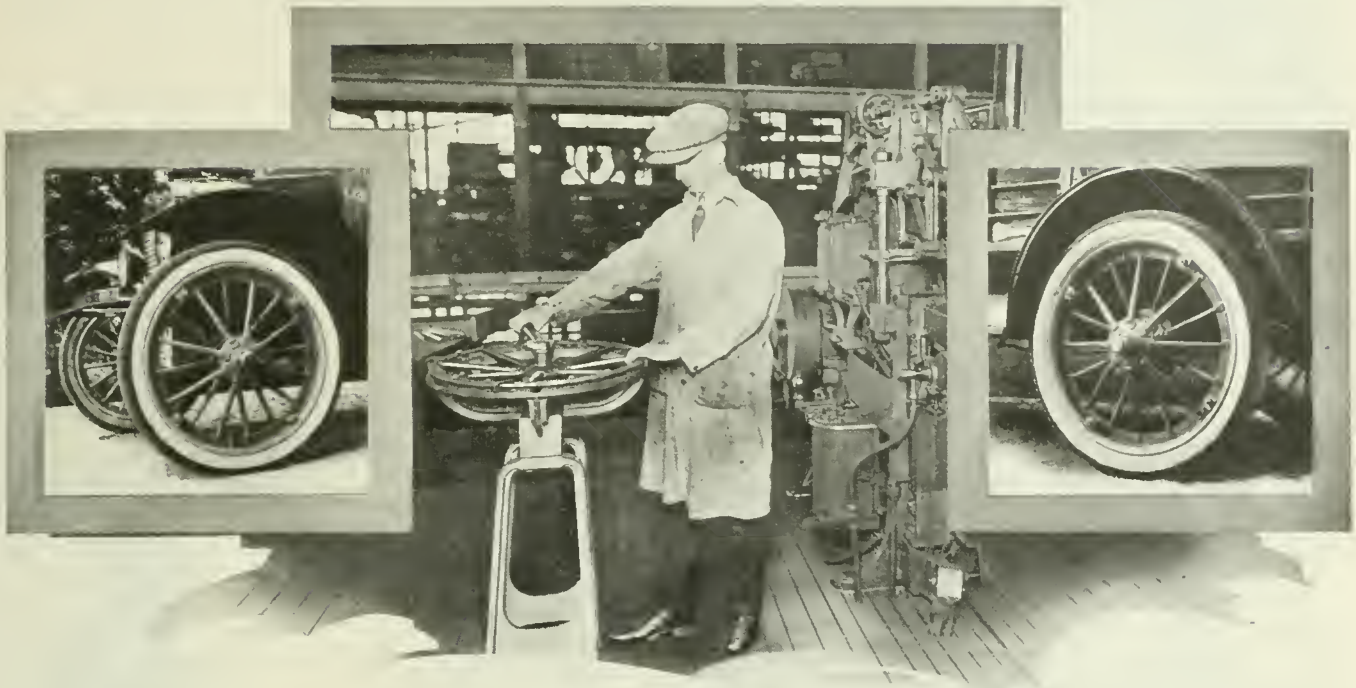
James H. Matthews & Co., 3946 Forbes Field, Pittsburg, Pa. General catalogue covering the line of marking devices and metal signs made by this concern. The new catalogue has been made up with a view to making it easier for the buyer to select the right marking device for each marking job. Instead of the usual description of the products, the space has been devoted to explaining how each article is used and illustrating what each device will do.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Book entitled "Material-Handling Equipment for Foundries," devoted entirely to the application of Link-Belt products to the modern foundry. The book is profusely illustrated by photographs of actual installations, and also by line drawings indicating proper methods of efficient installations. The practices and methods of six large and nationally known foundries are illustrated and described. The book is known as Link-Belt publication No. 690.

Scully-Jones & Co., 2013 W. 13th St., Chicago, Ill. Small tool catalogue 33, describing the company's complete line of "Wear-Ever" production tools. The catalogue lists the various tools in this line, and explains in detail the advantages and adaptability of each. Special attention has been given to simplifying the instructions for ordering, so as to enable the prospective buyer to express his requirements clearly. A number of tables are presented, giving dimensions of Woodruff keys, standard Morse tapers, Brown & Sharpe tapers, and tap drill sizes.

Boston Gear Works, Norfolk Downs, Quincy, Mass. Catalogue 42, covering the complete line of gears made by this concern. Among the new products shown are single annular bearings, Grundy flexible couplings, adjustable self-aligning hangers, fabroil non-metallic spur pinions, pillow blocks, silent chain drives, 2½ diametral pitch spur gears, and worm-gear reduction units. A section of useful tables is also included, giving decimal equivalents, weights of brass and steel, strength of gear teeth, horsepower for gears, belting, and shafting, tooth parts, etc.

Charles A. Schieren Co., 42 Ferry St., New York City, is publishing a "Leather Belting Handbook" which is intended to serve as a practical manual on belting and power transmission for engineers, plant executives, production managers, maintenance men, factory superintendents, foremen, and purchasing agents. It is being issued in eighteen separate sections. The book includes a discussion of the different types of drives; information about belting, such as belting rules and ratings; horsepower, etc.; care and operation; proper methods of joining ends of belts; alignment of drives; moist conditions; V and round belting; comparative operating cost of leather and rubber belting; selecting the proper kind of belting; data on how leather belts are made; plant lay-out, showing the most economical arrangement of belt drives; location of motors; and sizes of shafting. Copies will be mailed to those interested, upon request.



Making Welded Pressed-Steel Automobile Wheels

Methods and Equipment Employed in Making Automobile and Truck Wheels by a New Process

A NEW field for the use of pressed steel has been found in the manufacture of automobile wheels. Recent developments have shown that automobile wheels constructed of pressed steel, with the parts welded together, are unusually strong and well balanced, as well as attractive in appearance. The wheels here described are the product of the Stanley Steel Welded Wheel Corporation, Boston, Mass., and the success of this type of wheel from a mechanical point of view may be attributed chiefly to the welding process, by means of which the spokes, rims, and flanges are fastened together. For these operations, special welding machines of more than usual interest have been designed by Arthur M. Stanley, chief engineer of the company. Mr. Stanley has specialized in electric welding for many years, and has designed and built many of the machines now in commercial use. The machines illustrated are those built before quantity production was undertaken; machines of higher productivity are being constructed at the present time.

This article describes a new development in the manufacture of automobile wheels. It has been found that pressed-steel wheels, in which the parts are welded together, are unusually strong and well balanced. A welded pressed-steel wheel, weighing about the same as a wood-spoked wheel, has withstood a pressure of 4100 pounds when subjected to a dish test, before signs of failure were noticed, while a wooden wheel broke at a pressure of 2200 pounds. When subjected to direct crushing tests, the wooden wheel was completely destroyed under a pressure of 6 tons, while the steel wheel only bent slightly under 9 tons. The methods used in making wheels by this process are described in the present article.

Construction of the Wheel

The parts forming one-half of the wheel are shown in Fig. 1, together with the outer rims. Each half consists of a spider made up of two flanges, welded together and containing eight spokes welded into pockets formed by depressions in the two flange members. Two of these spiders are butt-welded at the hub portions of adjacent flanges so that the spokes of one spider will alternate with the spokes of the other, as shown at the left in Fig. 3. This unit is then assembled into the outer rims which, as may be seen in Fig. 1, are provided with pockets into which the spokes are welded in the final assembling. The fully assembled wheel is shown at the right in Fig. 3.

There is nothing unusual in the actual press work. The two flange members, one of which has a drawn-up octagonal hub, are made from ⅛-inch stock. The two flanges that form the center of the outer spider are the same for both front and rear wheels, but the innermost flange member of the inner spider is not the same for both wheels. This is due to the necessity of providing for the brake-drum and drive on the rear axle. A machine-steel sleeve or long bushing of octagonal shape is fitted into the hub of the rear wheel. This sleeve has a tapered hole and keyway for the driving key on the axle. The flanges that are shown in Fig. 1 are for the outer spider.

The rims are also made from ⅛-inch stock, each formed so that when welded together they will form the face of the wheel and fit into the demountable rims for the tire shoe. The rims are made by bending hot-rolled angle-steel stock into a circle, joined by welding, and the spoke pockets

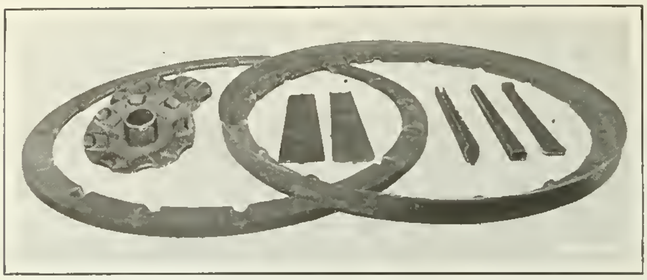


Fig. 1. Flanges, Spokes, and Rims for Pressed-steel Wheel

are formed in a press. The spokes are made from 1/16-inch stock in five operations, exclusive of welding. The appearance of the work after each operation is indicated in Fig. 1. The tapered spoke blanks are formed on the edge, partly closed, then entirely closed, welded at the seam, and finally flattened at the ends to fit the pockets in the wheel rim.

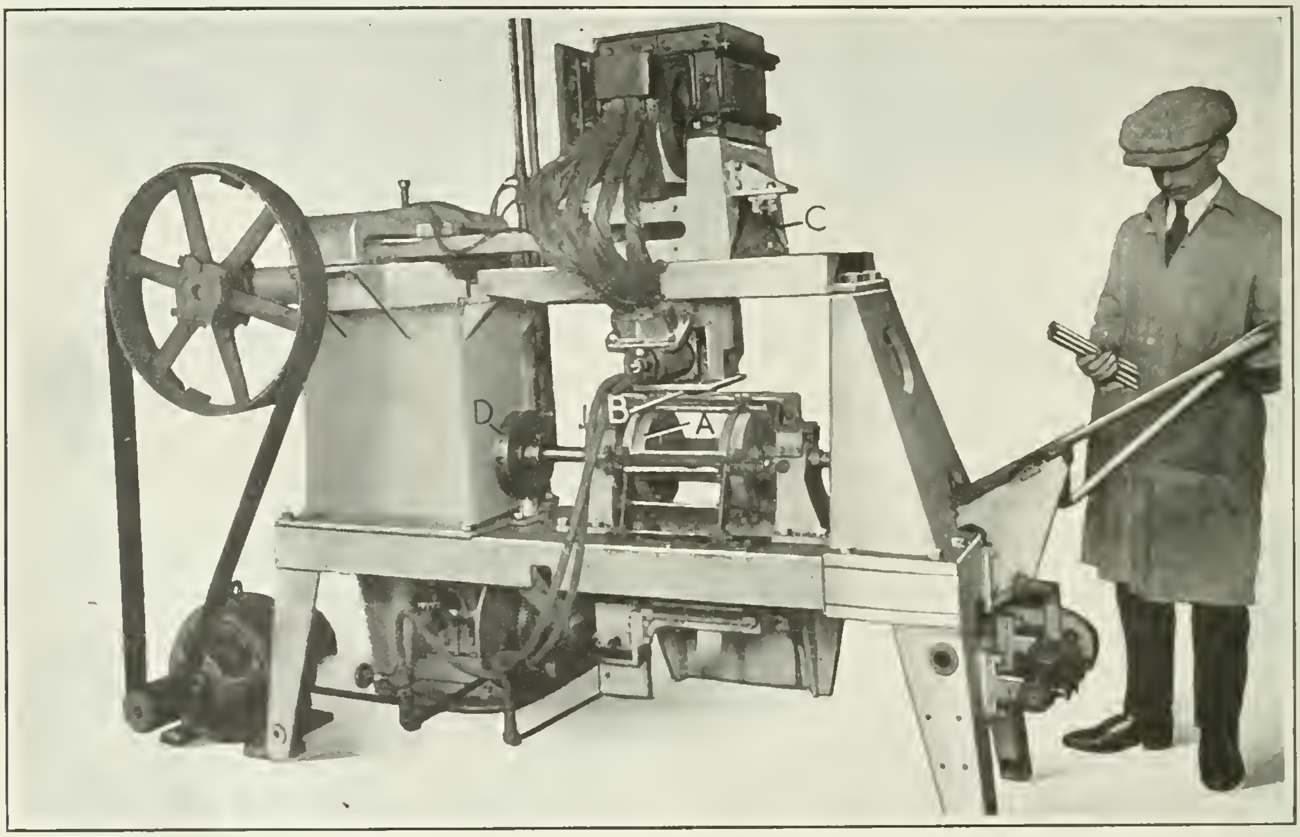


Fig. 2. Butt-welding Machine on which the Spokes are welded at the Seam

Two views of the spoke-welding machine are shown in Figs. 2 and 4. The machine is motor-driven, with automatic electric control for the welding current. There is an indexing work-holder *A*, which passes the spokes under the welding roll located at *B*, while the carriage *C*, which carries the roll, slides back and forth on the top rail of the machine. The carriage also supports a transformer for stepping down the current from 550 volts, 70 amperes to 4 volts at about 10,000 amperes, which is suitable for butt-welding. There are circuit breakers on the carriage at each end so that at the extremity of each traverse, while the welding roll is off the work, no current flows. Then with the mechanical return of the slide, electric current is passed through one side of the two-part roll into the work (which is now pressed together at the seam) and back through the other side of the roll, completing the weld at the end of the stroke.

Suitable adjustments are provided for regulating the amount of pressure for the welding roll. The roll consists of two copper disk-like parts, separated 1/16 inch and formed on the face to the contour of the spoke along the seam. A water pipe delivers circulating water to the rolls to prevent them from becoming overheated. The indexing movement of the work-holder is controlled by a four-notch Geneva gear, so that at each 90-degree revolution a spring plunger engages a hole in the index-wheel *D*, which is fastened to the work-holder shaft, and holds it while the welding rolls are making one pass over the work.

Method of Holding the Spokes while Welding

The formed spokes are fed by hand into a chute, whence they are deposited on a slide located beneath the work-holder. From here they are transferred into a carrier which moves vertically to lift each spoke and deposit it in the work-holder. Each station on the work-holder carries two spring clamps, which are operated by coming in contact with posts on the carrier as it holds the spokes up in position to be picked up by the work-holder. These spring clamps engage the work from each end and release it after the weld has been completed, so that with the next 90-degree movement the spoke is free to fall from its cradle-like support and drop into a receptacle on the floor. Fig. 2 shows the work-holder about to deliver a spoke into this receptacle.

The shaft from which the slide and work-carrier are operated by means of links and eccentric cams is situated on the right-hand side of the machine, as indicated at *E* in Fig. 4.

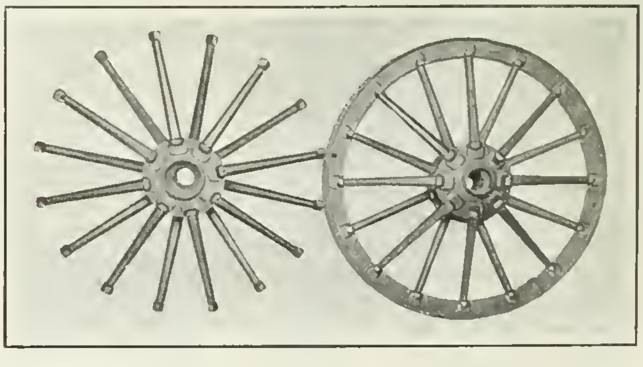


Fig. 3. Wheel before and after Rims are assembled

The view from this side of the machine gives an idea of the arrangement for delivering the spokes to the work-holder. A spoke may be seen at *F* as it rests in the carrier before being raised to the work-holder. One of the posts for operating the spring clamps by means of which the spokes are held is also visible.

The time required for the welding rolls to pass over the work and complete a weld is three seconds. The proper regulation of electric current and mechanical pressure makes it possible to weld the spokes without producing any flash at the joint which would involve subsequent labor in cleaning the weld.

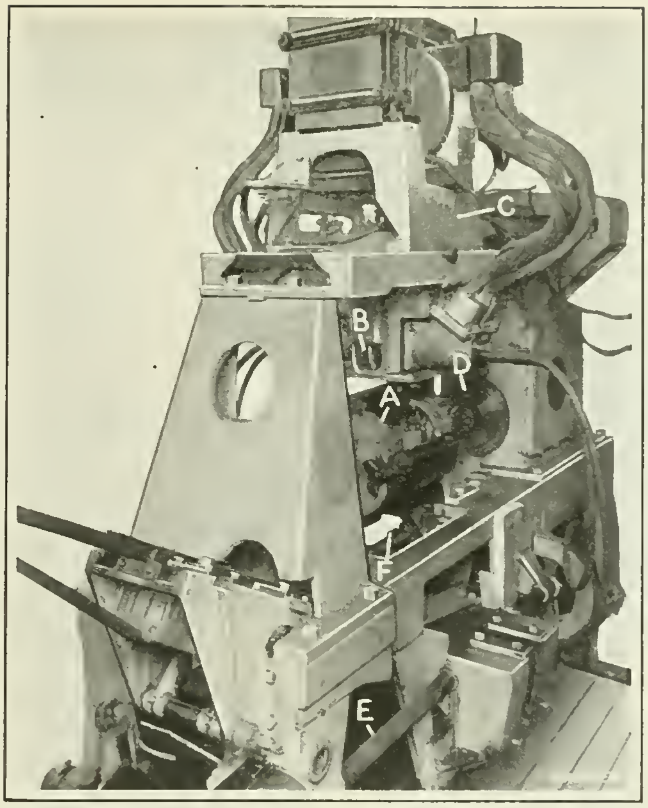


Fig. 4. Machine shown in Fig. 2 seen from the Opposite Side

Making the Spiders

The equipment for making the spiders consists of an assembling stand and a spot-welding machine, as illustrated in Fig. 7. This stand is used in assembling the spokes in the central flanges prior to welding, and also, in another operation, in assembling the rims after the spiders have been made. The spot-welding machine is also used for welding the rims, with suitable changes of electrodes and work-supports.

In making the spiders, a handwheel on the stand is adjusted to bring its hollow spindle to the correct vertical height, and then an arbor is fitted into the hollow spindle and prevented from turning by a spline. The outer flange member is next slipped over the arbor, and a rim fixture laid on the stand. This fixture is a replica of the rim itself, and has pockets so that the spokes may be laid in and clamped in position. For this purpose, four spring clamps are used near the periphery and a nut on the central arbor is tightened up with a wrench. This entire assembly is then lifted from the stand and transferred to the welding machine, where it is placed on the work-holder *A* which may be slid in or out on rods as required. The work-holder has provision for receiving the arbor on which the assembly is secured, and holding it in at the dish angle of the wheel when the outer spider is being welded, or vertically for the inner spider.

The flanges are first welded through the spokes and then between them, the radius of the circle for each series of welds being slightly different, so that stops on the work-holder may be swung horizontally to locate the center of the assembly correctly with reference to the electrodes. The stops are indicated at *B* and the electrodes at *C*. A spring sleeve in the work-holder permits the assembly to yield under the welding pressure, so that when the work is held between the pressure of the two electrodes, it will not be rigid but capable of readjusting itself without producing stress in any part. At the completion of each weld, the spider is lifted by the spring sleeve so that it may be indexed and readily removed from the arbor at the end of the operation. The indexing is done by a ratchet wheel with which a spring index-pin engages at each one-eighth revolution.

Operation of the Spot-welding Machine

The automatic machine for spot-welding the wheels deserves special mention. The upper electrode-holder is held in a frame that pivots to exert pressure on the weld, this pressure being automatically controlled by cam action. The

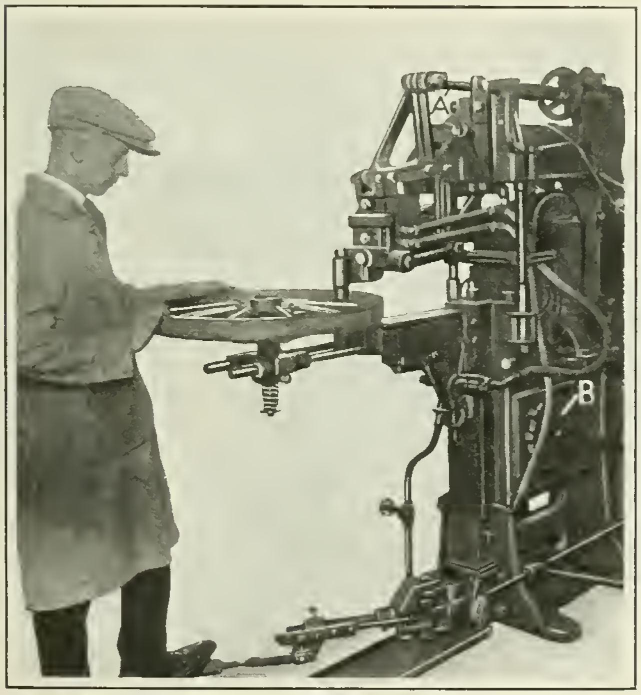


Fig. 5. Spot-welding the Rims on an Electrically Controlled Machine

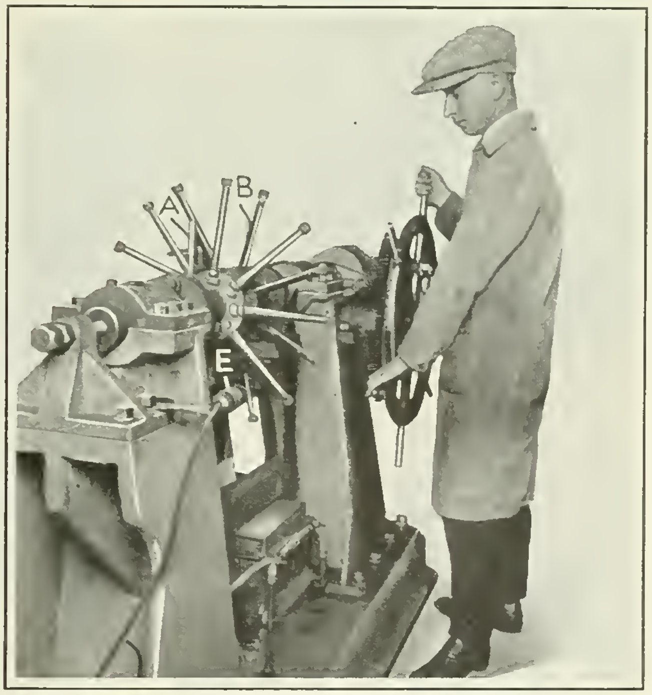


Fig. 6. Butt-welding the Two Spiders at the Hub

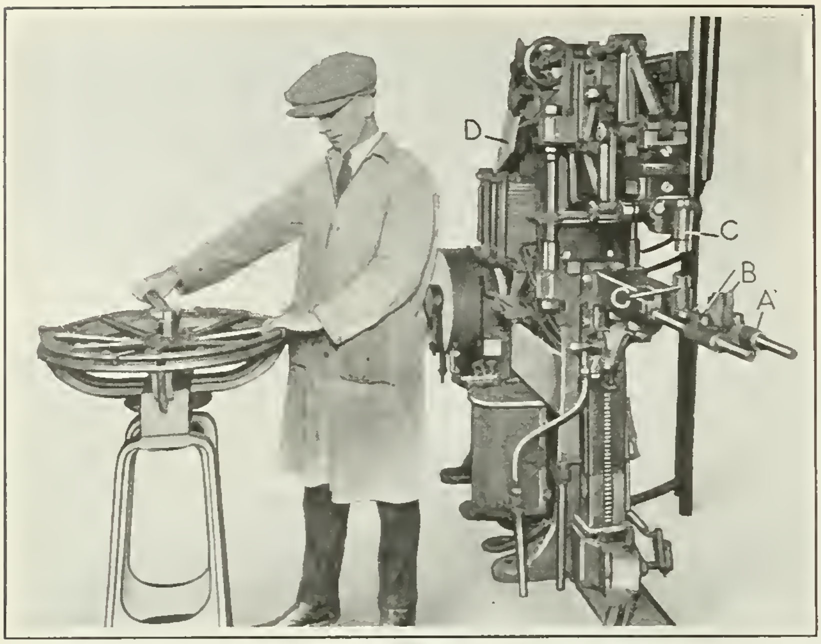


Fig. 7. Floor Stand and Spot-welding Machine used in assembling Spokes in Flanges and Rims

shaft *A*, Fig. 5, by means of which the pressure is transmitted, carries a heavy coil spring and a handwheel for setting the pressure. The spring is capable of transmitting 600 pounds pressure, and the arrangement for adjusting it is such that foot pressure is not required on the treadle. By simply tripping the foot-treadle, a clutch is engaged on the driving gear, which results in the pressure being automatically applied. The welding head is heavy and has considerable overhang; to compensate for this, heavy weights are hung on both sides of the machine, the one at the left being shown at *D*, Fig. 7. The electrodes are connected with a water line to prevent them from becoming overheated.

The entire cycle of operations in making a spot-weld includes depressing the electrode, holding it down under pressure for a given time, switching on the current, breaking the current, and finally releasing the pressure. On the right-hand side of the machine at *B*, Fig. 5, may be seen the rheostat for cutting out the resistance on the transformer and thus controlling the amount of current at the weld; this is necessary on account of the variation in the composition and thickness of metal. The controller for the current supply is located on the left-hand side of the machine.

The lighting circuit operates a remote control system, the breaker for which is located above the machine on a post, while the switch for opening and closing the lighting circuit is controlled by mechanical means when the foot-lever is operated. A 550-volt current of 100 amperes flows to the transformer, where it is stepped down to 4 volts 13,750 amperes. The time required to make one spot-weld is one second.

Butt-welding the Spiders

After the spokes have been spot-welded through the flanges, two spiders, one outer and one inner, are butt-welded on the special machine illustrated in Figs. 6 and 8. The spiders are chucked on octagonal expanding electrodes, made of copper. The flats on these electrodes are so located that the spokes on opposed spiders alternate in the manner indicated in the illustrations. The levers *A* and *B* operate the draw-in arrangements for expanding the electrodes.

The large handwheel, by means of which the movable spindle *C*, Fig. 8, is operated, is geared to a rack on the spindle by planetary gearing, so that after the operator has brought the two spider hubs together he can continue to turn it, to compress the heavy car spring *D*. Turning the handwheel also operates a ratchet, so that when the spring is compressed under about 2000 pounds pressure, the pawl and ratchet lock the handwheel and hold the spring in compression.

The current is then switched on by means of the push-button switch *E*, and soon the metal at the abutted ends of the hubs becomes plastic under the extreme heat. The pressure of the compressed spring will force the spider on the movable spindle toward the stationary spider about 1/16 inch, or until it is stopped by an adjustable collar on the end of the spindle. This movement operates a circuit breaker and shuts off the current. By this means the amount of pressure, determined by the fluidity of the hot metal, indicates when the weld has been correctly made. Uniform results are thus obtained and no excessive flash produced where the hubs are joined.

After the weld has been completed, there is a tendency for the operator to attempt to withdraw the movable spindle before it has released the work, which, of course, would tend to pull the still hot welded joint apart. A safety device is used to prevent this, which requires that the operator trip a foot-treadle. This treadle is connected to a bell-crank lever by a rod *F*, and the bell-crank is connected by rod *G* to lever *B*, which controls the expanding electrode. Tripping the treadle releases the ratchet lock for the compressed spring at the same time that lever *B* is operated to contract the electrode chuck. The spindle is then readily withdrawn, leaving the welded spiders on the stationary electrode. The other lever *A* is next operated to release the work.

In making a weld, the sequence of operations is as follows: The operator first chucks the two spiders, and then turns the handwheel until the heavy coil spring is compressed. He then pushes the switch and holds the push-button in until the weld is finished, which requires about three seconds, during which time the 1/16 inch movement of the mov-

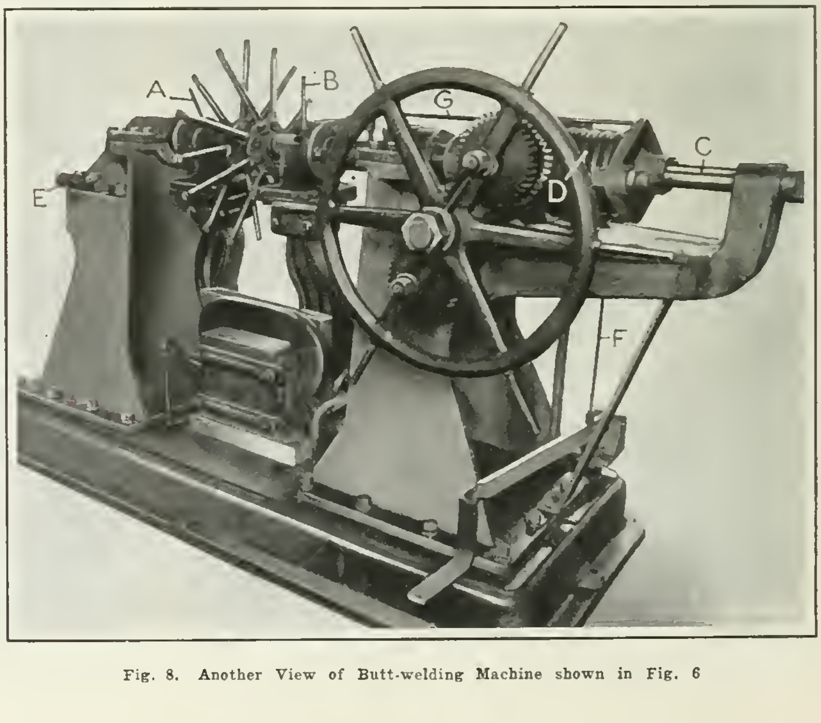


Fig. 8. Another View of Butt-welding Machine shown in Fig. 6

able spindle occurs. As soon as the spindle is stopped by the collar at the end, the current is released, and the foot-treadle depressed to disengage the ratchet and at the same time contract the movable electrode. The handwheel is then turned back, withdrawing the electrode from the hub of the wheel.

The heads that carry the two electrodes are made interchangeable for different diameters of wheels, and suitable longitudinal adjustments are also provided for both spindles. The same current and voltage is used as for welding the spokes, that is, 4 volts 10,000 amperes, stepped down from a 550-volt current supply.

Spot-welding the Rims

The final assembling operation in making the pressed-steel wheel consists of assembling two rims to the butt-welded spiders, and the stand shown in Fig. 7 is again employed for this purpose. The handwheel is adjusted to bring the hollow spindle in which the arbor fits to the proper height, the welded spiders are placed on the arbor, and the rims laid in place and clamped. This assembly is then transferred to the spot-welding machine, which has accommodation for a suitable work-holder of the same type as that used in welding the flanges.

The operation of welding the rims is illustrated in Fig. 5. One weld is made through each of the sixteen spokes and two between them, making a total of forty-eight welds around the rim. There is a nub on the end of the upper electrode, offset from the center, and this projection extends sufficiently to permit the end of the electrode to pass over the bulge on the spoke just about where it is flattened. (See Fig. 3). The nub is first located so as to weld spots through the flattened ends of the spokes; it is then turned around to shorten the distance to the wheel center for welding between the spokes. The same length of time is required for welding the rims as for welding the flanges—one second per spot. The last step in the production of the finished wheels is dipping them in gloss paint and baking.

Comparison between Welded Pressed-steel and Wood-spoked Wheels

Pressed-steel automobile wheels weigh about the same as wood-spoked wheels. Tests have recently been conducted to determine the relative strength of wood and pressed-steel wheels. In these tests, the wheels were held on an arbor, and subjected to a dish test; that is, pressure was applied axially until failure occurred. The wood wheel broke at an applied pressure of 2200 pounds, while the pressed-steel wheel withstood a pressure of 4100 pounds before signs of failure were noticed. At this pressure the wheel became distorted, but did not break.

Under direct crushing tests, the wooden wheel was completely destroyed at a six-ton pressure, while the steel wheel bent slightly at nine tons. These wheels have been on the road since May, 1922, and it is claimed that the owners have found them very satisfactory, giving easier riding qualities to the car. The inventor attributes this to the fact that the wheels, having members both in tension and compression, have greater resiliency and shock-absorbing qualities. Some of the wheels have been in bad accidents where side skidding occurred, which would doubtless have broken wooden wheels and might have damaged the car, whereas these wheels have stood the shock without damage to either the wheels or the machine. Another claim for this wheel is greater life of the tire. The inventor has used a car with these wheels, driving 10,500 miles over all kinds of roads and under widely varying conditions. Fabric tires have been used, and the rubber appears today to be as live as when the tires were put on. The longer life of the tire is believed to be due to the fact that the pressed-steel wheel possesses greater heat conductivity, and as a result, the heat of the tire is reduced.

GAGE FOR SPRINKLER-HEAD BAR

A gage having a ball-bearing slide and dial indicator is used for inspecting bars on trigger-pieces used in sprinkler heads for fire extinguisher systems. The bar is made of a brass composition consisting of 66 per cent copper and 33 per cent zinc. Fig. 1 shows the construction of the trigger mechanism. It will be seen that the bar is supported by a post, the two being braced by a strut soldered in place, which collapses at a predetermined temperature to operate the sprinkler head. In assembling the sprinkler head, a pressure of 1000 pounds is applied through the medium of the screw, and it is necessary that this pressure be determined by a definite number of turns of the screw. By carefully checking the distance between the screw and post, as indicated in Fig. 1, it is possible to maintain uniform results; if this is not done, the leverage produced by a given number of turns of the screw will vary in proportion to the error.

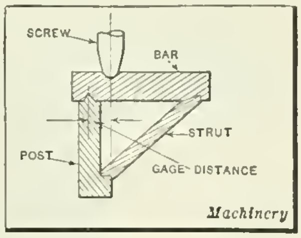


Fig. 1. Distance checked by Gage shown in Fig. 2

Method of Inspecting the Bar

The point of the screw fits in a cast hole in the top of the bar, and the post has a lug which fits into a groove cast crosswise in the bar. It is the distance between this groove on one side and the hole on the other that is checked by the gage shown in Fig. 2. The gage has a ball-bearing slide *A* carrying a post, the tapered end of which is of the same dimensions as the end of the screw in the sprinkler-head. The bar is supported by this post and by an upright at the rear, in which position it is held by means of the spring lever shown.

The standard in which the spring lever pivots carries a pawl *B*, which, after the bar has been located, is swung down until it engages the groove in the bar. It is pressed against the bar until the pin *C* can be passed through to locate it. The bar now occupies the same position relative to the gaging points of the gage that it does to the post and screw in the assembly.

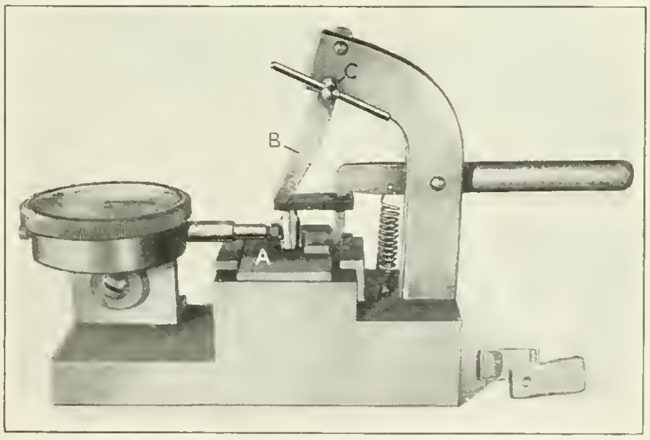


Fig. 2. Use of Gage for inspecting Sprinkler-head Bars

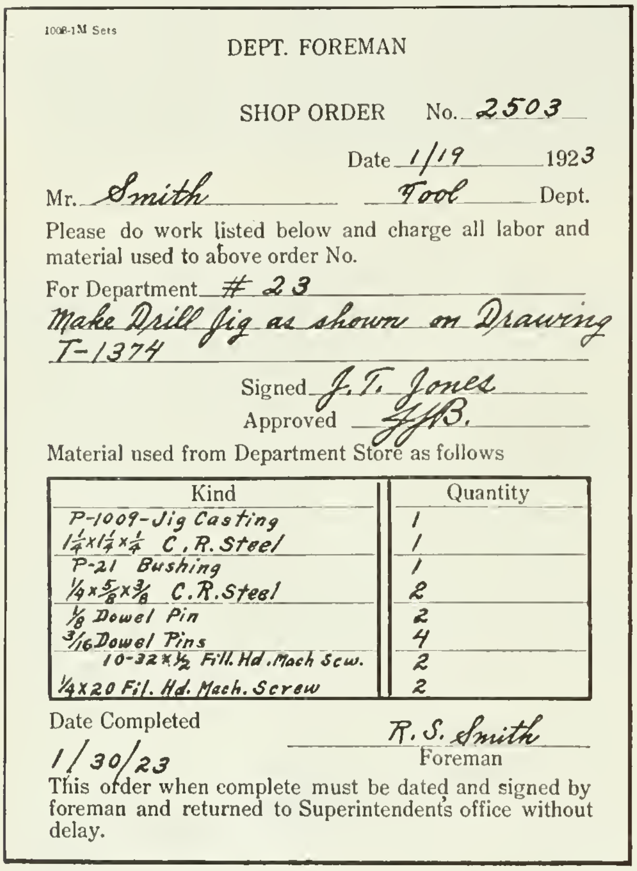
Pressing the pawl *B* into the groove to locate it correctly, may cause a movement of the slide that carries the vertical post, which will register on the dial gage any error that exists between the two gaging points. It will be noticed that the post extends through a bridge piece which has an elongated hole to permit this movement. The slide, being supported on ball bearings, will respond to any slight pressure produced in locating the bar in the position shown, and any resulting movement of the post will be registered on the dial of the gage.

TOOL-ROOM DRAWINGS

By JOHN J. BORKENHAGEN

The method of handling a tool-room job in one of the largest factories in Chicago is described in the following. When a new jig or fixture is designed by the engineering department, a detailed drawing and a shop order slip such as shown in Fig. 1 are sent to the tool-room foreman. On receiving these, the foreman makes up a sketch, which shows the work in its proper position in the jig or fixture. For clearness, the part is colored with red crayon.

On this sketch the foreman writes out a complete list of the materials required for the job and a list of the machining operations. The sketch and the shop order are next forwarded to the man in charge of the tool-crib, who obtains the parts and materials called for. The materials, sketch, and shop order are then placed in a pan and sent back to the foreman, who assigns the job to one of the toolmakers.



1008-1M Sets

DEPT. FOREMAN

SHOP ORDER No. 2503

Date 1/19 1923

Mr. Smith Tool Dept.

Please do work listed below and charge all labor and material used to above order No.

For Department # 23

Make Drill Jig as shown on Drawing T-1374

Signed J. T. Jones

Approved J.J.B.

Material used from Department Store as follows

Kind	Quantity
P-1009-Jig Casting	1
1¼x1¼x¼ C. R. Steel	1
P-21 Bushing	1
¼x⅝x⅜ C. R. Steel	2
⅛ Dowel Pin	2
3/16 Dowel Pins	4
10-32x½ Fill. Hd. Mach Scw.	2
¼x20 Fil. Hd. Mach. Screw	2

Date Completed

1/30/23

R. S. Smith
Foreman

This order when complete must be dated and signed by foreman and returned to Superintendent's office without delay.

Fig. 1. Shop Order Blank issued with Detail Drawing shown in Fig. 2

When the fixture is finished, the date of completion is added to the shop order, and one copy of the latter is sent to the production department, where a record is made that the job has been completed. From this department the shop order is forwarded to the cost department, where the cost of the materials is added to the labor cost. Two carbon copies of the shop order slip are made, one being retained as a production department record, while the other is sent to the cost department. The original slip is delivered with the finished jig.

Records of all the time spent on the job are sent to the cost department on the regular time cards and charged to the order number written on the shop order slip. In Fig. 2 is shown the drawing of a part for which a drill jig is to be made. The hub *A* is previously turned between centers on a lathe to a diameter of 1 inch. The jig is required to locate and hold the work for drilling the 0.249-inch hole.

The working sketch made by the tool-room foreman is shown in Fig. 3. In the original sketch, the starting lever *A* which is to be drilled is shown in red dot-and-dash lines, and the fixture in black lines. That part of the starting lever cross-sectioned in dot-and-dash lines is colored red. In addition to the dimensions shown in Fig. 3, the complete sketch gives full specifications for each part and a list of the machining operations required.

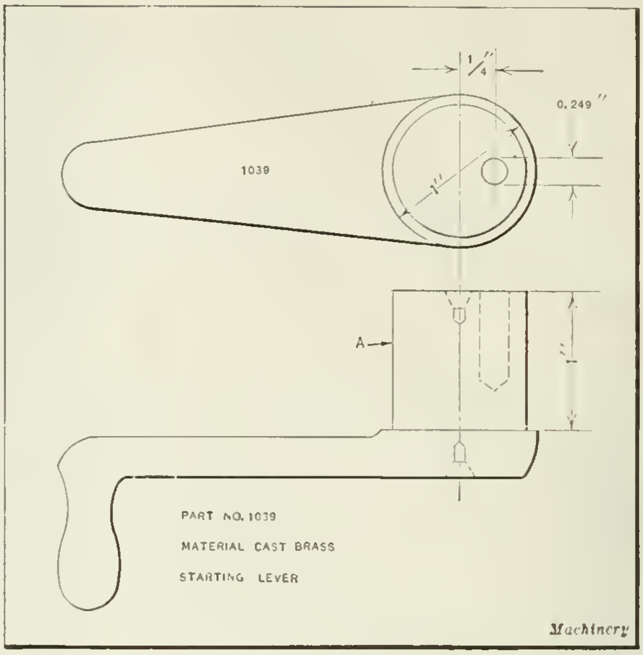


Fig. 2. Detail Drawing of Starting Lever for which Drill Jig is to be made

* * *

The eleventh annual meeting of the U. S. Chamber of Commerce was held at the Waldorf-Astoria Hotel, May 8 to 11. Among the subjects of interest to the machine-building industries were immigration and labor needs; fabricated production; transportation; and the influence of European conditions on American business.

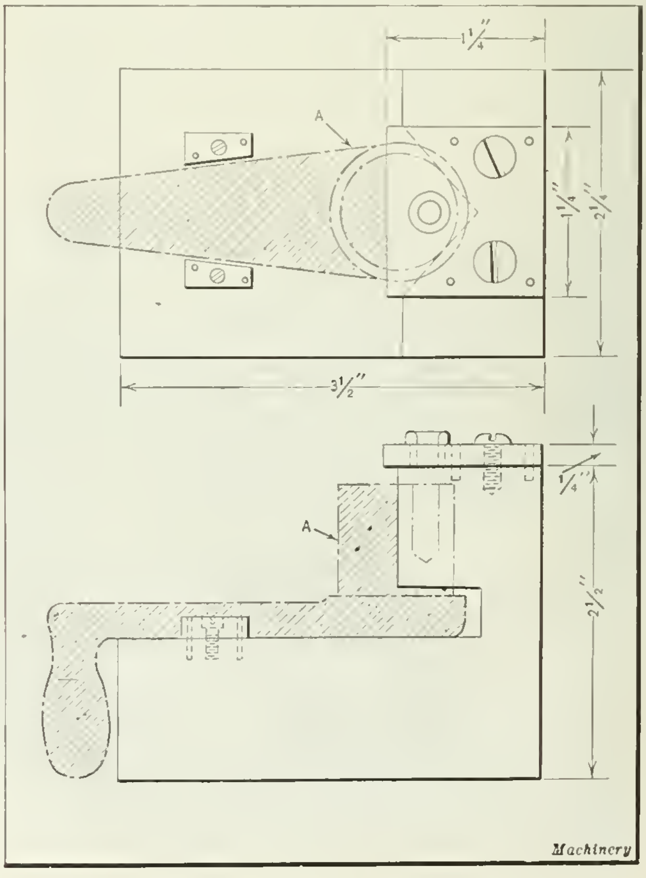


Fig. 3. Sketch used as Working Drawing in Tool-room

Work-holding Surfaces of Machine Tools

Table Design for Different Types of Machines—Third of Three Articles

By FRED HORNER

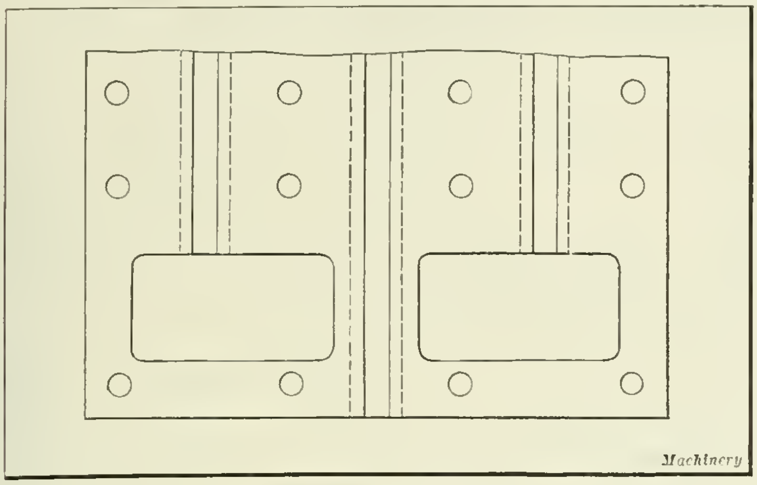


Fig. 18. Table machined flush around the Drainage Pockets to increase the Work-holding Area

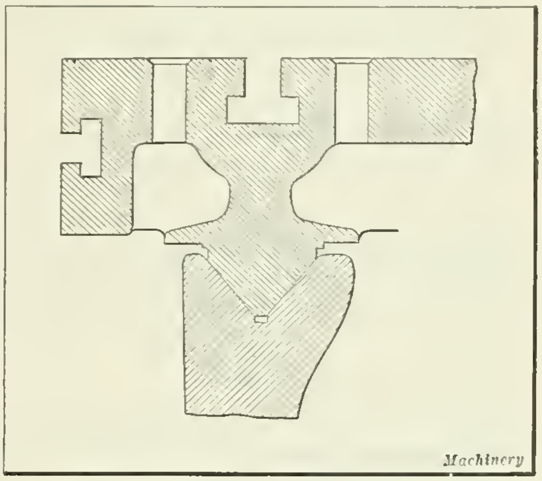


Fig. 19. Table Design in which Overhanging Lips protect the Ways of the Bed

In the first and second installments of this article which appeared in April and May MACHINERY, the provisions made on machine tool tables for clamping the work, jigs, and fixtures thereto, and lubricant drainage methods were discussed. The present and concluding installment will illustrate and describe other interesting table designs. While for general purposes there is an absolute necessity for having the table of a milling machine flush all over, this is not so with some manufacturing types of machines which have the size of work restricted within definite limits and do not require attachments that overhang the table area. In such a case a raised oil-pan rim can be cast around the table extending to a height of two or more inches above it. An alternative to such construction consists of sheet strips, clamped or hooked to the table or a steel pan surrounding it.

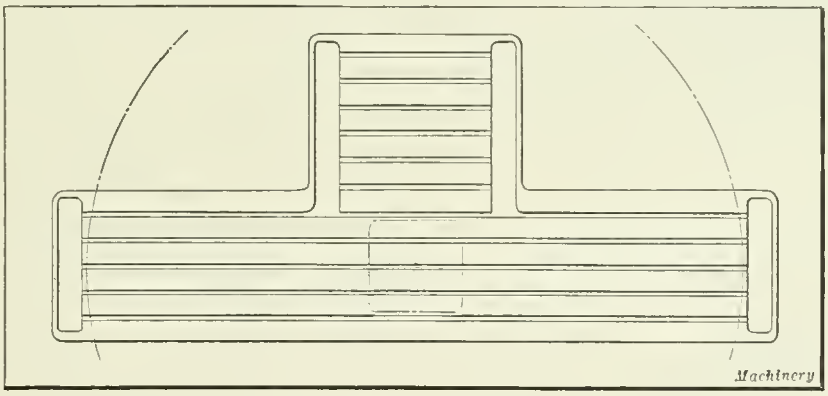


Fig. 20. Conveniently arranged Three-arm Base for a Radial Drilling Machine

The tendency toward extension of the bolting surface is noticeable in planer design. Many planers have the middle T-slot carried right through to the end of the table and have bosses cast to contain stop-plug holes. This enables the table to receive longer pieces than an ordinary one on which the pockets alone overhang. An advantageous design is a table machined all over to supply means of support, as represented in Fig. 18. A little detail of table construction concerns whether the plug holes should be drilled through or only partly so. If the latter practice is followed, the holes become a nuisance by filling up, and in the former case, there is risk of dirt and chips falling

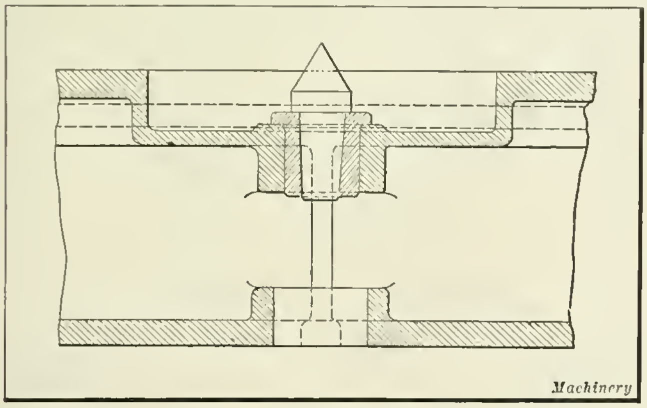


Fig. 21. Center provided on Heavy Vertical Boring Machines for supporting the Lower End of the Boring-bar

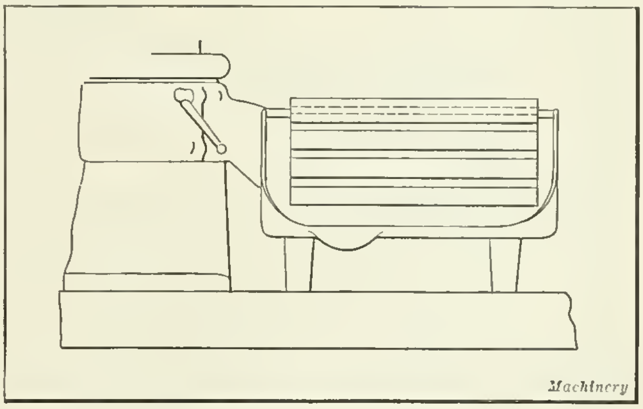


Fig. 22. Angle Table that swings on the Column of a Drilling Machine, and has Legs extending to the Base

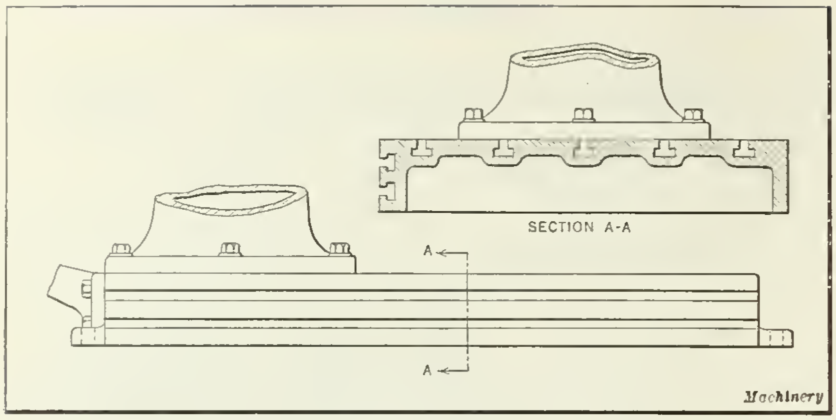


Fig. 23. Machine Base provided with T-slots on Vertical Face in Addition to those on the Top Surface

through on the ways of the bed. The casting of ledges on the under side of the table, as illustrated in Fig. 19, obviates this trouble. This provision is unnecessary with box tables, because the entire bottom side of the table is closed.

T-slotted Machine Bases

The bases or floor-plates which certain kinds of machines require are varied in their shape and in the arrangement of the T-slots. The shape depends on the form of the work and the movements of the tool above. Whether there happens to be a supplementary table or tables also affects the design of the base. The plainest patterns are rectangular plates having longitudinal slots only, or others set at right angles as well. The latter type is better for the rapid transposing of bolts about the surface, and is particularly useful when brackets, heads, etc., must be mounted on the plate, as well as the work, as in the case of horizontal boring machines.

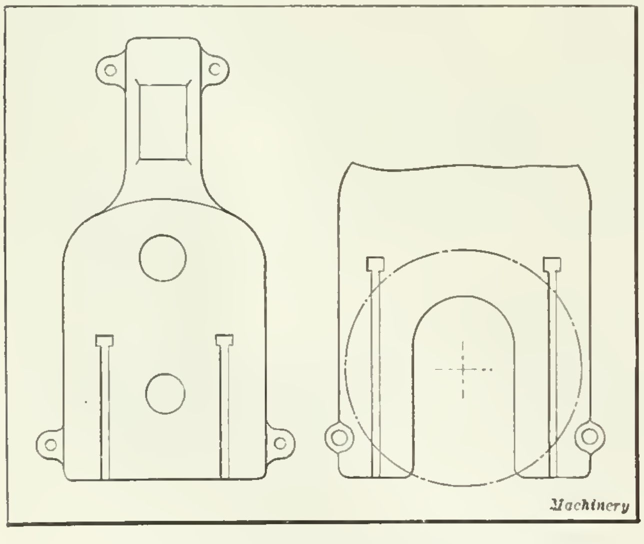


Fig. 24. Two Suitable Styles of Base for Drilling Machines not provided with Radial Swing

Plates of other than plain rectangular outline occur when the tool is carried at one corner or on an angle, or when it swings through a definite portion of a circle. Radial drilling machines may, as a case in point, embody a right-angle base, one arm of the base being utilized for bulky castings, and the other mostly for the reception of a box or swivel table. This principle saves time, because objects may be set up on one section of the base while drilling is being done at the other, and so the working time of the machine is practically continuous. A still better lay-out comprises three arms, as shown in Fig. 20, where the location of the column and the range of the spindle path are indicated by dot-and-dash lines. The work is bolted down on the areas to the right and left, and a box table can be used on the shorter section at the front. The relative proportions of the sections naturally depend on the class of work to be handled, and perhaps a longer extension may be required at the front. Fig. 23 illustrates a deep base with two T-slots on one side; these are a handy addition for clamping some shapes without the use of angle-plates or awkward blocking.

The bases for upright drilling machines without radial swing are either cast as continuous plates with provision at the rear for the attachment of the column, or are formed with projecting feet. Both styles are shown in Fig. 24. The one at the left is an unbroken plate with T-slots and a center hole for bushings. The number of slots may be increased on the feet at the right to two, or even three when the feet are wide. Bushing holes are common in many machine bases.

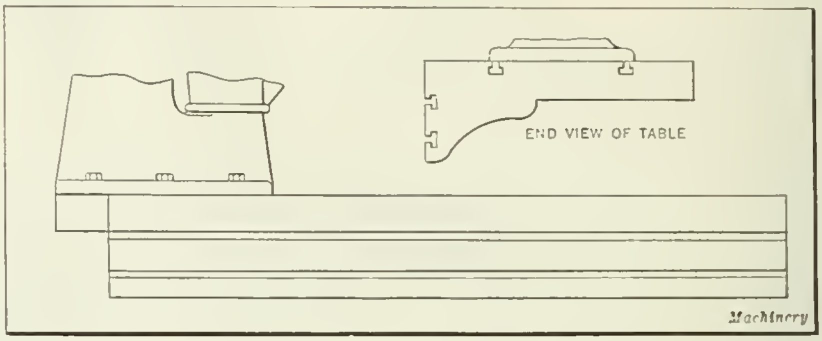


Fig. 25. Angle Table provided with Long T-slots on a Vertical Face to facilitate holding a Number of Parts at One Time

A fitting frequently applied to heavy vertical cylinder-boring machines is a center of the style shown in Fig. 21, which is used to support the bottom end of the boring-bar. A feature that must be mentioned in relation to bases concerns the methods of quantity production in plants where drilling operations are performed on automobile and other castings, held in cradles or jigs. The usual base is abolished in so far as using it for a clamping surface is concerned, and the jigs travel from one machine to another on wheels running on tracks laid in front of the machine.

Angle and Box Tables

For drilling, boring, shaping, and sawing operations, angle and box tables are particularly valuable. An angle table has the top and one side slotted, while a box table has at least three faces machined for the attachment of work. Either table may be a permanent fixture on the machine column or base, or facility for quick displacement may be

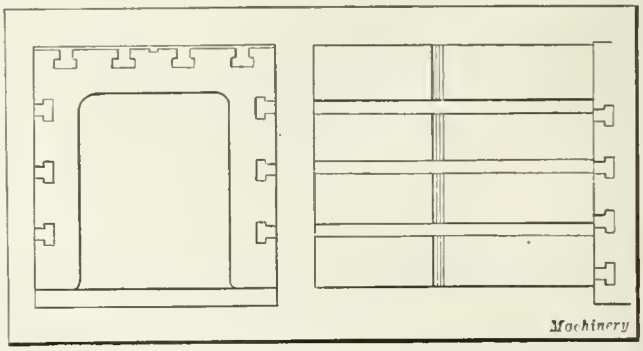


Fig. 26. Simple Form of Box Table used on Shapers, provided with Special Grooves for holding Cylindrical Parts

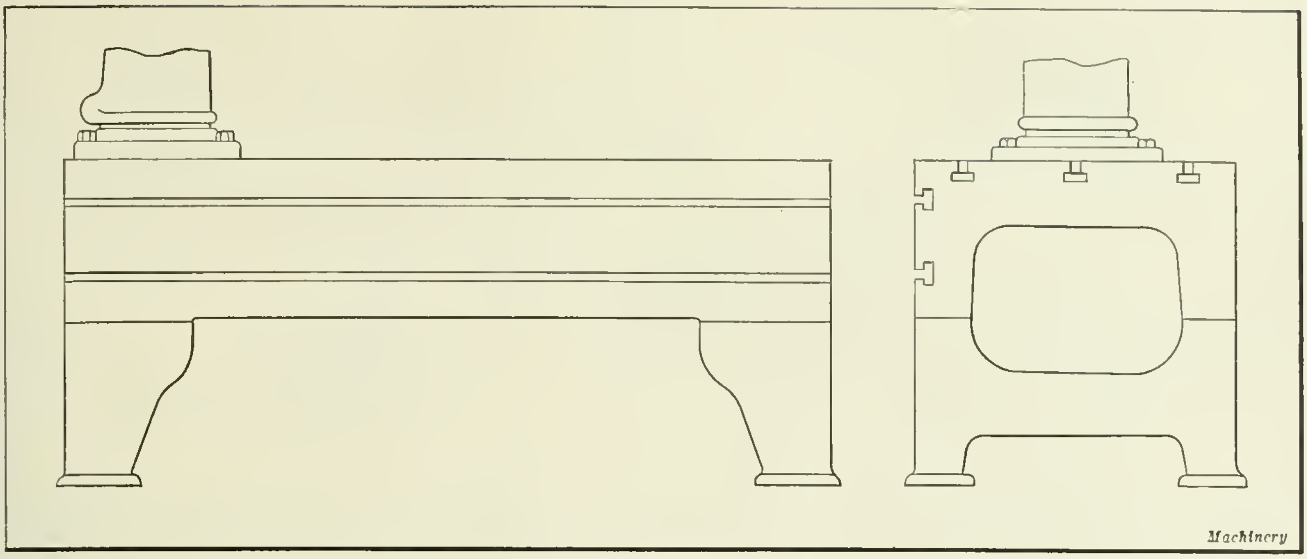


Fig. 27. Drilling Machine Table which is a Compromise between the Angle and Box Types, T-slots being provided only on the Top Surface and on One Vertical Face

provided. The box type probably holds the preference, partly because it is better balanced, and partly because a second vertical face is available for the attachment of special fittings or the setting up of work on one side while an operation is proceeding on work held on the opposite face.

The angle table exists in greatest numbers on drilling machines and small shapers. Sufficient room for the holding of much work to be drilled is afforded by providing T-slots of the length shown in Fig. 25; this view does not show the table supporting legs. Shaper tables differ from this in the proportion of the length to the depth, and in the fact that the bolt slots on the top may run transversely. The slots in the vertical face sometimes lie vertically, but they are then open to the objection that the bolts slip down when loose. The addition of one or two vertical V-grooves would add to the value of the face for clamping round pieces in upright positions.

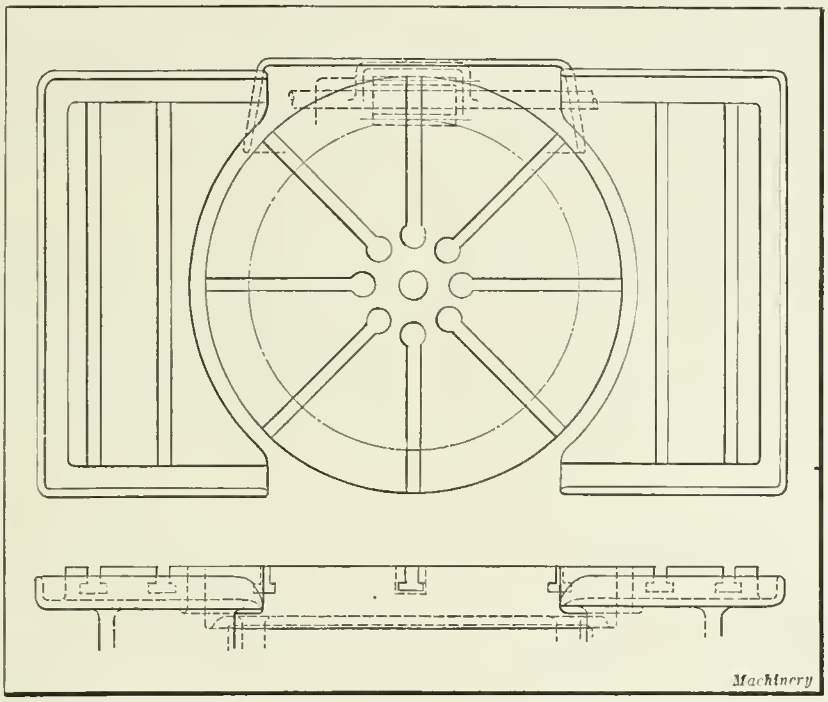


Fig. 28. Sectional Design of Table consisting of a Rotary Circular Table flanked by Two Sections that enable Work to be mounted for Longitudinal Machining

Many angle tables are arranged with bearings so as to swing around the column of a drilling

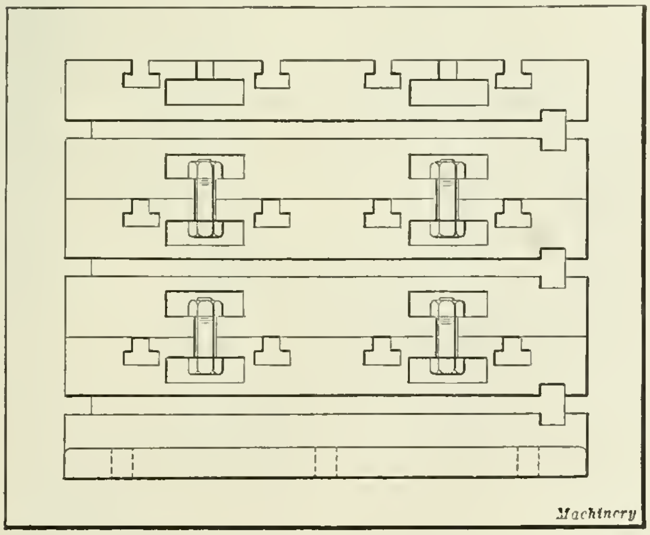


Fig. 29. Built-up Box Table of the Type furnished on Cold-saw Cutting-off Machines for raising the Work to suit the Height of the Saw

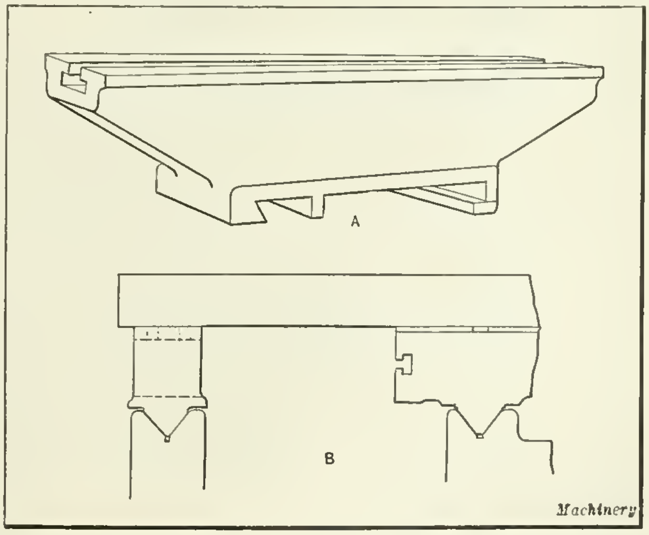


Fig. 30. (A) Casting used on Boring Machine Tables to provide Supplementary Support; (B) Use of a Supplementary Plate mounted on a Vee in Front of the Table

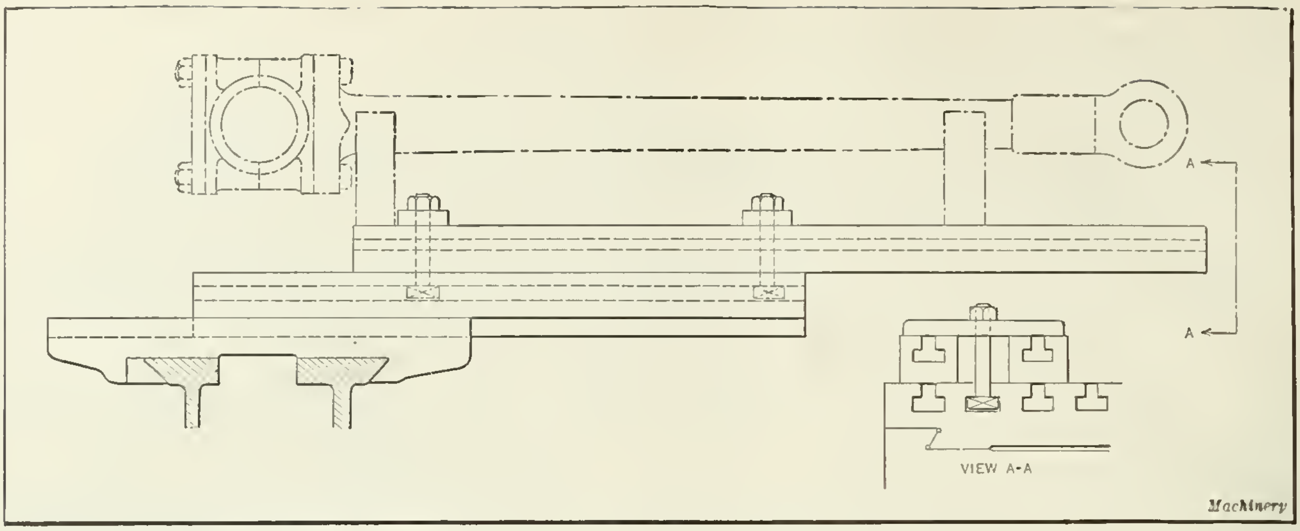


Fig. 31. Method of securing Long Connecting-rods on a Table by the Use of Simple T-slotted Bars and V-blocks secured to the Bars

machine, or around a separate pin adjacent to the column. Feet are cast on to bring the table into contact with the baseplate, as illustrated in Fig. 22; this illustration shows a rim cast all around the table edges to catch coolant and lead it into a sump at a lower point where a hole is provided for a drain-cock or pipe connection. The independent construction of such a table simply involves the casting of a strong column and a foot to rest on the baseplate. A swivel action is often added to provide a range of movement of 90 degrees.

The simplest form of box table is that usually adopted for shapers, and in Fig. 26 is shown a style that may be supplied with special grooves for the holding of cylindrical work, location of special attachments, circular arbors, etc. An increased holding capacity can be obtained on the top by casting the table farther out at the front as an overhanging ledge, or by bolting a supplementary table of larger area across the top. The T-slotted face of the saddle, which is invaluable for clamping heavy pieces, is carried far down in the more massive machines and even into a pit extending the length of the frame. Many set-ups are possible with these saddles when they exist in pairs. Long castings may also be supported in numerous ways between two box tables. In order to sustain the weights of very large castings, angle-brackets or stop-blocks are frequently employed against the vertical faces of the table.

Fig. 27 offers a sort of compromise between an angle and a full box table, the drilling service demanding slots only on the top and front face. For boring machines, as well as some drilling machines, a full box table, that is, one with slots on every side, is occasionally useful, though generally the requirements are satisfied if the bottom is left unslotted and used only for bolting to the baseplate by means of flanges. Heavy tables applied to cold-saw cutting-off ma-

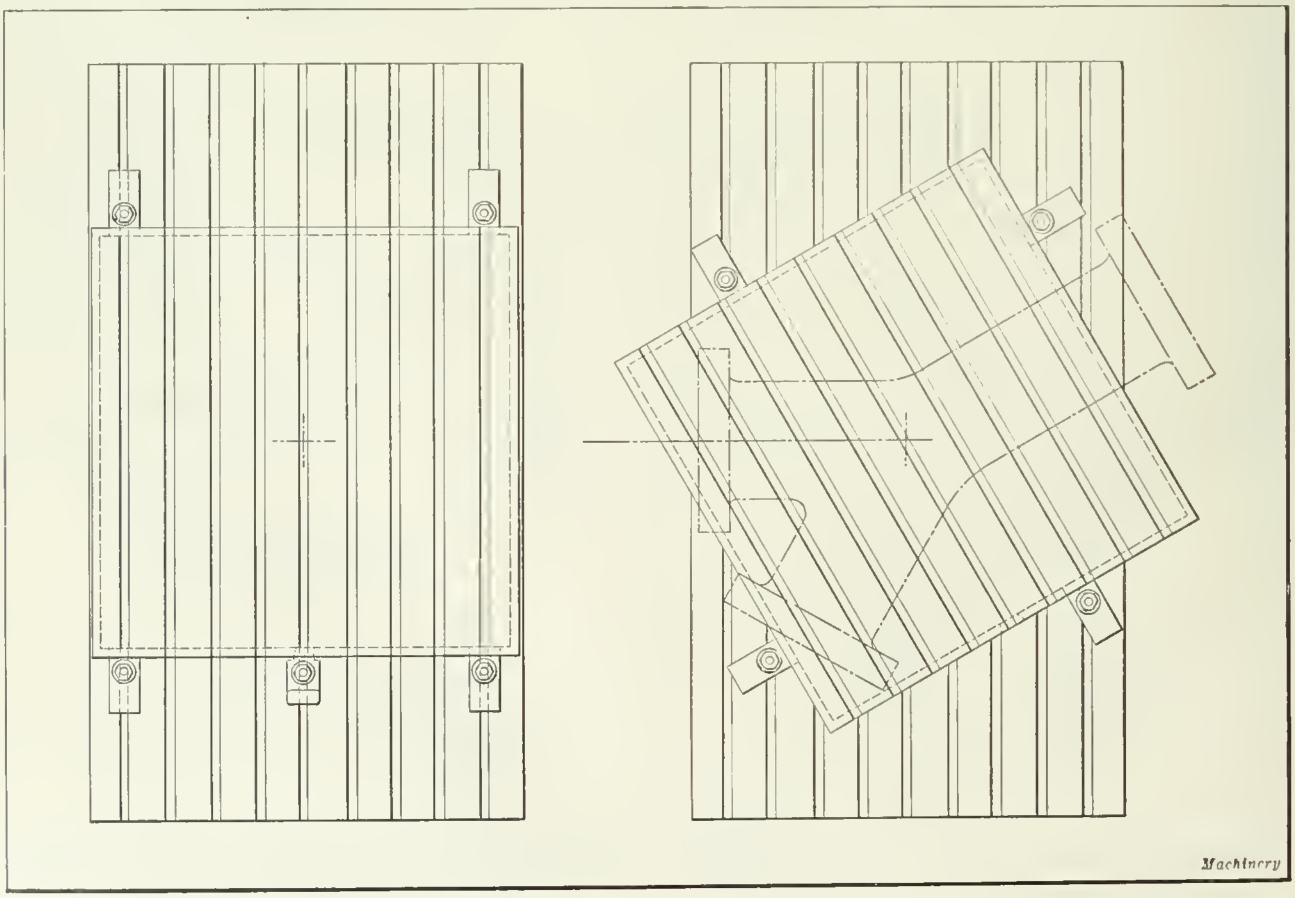


Fig. 32. Diagrammatic Views, showing the Positions in which a Quartering Table or Turntable may be employed

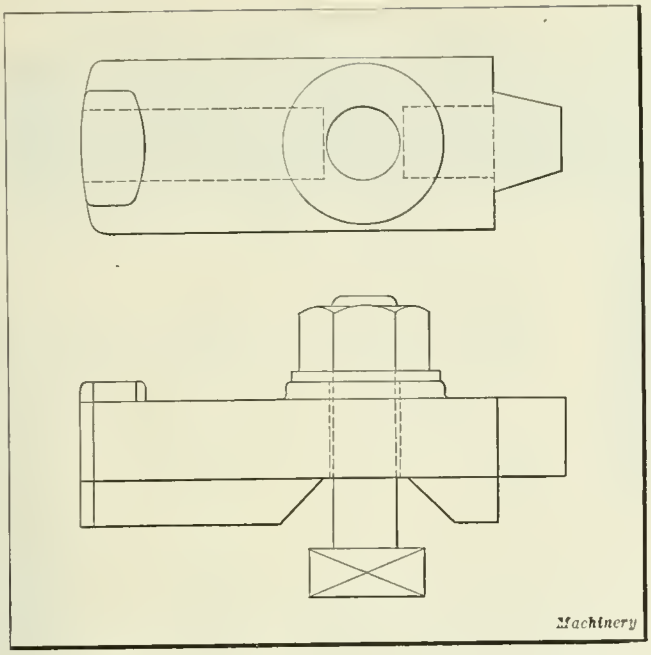


Fig. 33. Detail View of the Quartering Stop used on the Supplementary Table illustrated in Fig. 32

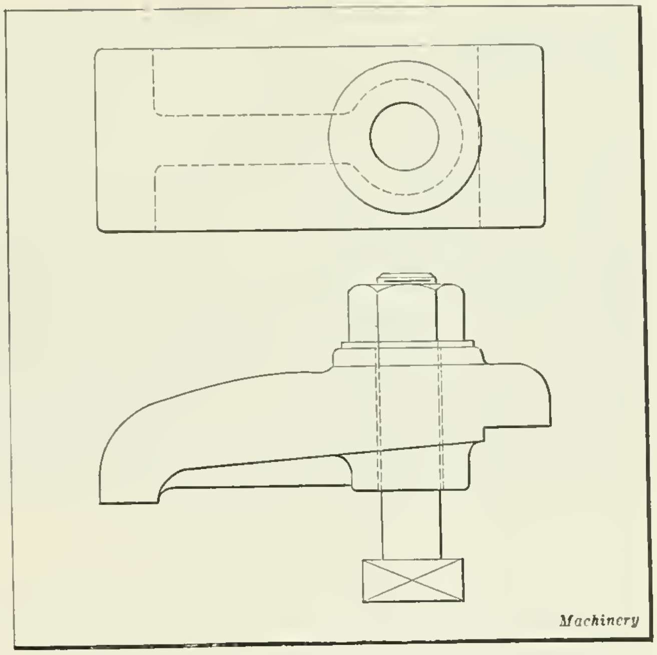


Fig. 34. Detail of the Clamps used in securing the Quartering Table to the Regular Table of the Machine

chines are generally adjustable without a screw or rack-and-pinion mechanism, the device commonly consisting of a rack or series of notches cast slightly below the machined level of the base, a pinch-bar being used to move the table along.

Built-up box tables are used for machines such as cold saws, when no alteration in the height of the saw is possible. Suitable adjustments of the work for height are brought about by removing or adding sections of the table. Such an arrangement is illustrated in Fig. 29, in which four slots will be seen on the horizontal surfaces, short side slots coming in from the edges at right and left, and longitudinal slots running around the flanks. The union of the sections is effected with bolts slipped into open slots having pockets that give sufficient play for the nuts and a wrench.

Sectional Table Designs

On some machine tools the T-slotted surfaces of the tables are divided into sections between which a tool may operate, or one section be fixed and the other arranged to travel. The space between sectional tables may be either fixed or adjustable. A somewhat unusual practice enables either straight or rotary feeding movements to be employed. This specifically relates to heavy milling machines of the vertical-spindle type. A central rotary table is flanked by fixed straight tables flush therewith, as shown in Fig. 28. Work may be dealt with considering the surface as a whole, or selecting the rotary section only. Thus, work requiring ordinary straight cuts can receive attention first, and then any circular cuts, such as for rounded ends on links or rods, may be made by clamping the piece to the rotary table only.

Two alternatives in the mode of construction are followed: In the first, the three tables are built as permanent members of the machine, while in the second they are each made separate and bolted to the main table. The first arrangement is shown in Fig. 28. The three tables are traversed by hand or power feed, and there is a power rotation of the circular table. A trough below the latter catches the overflow or coolant, while the streams from the flanking tables are controlled and diverted by suitable lips.

Supplementary Tables

Supplementary tables are utilized in various ways and for diverse purposes, such as to merely increase the effective clamping area for large parts, or to receive particular contours that cannot be conveniently mounted on a flat table. Attachments to furnish an unusual movement to a plain table necessitate the provision of a supplementary top, typical examples occurring in radius planing, milling, or grinding attachments. Requirements for extensions may be met in a cheaper manner than by providing an expensive casting of large area, this being evident from Fig. 31 in which simple bars clamped on a boring machine table are extended to support V-blocks into which a connecting-rod is bolted.

Supplementary support in the longitudinal direction of a boring machine table is easily obtained by supplying standard castings of the design shown at *A*, Fig. 30, to fit on the bed ways. Open-side planers do not usually possess exceptionally wide tables. The reason lies in the fact that much of the work performed on them consists of planing feet or ends, and all the extra support necessary is something to take the sag of the overhanging ends, so that a simple form of supplementary table usually satisfies the requirements. This may be a stout plate mounted on rollers moving along a runway standing

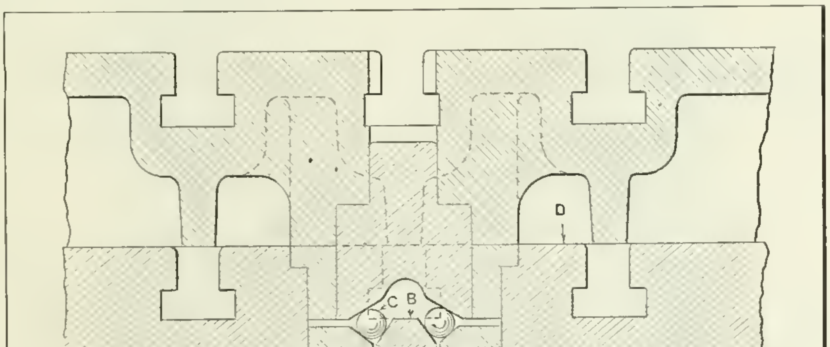


Fig. 35. Device incorporated in the Design of the Turntable to facilitate swinging the Table when heavily loaded

up from the floor, or a box-shaped narrow table sliding in vees as indicated at *B*.

Boring Machine Turntables

An interesting attachment for the tables of boring machines is the quartering table or turntable shown diagrammatically in Fig. 32. This is quite different from the standard rotary table which necessitates a pivot, a flat bearing circle, gib strips, and a worm and worm-wheel revolving mechanism. The turntable requires merely a pivot pin on the main table. It rests directly on the latter, and is indexed by means of a simple tapered peg. This gives four angular settings and intermediate swivel positions for the table. In drilling, boring, or facing at other than right angles, the proper setting is obtained by reference to positions lined out on the work or by means of a templet or bevel strips. Fig. 32 shows square and angular settings with the necessary change in the location of the clamps that bear down on the ledge of the table. Enlarged views of the quartering stop and the clamps are shown in Figs. 33 and 34, respectively.

As the weight of such a table is considerable, especially when loaded with massive work or a cradle or other fixture, some substitute has to be found for the worm-gearing available for turning standard rotary tables. An ingenious device that lifts the whole weight slightly on a central ball race is adopted, whereby a load of tons can be swung around by a pull of the hand. This device is illustrated in Fig. 35. On pulling knob *A*, which extends to the front of the main table, the multiple-threaded screw *B* rises and forces the circle of balls *C* upward, just enough to remove the weight of the table from surface *D*.

A novel combined locating and clamping device for the turntables on a horizontal boring machine of British manufacture is shown in Fig. 36. This device consists of two pinions and two H-shaped pieces having rack teeth at the bottom. The pinions occupy side holes below the main table T-slots. The act of turning a pinion causes it to force the corresponding H-shaped piece along, which, due to its wedge-shaped shoulders, tends to pull the turntable down. This device consumes less time in clamping than the placing of the usual clamps and the index peg in position, and leaves the table surface entirely free from obstructions.

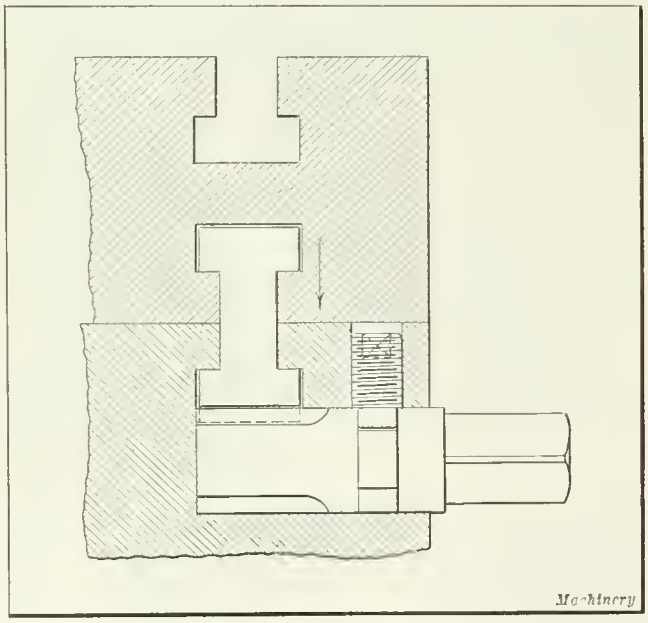


Fig. 36. Arrangement employed on a Turntable for locating and clamping

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The Bureau of Standards has published the results of recent tests made with several new solders for aluminum in Circular No. 78 entitled "Solders for Aluminum."

STABILIZER FOR PRONY BRAKE

By J. W. ROCKEFELLER, Jr.

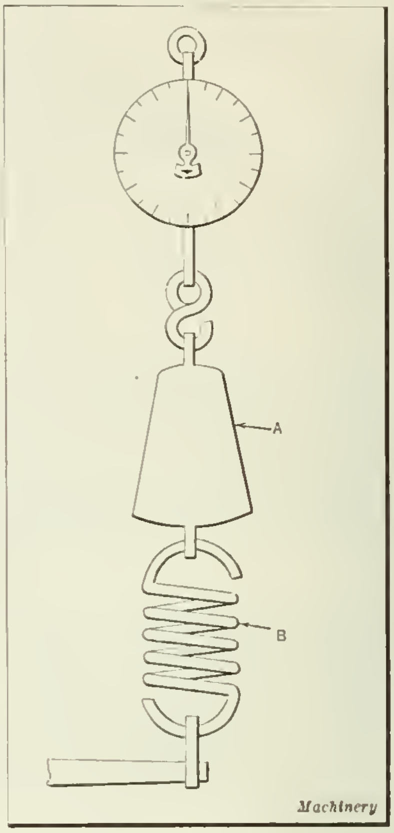
Manager Spring Department, John Chatillon & Sons, New York

The most convenient form of Prony brake is undoubtedly that from which a direct reading is obtained by measuring the torque with a spring balance or dynamometer. In using such an apparatus, however, it is often difficult to read the correct position of the indicator, due to the varying friction between the brake and the flywheel, and the consequent vibration imparted to the brake arm. This vibration is present to an annoying degree even when an oil dashpot is used to dampen the oscillations.

The writer has employed a simple remedy for this difficulty in a number of cases, with marked success. The matter of eliminating vibration resolves itself into a problem of mass, force, and acceleration. From the formula,

Force = Mass × acceleration

it will be seen that, with a given force, the acceleration becomes smaller as the mass increases. If the mass is great and the force is exerted for a short period of time only, the velocity attained will be negligible and the motion indiscernible.



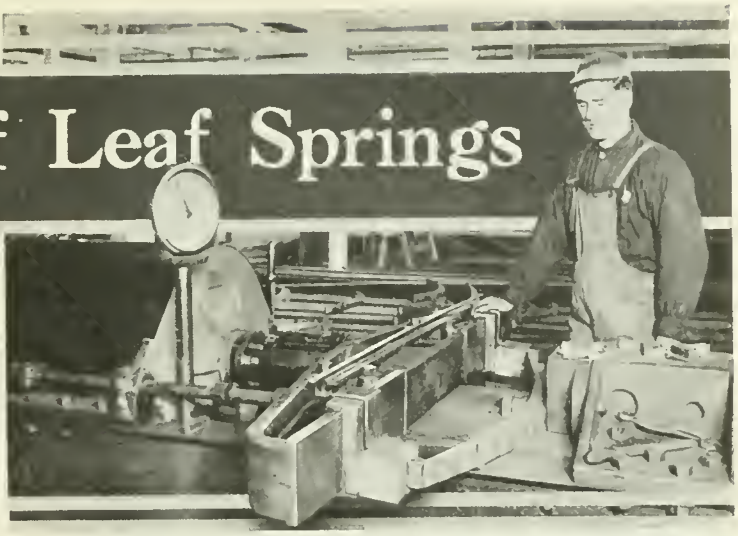
Method of employing Weight to stabilize Prony Brake

This fact is taken advantage of in the Prony brake stabilizer shown in the accompanying illustration. Between the balance and the brake arm are placed in series a heavy weight *A*, and a resilient coil spring *B*. The pointer of the balance is then set back to offset the initial force, or tare, exerted by the weight. When the motor being tested is in motion, the average torque is transmitted through the spring and suspended weight, and is accurately indicated on the dial of the balance. The momentary vibrations, however, are not of sufficient duration to move the weight, and their motion is dissipated by the auxiliary spring. By employing this type of stabilizer, an oil dashpot may be dispensed with entirely, and readings of a high degree of accuracy may be obtained.

* * *

In a paper read before the Birmingham Metallurgical Society, Birmingham, England, it was stated that the general properties of stainless steel, and also its resistance to corrosion, are influenced to a considerable extent by the heat-treatment which the steel has undergone. The material has the greatest resistance when hardened and the least when annealed, and cold working decreases the non-corrodibility to a considerable extent. Among the purposes for which stainless steel has been successfully used in the industries may be mentioned pump pistons, and hydraulic and steam valves of different types. The steel has been found to resist, to a remarkable degree, the erosion of high-pressure steam jets.

Manufacture of Leaf Springs



Methods used in Making Automobile Springs at the Plant of the Perfection Spring Company, in Cleveland, Ohio

By EDWARD K. HAMMOND

THE methods here described are those employed by one of the oldest and largest automotive spring manufacturers in the country. When this company started in business some seventeen years ago, springs were made by what was known as the hand-fitting process. The plates were first heated in the furnace, and then bent to the desired arch over a templet, as shown in Fig. 1. While held on the templet by means of tongs, this arch was maintained by quenching with water. The plates were then placed in the furnace again, heated to the desired temperature, and quenched in oil. The last operation in the heat-treatment required that they be heated again to a lower temperature than previously used, and then withdrawn and left to remain in the air until cool. This method was discontinued when springs had to be made in large quantities, as it was not only expensive but also quite slow. The Perfection Spring Co. was one of the pioneers in the development of machines for doing this work. Present-day methods of spring manufacture will be described in this article.

Shearing the Spring Plates

The raw bar steel is brought into the steel warehouse on freight cars, which are run from the railroad siding on a transfer table that carries them into line with tracks running longitudinally through the building. The proportions of the building are such that the bars can be unloaded from the cars and laid with their ends in proximity to a center aisle. Running down the center aisles are tracks that accommodate trucks on which motor-driven alligator shears are operated. With this arrangement the shears can be brought into a convenient position relative to the particular steel that it is required to use. Fig. 4 shows one of these shears in operation. The stop shown in the illustration can be regulated in relation to the jaws of the shears, so that any length of plate may be cut. All the plates are sheared in this way.

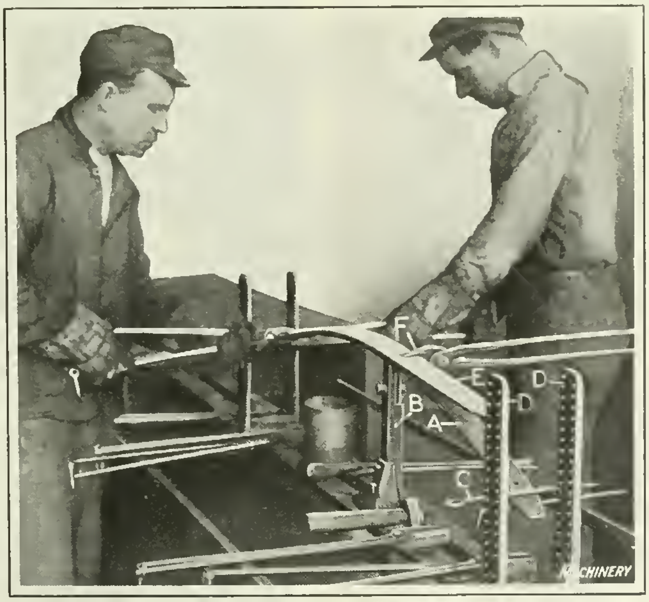


Fig. 1. Old Method of cambering Plates by Hand; this Method is still used in filling Small Orders

A well-equipped laboratory is maintained, and samples are taken from every shipment of steel that is received, and checked for chemical analysis. If this analysis shows that the steel is not within certain prescribed limits, it is rejected. A certain number of samples are also heat-treated and subjected to physical tests, such as cold-bend tests and tests for determining the elastic limit and tensile strength. The correct temperatures of the heat-treating furnaces are all determined and controlled by the laboratory, so that this all-important item is in the hands of experts.

Forming Eyes on the Main Plates

The majority of springs are made with eyes on the main plates, this work being done on a special cam-operated eye-forging machine built by the Coulter & McKenzie Machine Co., of Bridgeport, Conn. The ends of the main plate are heated to a forging temperature, and each eye is completed in three operations. First, the heated plate is inserted in a pair of dies, the end is scarfed off, and the eye slightly bent. It is then transferred to a second set of dies, which bends the end of the plate around and closes the eye. In the third operation the turned eye is placed in a set of dies which holds it while a mandrel is forced through to produce the correct inside diameter. One operator performs all these operations on one machine, without changing his position.

After the eye-forging operation has been completed, an entire set of plates for the spring to be made is sent to a lay-out department, where an experienced mechanic marks the positions of the holes to be punched. This set of plates serves as a sample for setting up the power presses to punch the entire lot of plates. Not only are holes punched in the center of the spring to accommodate the center bolt that holds the finished spring together, but clip rivet holes are also punched. Fig. 2 shows the type of machine used.

Trimming Ends of Plates

The next step, after the center and clip rivet holes have been punched, is trimming the ends of the plates. This operation is performed on a motor-driven crank power press illustrated in Fig. 3, and consists of tapering the ends of the plates and producing what is known as a "diamond trim." It

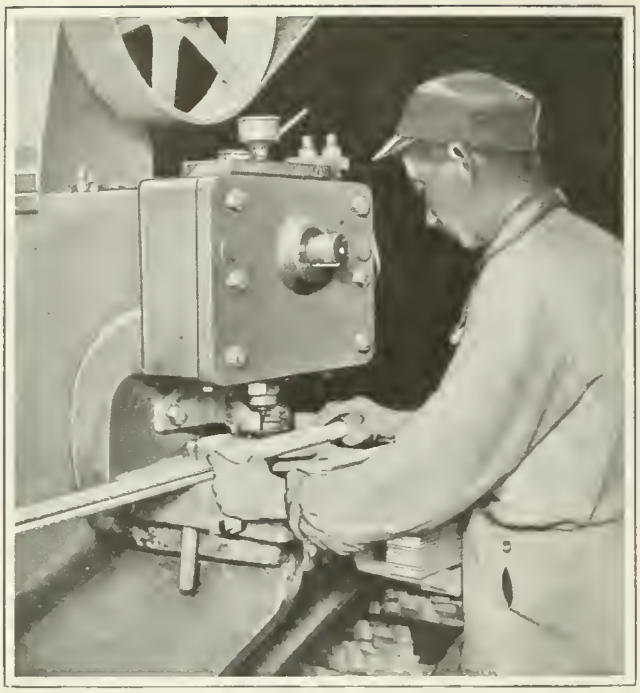


Fig. 2. Punching Center Bolt and Clip Rivet Holes

will be noted that this machine is equipped with four sets of dies for various widths of steel, but other equipment is also used in which a single die only is provided.

Cambering the Plates

Forming the necessary camber or arch constitutes the next operation in the fabrication of the spring. The plates, in complete sets to make up a spring, first go through an oil-burning furnace equipped with a walking-beam type conveyor. After passing through the furnace, the plates are removed at the opposite end, having been heated to a temperature of 1500 to 1600 degrees F., depending on the grade of steel used.

On the cambering machine there are two forms which are flexible and adjustable by means of set-screws. When a plate comes out of the heating furnace, it is placed on the lower form, after which the motor is started, which operates a screw ram causing the upper form to descend. This squeezes the plate between the two forms and bends it. Actually, a plate, called a "pattern plate," is placed between the lower form and the spring plate to be cambered, but this has no mechanical function, being used merely to prevent the continued application of hot steel on the lower form, which would rapidly destroy it.

After the bending, both the forms descend against the tension of coil springs, so that the heated plate being cambered is submerged in a bath of oil. Thus the plate is formed to the desired shape and quenched in oil in one operation. There is a slight tendency for the plate to spring back after it is removed from the dies in the cambering machine, and consequently the forms are set to a curvature somewhat in excess of that required, in order to provide the necessary compensation.

Several different forms of power-driven cambering machines are used, according to the class of work being handled, and while the principle of operation is the same, certain variations are required for different types of springs. When there is a reverse curve on the springs, it is necessary to employ both an upper and a lower form, so that the reversal of curvature can be accomplished by means of the set-screws that control the shape of these forms. In the case of springs having a curvature in one direction only, a lower form is used, and the upper member consists simply of a flexible band which is pulled down on the heated plate, causing it to take the required form.

Tempering the Spring Plates

At this point the steel is exceedingly fine in structure, but it has an undesirable degree of hardness. To remedy this, plates are placed in a furnace of similar design to the ones in which the plates are heated preparatory to cambering. The walking-beam conveyor is so timed that it takes about one hour to carry the steel the length of the furnace. The temperature of this drawing furnace is considerably lower than that of the heating furnace, being about 860 degrees F. After being removed from the furnace, the plates are allowed to cool in the air.

As a means of checking the heat-treatment, a certain number of plates are turned over to an operator, working under the direction of the laboratory, who tests them by means of the Brinell hardness machine. Certain prescribed limits have been set for this hardness, and all tests must show that the plates are well within the limits before they are permitted to proceed further.

Block-fitting

The next process after tempering is known as "block-fitting." At the discharge end of each tempering furnace there is a work station, where fitting blocks and a set of master plates of the correct form for each of the spring plates are used in block-fitting the springs. The block-fitter takes the various spring plates as they come through the furnace, and places them on a flat plate beside the corresponding master, in order to test their form. Each plate in the spring must fit the plate next to it. During the process of block-fitting the steel is hot—that is to say, it is about the same temperature as when it leaves the tempering furnace.

Grinding the Faces of the Spring Plates

As a leaf spring is deflected, the action causes the plates to slide on each other. In order to facilitate this action, it is necessary to surface the contact faces of the plates. This consists of removing the loose scale formed when the plates are tempered, and the rough spots on the surface of the steel. The surfacing is done on a grinding stand, and is by no means a finish-grinding operation. It is merely required to remove those spots that are sufficiently rough to seriously impede the sliding action. The amount of grinding that is done on the plates varies in accordance with the customer's specifications.

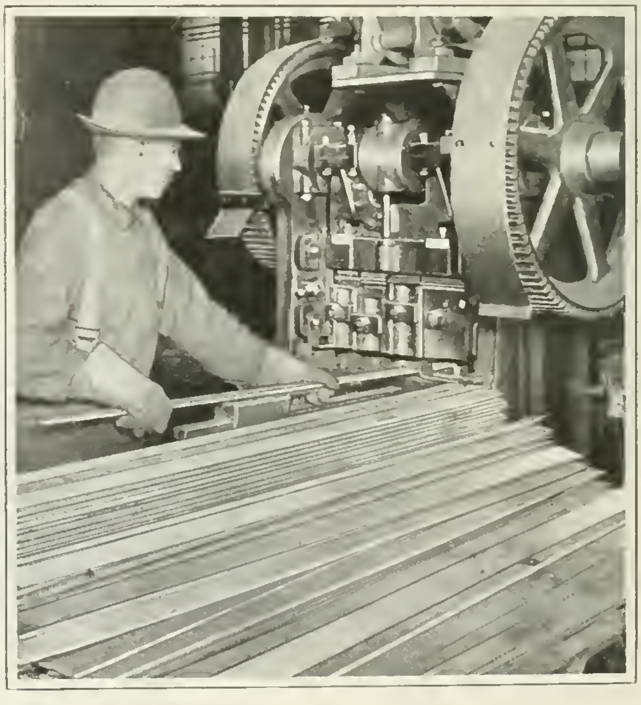


Fig. 3. Press used in trimming Ends of Plates

Pressing in Bushings and Milling Eyes

After the scale has been thoroughly removed from the plates, the springs are placed on a conveyor table for assembly. The first operation consists of pressing bushings into the eyes of each main plate. This is done by an air-operated arbor press. After the bushings have been pressed in, the plate is transported to a Gardner duplex ring-wheel grinder, on which the faces of the eyes are ground. This machine is equipped with a sort of cradle on the rocker arm, in which the under side of the eye is supported. The end of the plate is passed between the two opposed grinding wheels, so that the faces of the eyes are ground to a uniform surface, and the bushing to exactly the required width. After the eye has been milled, the inside diameter of the bronze bushing is reamed to the desired size.

Final Assembly and Inspection

When the foregoing operations have been completed, the main plate is again placed on the conveyor table, together with the rest of the plates of the spring, and the operator applies a graphite grease lubricant with a brush to each of the ground surfaces. As the plates are carried along, the rebound and alignment clips are riveted in place. The plates are then assembled on a pin through the center-bolt hole, after which the pin is removed and the center-bolt inserted and tightened. Clips bolts and spacers are then assembled, the nuts tightened, and the ends of the bolts cut off and riveted over, so they will not become loose.

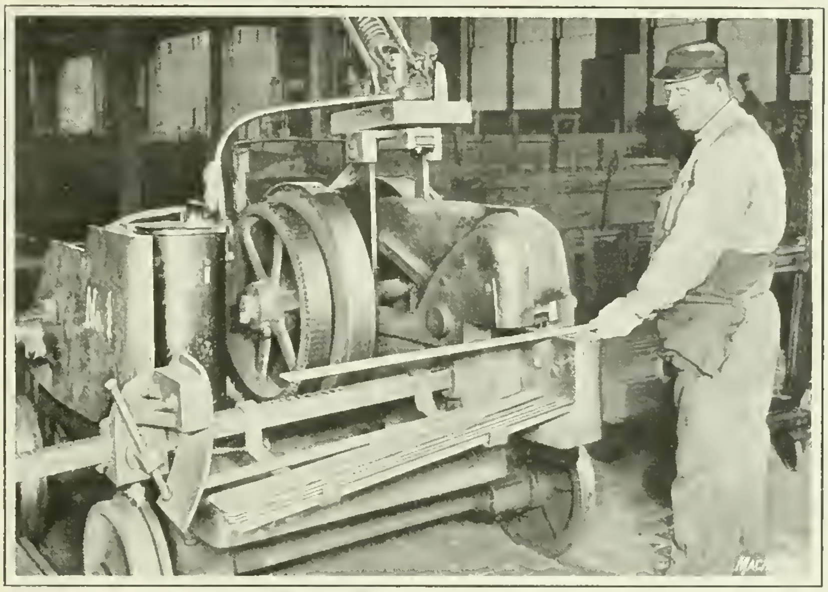


Fig. 4. Cutting out Plates to the Proper Lengths on Alligator Shears

The springs are next subjected to what is known as a break-down test, which consists of first measuring the opening of the spring, then deflecting it to very near the elastic limit of the steel, releasing it, and again measuring the opening. This is really a further test for heat-treatment. If it is correct, the spring will return to its original position.

The inspector then goes over each spring thoroughly, checking up the reaming of the bushings, milling and parallelism of eyes, etc. It is essential that the eyes be parallel with the body of the spring and also with each other, in order to facilitate assembly of the spring on the car. The test for parallelism is made by placing the spring in an upright position on a surface plate. Rods are then placed in the eyes and the necessary measurements taken. These measurements have to be within certain limits.

The final operation on the completed spring consists of a capacity test. This is carried out on an Olsen testing machine, the rate of deflection of the spring being checked, as is also the height of the spring under the normal load that it will carry under the car. The heading illustration shows the machine employed for this purpose. After being tested, the springs are ready for shipment.

* * *

According to *Safety Engineering*, statistics show that industrial accidents increase considerably on cloudy days, when artificial lighting is used for a considerable part of the day. This points to the need of proper artificial light.

COOPERATION OF ENGINEER AND DESIGNER

By THOMAS A. REILLY

Both the engineer and the designer have important work to perform in developing or bringing out a new machine. Hence a spirit of cooperation should exist between these two men; otherwise each will be greatly handicapped in his work, and the product of their labors will suffer as a result. Each man should concentrate his efforts on his own part of the job, and not attempt to encroach on the other's work or criticize it simply because *he* would do it in a little different way. As a general rule, it is the designer's place to work out constructional details, and the engineer's place to check the principles involved and see that the design as a whole will meet requirements.

Unfortunately, some engineers acquire the habit of making trivial changes in the details worked out by the designer. Unnecessary changes of this kind only serve to create a feeling of resentment in the mind of the designer, whose experience in such matters may be of more practical value than that of the engineer. The engineer who acquires this habit is likely to allow himself to be led off into a maze of insignificant details, while the principles underlying the work, which it is really his job to check up and verify, are lost sight of. As a result, ideas incorporated in the work by the designer which should receive the careful consideration of the engineer are often allowed to pass his inspection unnoticed.

In order to form an efficient productive unit or "team," the engineer and designer must have confidence in each other's ability. Mutual confidence requires that each man perform his own particular work carefully and intelligently. Once this condition is established, a spirit of cooperation will invariably develop, which will be far-reaching in its benefit to both the men and the company that they serve.

* * *

THE SWEDISH MACHINERY INDUSTRY

The situation in the Swedish machinery industry, as indicated by official statistics, shows a slight improvement for the better. There were 311 shops in operation last fall, many of which had been closed for a considerable time. No material change has taken place, however, in the number of workers employed, nor in the number of working hours. Wages in the industry are about 40 per cent below the scale prevailing in the latter part of 1920. The best employment is in mining machinery, electrical machinery, paper mill equipment, and shipbuilding. The shops engaged in agricultural, road-making, match-making, metal-working, and woodworking machinery have only a few orders on hand. German competition is still felt quite definitely in the Swedish market, and foreign competition, in general, shows no signs of becoming less serious, which is partly due to the fact that the exchange value of Swedish currency has reached its normal basis. The stocks of machine tools on hand are quite large.

Burnishing Machine for Crankshaft Bearings

By JOHN E. COLLINS

A MACHINE that eliminates the old hand method of scraping in crankshaft bearings of automobile engines is described in the following: The whole engine, so far as the main bearings are concerned, is limbered up in one operation on this machine. The bearings, as they come to the burnishing machine, are reamed a little under size. The cylinder block, with the crankshaft, camshaft, and pistons assembled, is placed in the special fixture of the burnishing machine, and the crankshaft is then turned over at the rate of about 610 revolutions per minute for a period of about one-half minute. During this operation the crankshaft is left dry. A mixture of oil and compound is then pumped directly to the crankshaft bearings, and the rotation continued for about five minutes.

The cylinder block is next transferred to the assembly track where the final assembly operation is completed. At the end of the assembly track the crankcase is filled with oil, and the complete engine goes to the dynamometer test block where it is given a running test for two or more hours under various loads. This burnishing machine should not be confused with a running-in machine, which simply takes the stiffness out and gives the bearings a smooth finish. The machine described in this article is used in the plant of the H. J. Walker Motor Co., at Cleveland, Ohio.

The bearings are reamed about 0.004 inch under size when they come to the burnishing machine. This excess metal grips the shaft tightly and must be rolled down to permit the shaft to turn freely. The rolling down operation must be completed quickly (in one-half minute, as mentioned previously) in order to prevent the bearing from heating up and "freezing" to the shaft or the babbitt bearings from being melted. In order to accomplish this, a thirty-horsepower, three-phase, sixty-cycle, 440-volt motor is used to drive the burnishing machine. This motor is connected through a silent chain drive to a large shaft which turns a heavy cast-iron flywheel. The flywheel is 22 inches in diameter by 18 inches thick, and is bolted to one member of a 30-inch cone clutch which can be quickly engaged or disengaged by a conveniently located handle. Thus the motor and flywheel may be allowed to turn without driving the remaining parts of the burnishing machine, when desired.

When the clutch is engaged, the turning pressure is transmitted through an Oldham coupling to the crankshaft of the cylinder block placed in the burnishing fixture. The part of the Oldham coupling to which the crankshaft is attached is shown at *A* in the illustration Fig. 1, which is a side elevation of the cylinder-block holding fixture. The principal parts shown in Fig. 1 are easily identified

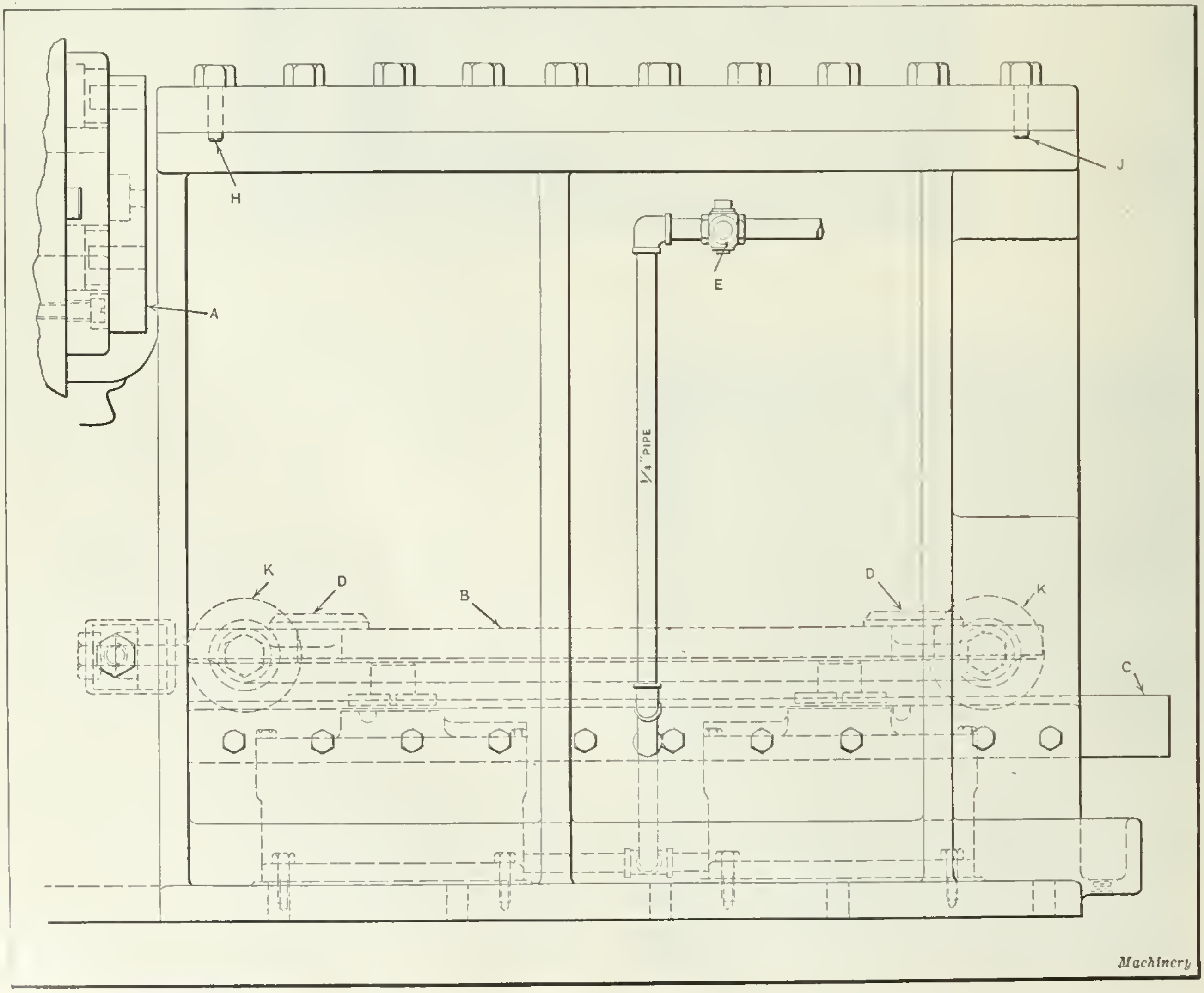


Fig. 1. Cylinder Block Holding Fixture of Crankshaft Bearing Burnishing Machine

in the end elevation, Fig. 2, as the same reference letters are used in both illustrations.

The carriage *B* is rolled out from the fixture on the track *C* so that the cylinder block can be lowered on it. The cylinder block is brought to the burnishing machine without the head assembled, and is put in the carriage with its bottom flange up so that the crankshaft can be readily inspected and the bearings adjusted, if necessary. Two round blocks or pins *D* serve to position the cylinder block on the carriage when it is rolled back into the fixture. The air valve *E* is then opened. The carriage has two air cylinders under it which lift the carriage and the cylinder block against parts *F* and *G*, where it is located by two pins *H* and *J*, Fig. 1, which pass through holes in the cylinder block flange. The carriage is shown in the raised position but with no cylinder block in place. As will be noted, the flanges on wheels *K* do not leave the track *C*. The flange at the end of the crankshaft is bolted directly to the flange of the Oldham coupling *A*.

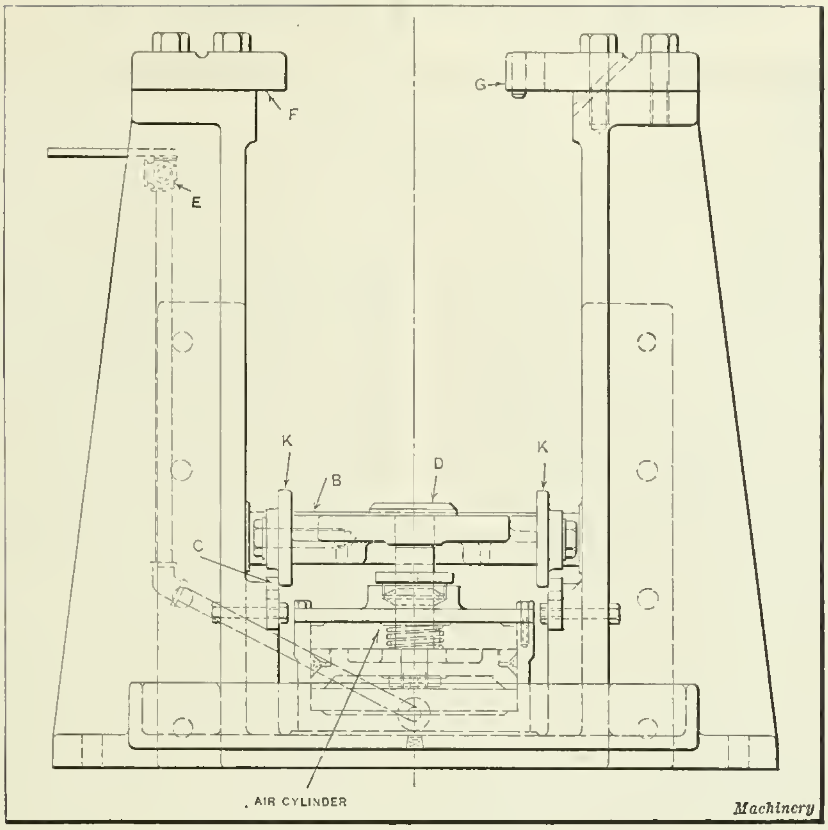


Fig. 2. End Elevation of Fixture shown in Fig. 1

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A COURSE IN MACHINE SHOP PRACTICE

A comprehensive course in machine shop practice has been introduced at the University of Michigan, and has recently been described by O. W. Boston, acting director of the engineering shops and assistant professor of shop practice. The new course is a substitute for the ordinary manual training course generally provided, and gives the student a broader viewpoint of present-day machine shop practice, at the same time emphasizing the economic features of quantity production work.

The present course includes both lectures and actual shop production work. It gives definite information on the history and development of quantity production and present practice, together with questions and problems. Lantern slides are used in connection with the lectures to illustrate the development of typical machines and tooling set-ups. In the shop, 30 per cent of the time is devoted to tool-room work, involving the use of machines not commonly employed in production; and 70 per cent of the time is devoted to the manufacture, in quantity, of two small devices. This serves as a training for the student in production methods and illustrates the economic factors that tend to reduce costs by quantity production and standardization. Jigs, fixtures, and gages are freely used, because it would be impracticable to demonstrate successfully the use of production machinery, such as automatic screw machines and turret lathes, without the use of special tools and gages. The value of jigs, fixtures, and gages can be definitely shown to the student only by having him engage in actual quantity production. The simple routine of labor also is emphasized, so that the students may recognize that this routine is one of the necessary elements in production. As all operations are worked on simultaneously, the "flow of material" from operation to operation is illustrated.

In order to produce a large variety of parts at low cost when each part requires several operations, routing cards, stock records, time studies and instruction sheets are necessary. The course at the university includes all these features, and the students become acquainted with actual factory procedure in this way. The material for the devices built is furnished by an outside commercial concern, which also sells the finished product. This relieves the educational institution of any commercial activities; but an agreement has been made between the university and the manufacturer, whereby the university receives a certain amount for the labor required to produce each device. This compensation is slightly below what would be a commercial price, and in return for this concession, the university is free from any obligation to meet delivery schedules and is given a higher scrap allowance on material than would be permissible in regular commercial work.

Apart from the production work, the course includes thorough instruction in the history of production engineering; the elements of accounting in quantity production; stock records; application of standardization as affecting machines, tools, and materials; time studies; wage payment plans; different types of machine tools, and the cutting tools used in them; materials for cutting tools; speeds, feeds and cutting lubricants; milling cutters, drills, reamers, taps, dies, broaches, grinding wheels, and methods used for grinding, buffing and lapping; gears, gear-cutting, and gear-cutting machines; jigs, fixtures, and special tools; standardization, measuring instruments, and gages; automatic machines; die-casting; punch and die work; metal spinning; and a specific example of a manufacturing lay-out for producing a given article in quantity.

In the instruction relating to the subject last mentioned, the entire process, beginning with the drawings, is entered into. Experiments necessary to determine the best design of the product are dealt with; and the question of whether to purchase or manufacture parts is taken up, together with the ordering and fixing of delivery dates for all materials; the determining of material required for different parts—castings, forgings, stampings, and bar stock; machining methods to use; the selection of machine tools; routing and instruction sheets; the design of jigs, fixtures, and gages; and time study of the operations and inspection methods. A course of this kind will tend to prepare the college-educated engineer for quantity production work in the industries, and will tend to make college-trained engineers less scarce in production shops.

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FREE ENGINEERING SERVICE

A recent editorial in MACHINERY calling attention to the heavy burden placed on manufacturers of machine tools in supplying prospective customers with free engineering advice, has brought out additional information in regard to this practice. One of our leading machine tool builders recently stated that an important factor in the increased cost of machine tools is the free engineering service furnished in connection with the sale of machines. Neither the increased price of materials nor the higher wages add so much to the cost as does the consulting engineering advice required by some customers. Frequently the cost of this service is so great that it not only eliminates any profit from the transaction, but actually produces a loss.

One case was mentioned which, though extreme, illustrates the point very clearly. A buyer who was in the market for a machine costing about $1800 requested each one of the prospective sellers to send, not only a salesman, but an engineer, to look over his factory and advise him in regard to the best method of producing his work and the tooling equipment required. After the visit of inspection all the bidders furnished tooling lay-outs and designed special equipment to aid the customer and to induce him to buy their machine. When, finally, the order was placed for the $1800 machine it was found that the competing manufacturers had spent in traveling expenses, engineering and drafting-room work about $2400. In another case, a prospective buyer of a machine tool selling for $2800 asked the manufacturer to furnish data which would have cost approximately $1000 to compile, and which the latter of course declined to do.

One manufacturer developed a design for a machine that could be sold for $750 when built in lots of fifty to a hundred. This cost estimate did not include any provision for free engineering service, and when the machine was placed on the market it was found necessary to raise the price to $1000 to cover the overhead charges caused by free engineering advice, providing tooling lay-outs, making time estimates and sending demonstrators to some of the customers' factories to train their men in the operation of the machine.

It is true that many customers ask for no engineering service, but those who do ask for it thereby increase the cost of the tools requiring it, and get something for which the buyer who needs no service helps to pay. Several machine tool manufacturers say that the large concerns are the ones most likely to insist on this free service, although they are better able to pay for it as a separate item; but under existing competitive conditions it is difficult for a few manufacturers to insist upon such a payment. It is also difficult to draw the line between legitimate service and that which is really an imposition upon the manufacturer.

* * *

DESIGNING ENGINEERS NEEDED

This month thousands of young men will graduate from our engineering schools and colleges to enter various industries. Their training was intended to qualify them to become designers of machinery, but a comparatively small number of the graduates of engineering schools devote themselves to machine design; the larger number, as shown by a questionnaire recently sent to the alumni, seek to enter the sales department or to obtain office positions.

A mechanical executive of one of the largest builders of steam, electric and hydraulic equipment in the country recently stated that unless engineering design could be made more remunerative to young engineering graduates there would be a distinct scarcity of that type of engineer in ten or twenty years. The compensation and opportunities offered to engineers who undertake selling and industrial efficiency work are generally so much greater than those offered to the designer that many who may be qualified for either line of work will select the former. This will bring about a serious condition in the engineering industries; because, manifestly, without a sufficient number of able designers, particularly in the electrical and power generating fields, we shall find ourselves in the position of following instead of leading European nations in new mechanical developments.

At present many designing engineering positions in important plants are filled by men born and trained abroad; and while all are welcome, manifestly it is desirable that the training facilities of American engineering schools should be used to their fullest capacity in training native born engineers. No engineering schools in the world are so well equipped as ours, and a large proportion of their instruction is wasted if the specialized engineering knowledge their graduates acquire is not used to a greater extent in the particular field where it is most needed.

This condition merits the consideration of all executives in the machine-building industries. As we shall need skilled labor in the future and must provide for the proper training of young men in shop work, we must also provide for the training of a sufficient supply of designing engineers, or the work for the shop men will be lacking. Our theoretical training is well taken care of, but when the young men finish that, they should find the designing engineer's work sufficiently remunerative to warrant taking it up, if their inclination points that way.

* * *

KEEPING NEW EQUIPMENT IN REPAIR

One of the important factors in improving business in the machine-building field has been the active railroad buying during the past year. During the fifteen months ended March 31, our railroads authorized expenditures amounting to $1,540,000,000 for new locomotives, cars, tracks and other facilities. In that period over 4200 new locomotives were ordered, of which about one-half were placed in service; nearly 225,000 new freight cars were ordered, of which about 118,000 were put in service.

To keep this new equipment in good condition, additional shop facilities and machine tools are urgently needed. During the past year the railroads have ordered considerable new equipment for their shops, and some machine tool builders have found the business from railroad shops and locomotive building plants a very important part of their total sales. The mechanical executives of the railroads know that the full benefit of new locomotive equipment and other rolling stock can be obtained only by the operation of good shop equipment, and the increased railroad buying indicates that the men responsible for the finances are also beginning to recognize this. The effect of this new attitude is already in evidence. On May 1 the railroads had fewer locomotives in need of repairs than at any time since the American Railroad Association began to keep records. On that date the number of serviceable locomotives was 50,259, and those in need of repairs requiring twenty-four hours or more, 12,473. Better machine tool equipment will reduce this number still further.

The Upward Trend of Business

By A. W. HENN, President, The National Acme Co., Cleveland, Ohio

THERE is every reason to believe that the present activity in nearly all lines of business, which amounts to a boom in some industries, will continue throughout the year. Every factor making for business prosperity and stability is favorable, and nothing short of a catastrophe can be expected to change the course of business during the present year. There is no serious labor unrest; and no labor troubles of any importance are in sight except in the building trades, where periodically—every spring—there are local strikes at the very time when it would be to the greatest benefit of all concerned to preserve peace. The important fact to consider, however, is that there is now industrial peace in the great fields of employment—steel mills, textile industries, coal mines, and railroads.

While labor is not inclined to create industrial disturbances by means of strikes, there is a tendency for wages to rise still further from what is already a high level, so that we are seemingly close to the border line of labor inflation, if not now at or even partly across it. With labor and materials tending upward in the metal-working industries—notably in the machine-building industry—prices in general will rise for the next six months at least. Labor again shows a tendency to shift from job to job, and manufacturers must recognize the fact that hiring men away from other employers does not increase the labor supply. This practice merely increases the cost of manufacture, causing prices to rise and producing stagnation of business, because buyers are unwilling or unable to pay the mounting prices.

An undue increase in the cost of materials will tend to bring about the same conditions. Already certain steel that a year ago sold for 1.60 cents a pound sells at 3 cents; and pig iron, which was sold at $20 a ton, now sells at over $30. If prices for raw materials in the machine-building field go much higher than this the tendency will be to curtail buying and slacken the pace of manufacture. There is every reason to believe, however, that material prices are not going to rise much higher, because, on the one hand, those in control of raw material prices do not want a repetition of the 1920 experience, and on the other hand, manufacturers are buying more conservatively, so the present demand will not increase much. If manufacturers generally will be conservative in their buying and will refrain from indiscriminate hiring of men away from others engaged in the same line of business, the present period of prosperity is likely to last much longer than it otherwise would.

The Railroad Situation

One of the most favorable signs pointing toward a continuation of business prosperity and normal conditions in industry is found in the railroad situation. The railroads are beginning to get back into their own. They are in a better state financially at present than they have been for many years past. The public attitude toward the railroads is also more favorable. There is less likelihood of injurious legislation and better prospects for constructive aid. The railroads will have some difficulty in handling the traffic that will be offered to them during the remainder of this year, but they are striving energetically to meet the situation. A larger number of locomotives and cars will be built this year than at any corresponding time in the history of American railroads; and as the industries have become adjusted to the increased freight rates and fares, it is not likely that any serious pressure will be brought to bear to impair the financial position of the roads.

The Automobile Situation

Fears have been expressed that during the latter part of this year there will be a serious curtailment in the production of automobiles. While it is likely that the production cannot continue throughout the year at the present pace, which would mean a total production for the year of over 3,000,000 cars, it is not generally believed that there will be anything like the slump that was experienced in 1920. The country as a whole is prosperous, and there are still a large number of new users of cars coming into the market. Furthermore, as has been pointed out by Colonel Ayres, in his careful investigation of the subject, the life of an automobile may at present be estimated at seven years, and as there are over 12,000,000 cars in use, the demand for replacements alone would be close to 2,000,000 cars annually. While there doubtless will be fluctuations in the automobile industry, the same as in every other line, the automobile is now so firmly established as a means of communication that the production must go on at a reasonably constant pace. This production is not likely to be less than 2,000,000 cars a year, and probably will average beweeen 2,000,000 and 3,000,000 cars for many years to come.

Machine Tool Prices

A subject that is of particular interest to the makers and users of machine tools is that of machine tool prices. Some buyers intimate that if machine tools increase a great deal more in price, there will be a curtailment in buying. The answer to this is that machine tools, as well as other products, cannot be priced solely with a view to encouraging buyers; the price must be equal to the cost of production, plus a reasonable margin of profit. Surely the manufacturer whose enterprise and ingenuity has made possible the development of the modern types of machine tools is entitled to something more than the mere cost of production. In any event, present machine tool prices, when compared with the prices of other classes of machinery of equal quality and ingenuity of design, are unusually low. Machine tools sell anywhere from 20 to 50 cents a pound; whereas many other lines of machinery sell at prices up to $1 a pound.

In the machine tool industry, it may be conservatively stated that, on an average, only three years out of every four, produce a return to the manufacturer, and the fourth year almost invariably entails a loss, due to the periodic decrease in demand for machine tools. In an industry subject to such fluctuations, it is therefore necessary—and all machine tool builders, if they expect to remain in business must consider this fact—to earn such an amount during the three years when the demand is about normal that the business may be carried without undue loss during the fourth.

Buyers of machine tools cannot be expected to consider this fact, as they naturally are interested merely in obtaining their equipment at the cheapest price possible at the moment, but manufacturers of machine tools must carefully plan ahead, so that both their individual plants and the industry as a whole may be placed on a firm financial basis. It is only by so doing that they will be able to employ a sufficient percentage of their earnings in experimental and development work, a prime necessity if they are to keep pace with the constant demand for improved equipment.

National Machine Tool Builders' Convention

THE twentieth spring convention of the National Machine Tool Builders' Association, held at Hotel Greenbrier, White Sulphur Springs, W. Va., May 9 to 11, was characterized by the attention given to administrative and executive problems now facing the industry. In addition to the discussions of association activities at the convention, two unusually interesting and valuable addresses were made, one by Dexter S. Kimball, Dean of the College of Engineering, Cornell University, on "Machine Tools: The Master Tools of Industry," and one by C. A. Plaskett of the U. S. Forest Products Laboratory, Madison, Wis., on "Making Better and Cheaper Containers for Foreign and Domestic Shipments."

Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Springfield, Vt., was elected a member of the board of directors of the association, to succeed Winslow Blanchard, president of the Blanchard Machine Co., Cambridge, Mass., who died April 7.

President Kearney's Address

In his address, E. J. Kearney of the Kearney & Trecker Corporation, Milwaukee, Wis., president of the association, laid particular stress upon two questions: "Have We Learned Anything from the Long Period of Idleness?" and "What Steps can be Taken in Preparation for the Next Depression?" Mr. Kearney said in part: "I shall not attempt to make a catalogue of all the lessons that have been learned or of all the defenses that should be set up, but reference to a few may serve to stimulate thought and provoke discussion, and thereby be the means of bringing out the answers. May not the following be considered as answers to the first question?

"1. The demand for machine tools is subject to the greatest fluctuations, even greater than that for the most useless luxuries.

"2. A continuous record plotted into a curve showing the fluctuations in volume of orders on a percentage basis, using any selected period as 100 per cent, is of the greatest value and would have saved millions in 1920.

"3. The beginning of a period of depression is the wrong time to accumulate stock.

"4. Price reductions have no bearing whatever on the sales of machine tools.

"5. Idleness costs money, but is unavoidable from any knowledge that we now possess.

"6. The absence of substantial cash reserves with which to enter a long period of depression means price cutting, loss of self-respect, discredit among our competitors, humiliating pressure from banks, expensive refinancing, creditors committees, or receiverships.

"As to the second question 'What Steps can be Taken in Preparation for the Next Depression?' the following suggestions may be made:

"1. Closer Cooperation with Dealers. A new concern, without any knowledge of how to reach the user, may copy the design of an existing machine and get it on the market in good times through the medium of a dealer. This is, in a large measure, responsible for the highly competitive conditions and the low prices that usually prevail in our industry. This is especially true of tools that are simple in design, such, for example, as upright drills and shapers, but extends throughout the entire line, though in somewhat less degree. Thus a new competitor is launched with no knowledge of costs or prices. It would not be generous, or in accord with public policy, to set about trying to prevent the development of new competition on the part of capable and experienced men; but there should be more cooperation with the dealer in this regard, for the practice leads not only to a weakening of old established concerns, but to loss, disappointment and bankruptcy to the uninformed who make a start in boom times. The manufacturer who relies on a dealer should see to it that the dealer relies on him. There should be mutual confidence and close cooperation for the good of both. This policy broadly and intelligently followed will help when the next slump comes.

"2. Study of Business Curves. A second way in which preparation can be made for the next depression is to get in the habit of closely following the percentage curve showing in what direction the volume of new business is going, and at the first sign of a distinct downward tendency, to decrease the volume going through the factory before it is too late to prevent the accumulation of a dangerously burdensome inventory, as was done in 1920.

"3. Accumulating a Surplus to Meet the Depression. The third item in the list of things to do in preparation for the next period of idleness is to prepare for its cost. No argument need be advanced, for the reason that our experience is all too recent. The deficit is not yet wiped out. The money that has gone and the debts that have come, both testify to the cost of idleness. When business recovers and orders are coming in in excess of plant capacity, machine tool builders, although they are among the steadiest and most conservative of business men, begin to relax their vigilance. It is not so well understood as it should be that overhead kept down in good times will help to keep down the cost when the orders are few; nor, perhaps, that the burden reserve accumulated in the good years will have a tendency, when rightly viewed, to keep dividends down to a safe and wholesome basis, prevent overexpansion, and generally steady the industry.

"4. If the assumption is correct that price cutting to one customer and selling at top prices to the trusting buyer, is no longer followed by men of intelligence and common business integrity, we can devote ourselves to a consideration of the factors that enter into price. The selling price of machine tools depends on five principal factors: (1) Usefulness to the buyer. (2) Cost. (3) Competition. (4) Reputation. (5) Selling methods. There is an increasing tendency to give first place to competition in establishing the price, when in reality usefulness to the buyer and cost are the main factors."

Relation between Price and Competition

In further discussing the methods for setting a fair price for the product of a manufacturer, Mr. Kearney pointed out that the uses to which a machine may be put are infinite in variety. For that reason a special, and perhaps exclusive feature, is of no particular value except to a certain percentage of the buyers, say, for example, 30 per cent. Fixing the eye on competition and setting the price low enough to obtain 35 per cent of the business, may result in the total elimination of profit from the 30 per cent of the cases for which the machine is best adapted.

There is a place for the light, low-priced machine where it will answer the purpose just as well, or better, than a heavy one of higher price. The heavy machine, in striving to compete, throws away its profit on all sales, including those for which it is best adapted, by attempting to enter a field where it would not be found except as an incident, being used in part on work for which the light machine is ill suited. The same principle applies to highly developed, as against simple machines, and also to machines of high accuracy and finish as compared with ones in which these features are absent.

It is not possible for one shop to build all classes of machines in a given line, as, for example, heavy and light, highly developed and simple, those of greater and less precision, for the reason that such a mixture could not be manufactured with the same shop personnel, and the concern attempting such a program would have much difficulty in marketing the higher grades. This is no reflection on the makers of the lower grades. They have their field, but the maker of the accurate product should not attempt to reach their price, nor is it necessary.

Competitive Basis of Machine Tool Industry

'The machine tool business is highly competitive," said Mr. Kearney, "but fortunately price is not the only basis for competition. The concern that brings out a new machine, or adds a few features to an old one that will increase production or improve the quality of the product over that of previous standards, is performing a public service for which it should be rewarded.

"There is another subject that has been much in our minds of late and that may have a vital effect on the competition of the future, tending in the direction of price competition rather than in the direction of design and quality—that is, standardization. There is room for progress in the matter of standardization, but it must be pointed out that the nearer together machines of different makes come in their general dimensions, the nearer together they will come in price.

"Let us build the best machines that can be made, build them with points of real difference. Let our product, to some degree, reflect our individuality.

"A stranger listening for the first time to the complaints that we manufacturers make about our industry would probably go away with the idea that there is nothing desirable in the manufacture of machine tools. Such, however, is far from the case. It is not a get-rich-quick route. It is something more worth while. It is the foundation of mechanical progress. We are in it not only for the money that can be made, but for the real joy of it. Go where you will, no industrial center will be found where manufacturing is being carried on, be it cornhuskers, printing presses, automobiles, or airplanes, that does not have among its leaders and men of affairs graduates of the machine tool shops of Hartford, Worcester, and Providence. In this respect, we are performing a really valuable service in training mechanics to go out into all the world as apostles of progress. Is this service to humanity not a service worth striving for?"

Report of Mr. DuBrul

In his report on business conditions and association activities, Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, stated that since last October there has been a considerable increase in activity in the industry, but it is not likely that this increase will continue at a very rapid rate from now on, because the activity of other industries is limited by the supply of labor, and until a more ample supply of labor is available we are not likely to witness much expansion of manufacturing facilities. The machine tool business necessarily shows its greatest activity when other industries are greatly expanding their facilities.

Statistics on building operations indicate that the end of the building boom is very close at hand. The high cost of buildings at the present time is likely to prevent many projects heretofore contemplated from reaching the point of contracting. Railroad buying has not been so large as it should be in view of the conditions of the railroad shops, which are badly in need of much new equipment. But no matter how much they might like to have new equipment, the railroads do not buy it unless they can see good prospects of paying for it.

Forecasting Business Conditions

It was further stated by Mr. DuBrul that it has been visibly demonstrated, by statistics and charts, that the machine tool business is one of the most irregular of the industries, and is subject to longer and deeper depressions than the average. It is of prime importance, therefore, and should be of great interest to all machine tool builders, to use every means available in forecasting conditions so as to keep their own individual businesses in a healthy state. The better forecasts that all business men of the country learn to make, the less serious will be the swings of the business cycle. It is the duty of industrial managers to use every means available in making good forecasts. The growth of radicalism will become more and more marked unless these fluctuations are better controlled.

In the fall of 1921, President Harding called a conference to discuss the causes of and remedies for unemployment. It was soon recognized that the greatest distress of unemployment is caused by the fluctuations of business due to the business cycles. The conference appointed a committee to study the question of unemployment in relation to these business cycles, and many interesting facts are brought out in the full report of this committee, now available. In many industries men honestly believed that there was a lack of material and supplies, and that prices would continue to rise in 1920. Yet, if full information had been available, it would have shown a surplus accumulation of speculative stocks of goods. Had business been possessed of the true facts, comment on those facts would have prevented the spread of the idea that there was a much larger effective demand than actually existed.

Minimizing the Effect of Business Cycles

The committee points out that the present buying habits ought to be changed; business men should be induced to buy from hand to mouth when a boom is on, and to buy in larger quantities in a period of depression. This would prevent the over-stocking in boom times and the under-stocking that is always prevalent in times of depression. Since the only means of absolute demonstration of conditions is through the use of statistics, the committee urges that much more statistical study be given to the trends of each industry.

The committee also points out that the present tax laws tend to make companies extravagant in maintenance charges in good times, instead of putting men on maintenance work when production activity is low. Finally the committee recommends that every business man pursue the policy of systematic accumulation of reserves in times of prosperity for use in expansion and improvement in times of depression. It is to be hoped that the customers of the machine tool industry will take this advice to heart and change the buying habits which now make the machine tool industry most irregular.

Cooperation with the Department of Commerce

A valuable report was presented to the meeting by J. W. Carrel, vice-president and general manager of the Lodge & Shipley Machine Tool Co., who is chairman of the committee to cooperate with the Department of Commerce. Mr. Carrel pointed out that the Department of Commerce has much valuable information in its library and files which is available to machine tool builders interested in building up foreign trade. He emphasized the importance of obtaining accurate export trade information and advised the members of the association to take advantage of the facilities offered by the Department of Commerce.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, May 11

REPORTS from the principal engineering centers in the district covered by Coventry in the south to Sheffield in the north, afford many indications of steady trade improvement. Inquiries are plentiful, although for the present only a small proportion appear to mature into orders. However, the tendency as a whole is in the right direction, signs of returning confidence are to be observed in most quarters, and several development schemes of considerable importance, which have been held up owing to general trade depression, are now going forward. It is also apparent, despite frequent reports to the contrary, that strong efforts are being made to relieve the raw material shortage. In practically all districts where iron is produced there has been a striking reduction in the number of unemployed during the last two or three weeks. Numerous blast furnaces have been blown in, and several firms are producing pig iron to the full extent of their capacity. Steel making plants as a whole are also very busy.

The Machine Tool Industry

In the machine tool shops there is still a shortage of work. Some factories have turned temporarily to other lines of production and are doing fairly well, but the majority are depending upon the growth of their regular business, and their recovery rests upon a general renewal of industrial activity. In this respect conditions vary, and it is not surprising to find some works better employed than others. Even so, there are very few instances where an appreciable measure of improvement cannot be observed. As a matter of fact, in the writer's opinion, the situation is much better than outward appearances indicate. A good deal of work is now in the hands of the estimating and designing departments, which, while representing a necessary and very important stage of production, leaves the shops somewhat scantily employed.

One of the features of the present situation is the brisk demand for machine tools of a special character. Inquiries of this nature have developed into considerable proportions of late. In a number of cases the pressure of work is very heavy, and the difficulty of obtaining draftsmen of ability in sufficient numbers to cope with the work in hand is mentioned by several firms.

The demand for standard machines is also improving. Particularly is this noticeable in respect to gear-cutting and grinding machinery and similar tools used in the automobile industry. Many firms that previously bought gears from outside sources are now installing gear-cutting equipment of their own. In addition, the firms that supply gears to the trade are considerably increasing their equipment.

The Automobile Industry

As is usually the case at this time of the year, automobile manufacturers are fully employed, and the prospects of increased sales of machine tools in this direction are improving rapidly. At the present time, fully 50 per cent of the output of machine tools, in the Birmingham area at all events, is finding its way into the automobile factories. Among the more progressive motor car builders there is a distinct movement toward standardization. The number of models produced are being cut down to the minimum, and efforts are being made to use efficient tooling on the smaller variety of parts on a more intensive scale. By these means it is hoped that costs will be reduced.

Although the approval of standardization is by no means general in the automobile field, success has followed wherever it has been tried. One well-known factory is now producing a single type of power unit by intensive tooling methods and has effected a five-fold increase in production without adding to its overhead charges. This has enabled the price of the finished car in which the unit is embodied to be reduced to an exceptionally low figure, and at the present time the supply is far from equal to the demand. The management has therefore decided to double the present rate of output—a ten-fold increase over that of a year ago.

Effect of Requirements of Automobile Industry on Design of Machine Tools

Increased output demands machines of a highly efficient type, simple to operate and capable of high and continuous duty. An examination of many of the tools recently installed in motor car factories, or in process of construction at the makers' works, reveals the fact that such items as change-speed and feed-gear boxes have been eliminated. It is contended that as the machine will perform but one operation throughout its useful life, the only speed and feed necessary is that which is most suitable for the work in hand. Hence one or two pairs of change-gears take the place of an elaborate, but, under the circumstances, useless piece of mechanism. The control gear similarly has been reduced to the utmost simplicity, so that the machine may be operated with a minimum number of movements. On the other hand, it is obvious that the machines have been considerably improved in detail. Many parts are made from special heat-treated steels, and the shafts and spindles are invariably mounted in ball thrust or journal bearings, with the result that they remain accurate, absorb the minimum amount of power, and run for long periods without attention. These are the types of machines in which the motor car makers appear to be most interested, and providing the salesman can show, say, a 15 per cent saving over the existing method of machining, satisfactory business usually results.

Apart from the above, methods are being developed which are expected to have an almost revolutionary effect on existing methods of production. For the present it is not possible to make any very definite statement, as the development is still in its infancy. However, it is engaging the serious attention of well-known production engineers, and may be said briefly to consist of a system whereby a series of simple standard machine tool units, for instance, a drilling unit, a milling unit, a turning unit, and so on, may be arranged in line for the production of a single specified component. To machine the part, operations are subdivided to such an extent that each unit performs its work automatically, without any attention on the part of the operator other than changing the work. The type of jigs or fixtures used are designed so that setting and clamping of the work are performed, in many cases, with a single lever movement. Each unit is, of course, arranged on a common foundation closely adjacent to the next unit in sequence; hence there is very little time or effort lost in transferring the parts from one machine to another. Utilized to its full capacity, the above system obviously is only intended for production on a very large scale. On the other hand, it is capable of reducing costs to such an extent that the article produced can be marketed at a sufficiently low figure to attract a proportionately larger circle of new buyers.

Spark Tests for Steel

By S. P. ROCKWELL, Hartford, Conn., Consulting Metallurgist for the American Gear Manufacturers' Association

IT has long been the practice of toolmakers and hardeners to judge the grade of steel by observing the characteristics of the spark produced when a sample is held against an abrasive wheel. Charts have been prepared in the past showing "spark pictures" of high, medium, and low carbon steels, and of steel containing chromium, tungsten, and manganese. But it is only within the last two years that this method has been placed on a thoroughly practical working basis, so that it can be used as a reliable means for the inspection of steel. F. H. Starkey and D. H. Stacks, of Hartford, Conn., both of whom were for many years connected with the Whitney Mfg. Co., have been instrumental in developing the spark test method to a point where it has proved practicable for factory inspection. This method of inspecting the grade of steel depends largely on the inspector's ability to concentrate; anyone who is mentally alert, has good eyesight, is not color blind, and is conscientious in his observations, may become proficient in using it.

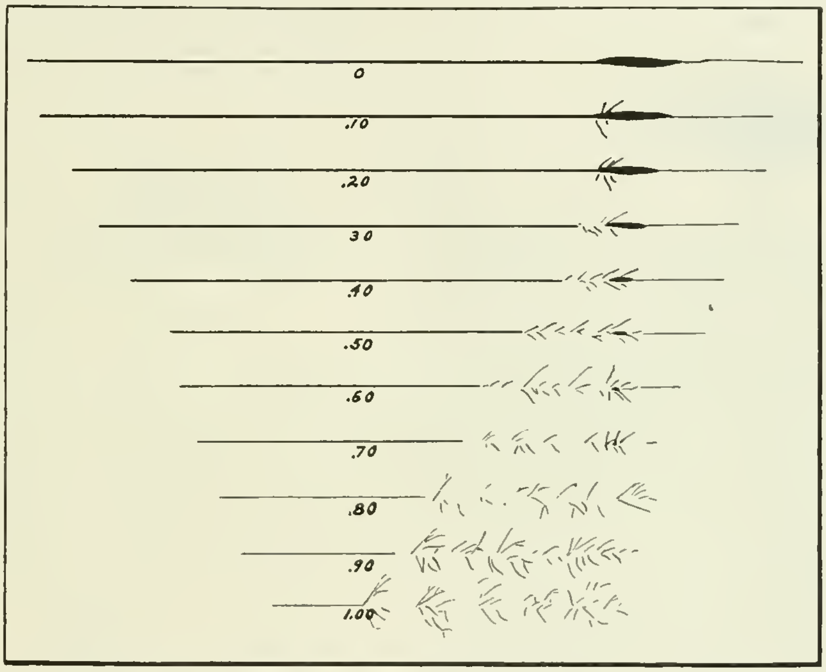


Fig. 1. Single Streaks in Spark Pictures of Carbon Steels with Different Carbon Content

It has been claimed that by simply observing the spark picture of a piece of steel it is possible immediately to determine the carbon content. As a matter of fact, this can rarely be done. It is doubtful if anyone could estimate within plus or minus 0.10 per cent of carbon, unless the grinding wheel speed and the type and grade of wheel have been standardized, and unless analyzed steel standards from the same heat as the steel being tested are available. But if wheel speed and wheel are standardized and a standard from the same heat is available, then it is possible to estimate the carbon content to within plus or minus 0.02 per cent for the lower carbon steels, and to within plus or minus 0.05 per cent for the higher carbon steels.

The carbon content of alloy steel may be determined as accurately as for the straight carbon steels, provided the percentage of alloying elements is not very high, as would be the case, for instance, in high-speed steel. In addition, the presence of other elements may be determined. The presence of chromium can readily be determined within ranges of 0.3 per cent; nickel below 1.5 per cent is somewhat difficult to determine, but nickel from 1.5 to 3.5 per cent is readily discerned. In tungsten steel, one may discover minute traces of tungsten, and also distinguish between 2 per cent, 5 per cent, and 8 per cent tungsten steel and higher. Nickel-chromium steels may be sorted by the spark test into grades agreeing with the S. A. E. specifications. The beginner, however, should become accustomed to the carbon steels first, for after he has become thoroughly conversant with these, the examination of other steels will be easier.

In looking at the spark picture produced by carbon steel, when pressed against an abrasive wheel, a series of streaks and explosions are in evidence. Fig. 1 shows, as accurately as a diagram can indicate it, the general appearance of the spark pictures of different classes of steel. The author has tried to obtain photographs to show the spark picture characteristics, but owing to the character of the light and the instantaneous appearance of the spark picture, these efforts have not been very successful. If we analyze a single streak in the spark picture produced by a medium carbon steel, we find a carrier line, a carbon explosion or crow's foot, an iron burning flash or bird's tongue, and a gas streak.

In chromium steels the explosion is different from that in a carbon steel. Each fork of the explosion breaks into another fork, and these explosion lines also curl, the appearance being similar to that of a daisy. The iron burning lines are much shorter than for carbon steel, and a little darker in color. With high tungsten steels the carbon explosion is absent. The color of the burning lines is dark red. As the tungsten decreases, carbon explosions appear with the characteristic daisy form that is associated with the chromium content, as mentioned. In manganese steel, the carbon explosions are bushy, somewhat like a bloom of wheat. Silicon below 0.20 per cent increases the appearance of bushiness.

Sometimes it is practicable to use colored glass filters for examining the sparks of alloy steels. These filters eliminate some of the different colors which are caused by the various elements in the alloy steel, and thereby make it possible to observe each element by itself.

Application of the Spark Test

The piece of steel to be tested should not be placed against the edge of the wheel. It has been found more satisfactory to place it against the side surface of the wheel at a point ¼ to ½ inch from the outer periphery. There should be no obstruction in front of the spark, as it is generally easier to study the characteristics at a distance from the wheel at a point where the carrier lines are more separated. A black background should be used, against which the sparks can be clearly seen. The usual way, when testing is being done on a large scale, is to set the wheel in a black painted cabinet, so that the color and characteristics can be readily seen. The length of the spark has little to do with the determination of the grade of steel, because the length usually depends on the size of the piece being tested and the method of pressing it against the wheel. The only difference in the method of testing hardened and annealed work is that more pressure is required to obtain the same length of spark with an annealed piece of work.

In determining the grade of a piece of steel, estimate roughly the carbon content from the spark picture characteristics. If it appears to be about 0.20 per cent, obtain standards having 0.10 and 0.30 per cent carbon. By testing these pieces, and testing the unknown sample, immediately after, it is easy to determine whether the sample being tested is nearer the 0.30 per cent carbon content or the 0.10 per cent carbon steel. The test may be continued by obtaining a 0.20 and 0.25 per cent carbon standard, and comparing the spark pictures of these standards with the spark picture of the sample being tested; in this way, it is generally possible to determine the carbon content quite accurately. For accurate work, analyzed standards of the same heat of steel should be used, but for rough determinations, standards of the same type of steel are satisfactory. Such standards should always be kept on hand, varying by 0.05 per cent carbon.

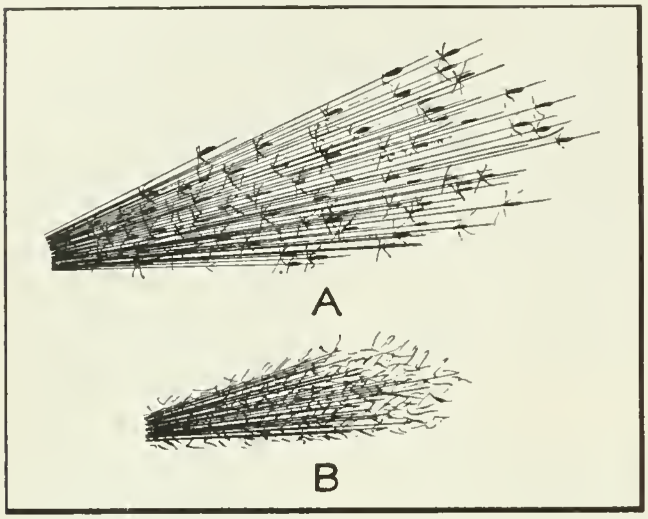


Fig. 2. (A) Spark Picture of Medium-carbon Steel: (B) Spark Picture of High-carbon Steel

When a new lot of steel is received in the shop, half a dozen bars are selected, the sparks of each observed, and pieces cut from the bars having the lowest and the highest carbon content, as shown by the spark test. These samples are analyzed, and the analysis is stamped on the samples, after which they are used as a standard. Generally speaking, a piece of steel should never be chemically analyzed without saving a piece of it with the analysis stamped on it. These standards of known composition are frequently of great value. An inspector of material who uses reliable standards to compare with, can almost always accurately determine the carbon content of steel without difficulty.

* * *

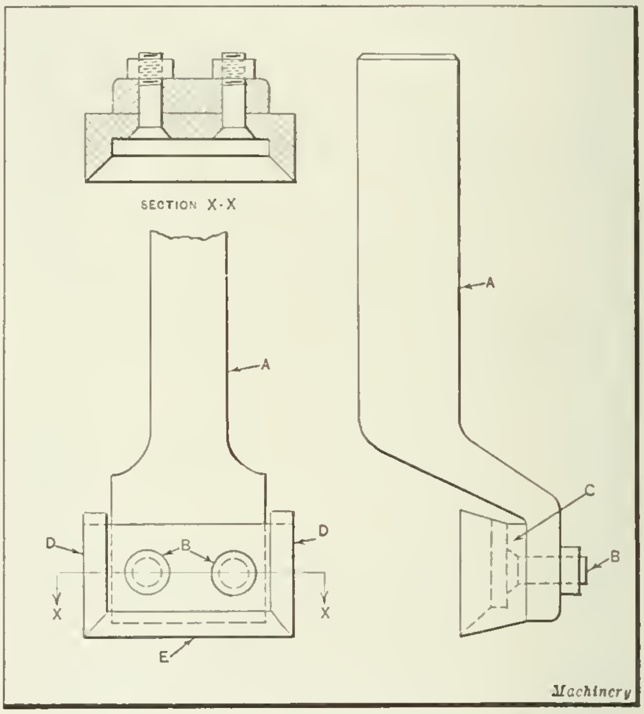
Among the things necessary to place the railways in a position to handle the constantly increasing traffic of the country, Howard Elliott, chairman of the Northern Pacific Railway Co., mentions improved designs of locomotives and cars to provide the maximum capacity and strength with a minimum of dead weight, a better supply of well designed repair plants equipped with high-power, rapid-working machine tools, and better equipment in all the shops and roundhouses where mechanical work is performed. The necessity for these improvements has long been recognized by everyone familiar with machine shop work, and the sooner the railways are able to put this program into effect, the better it will be both for their own economical status and for the public, who will gain in improved service.

TOOL FOR REMOVING BABBITT FROM LOCOMOTIVE CROSS-HEAD SHOES

By H. H. HENSON
Machine Shop Foreman, Southern Railway Co., Chattanooga, Tenn.

The tool shown in the accompanying illustration is intended primarily for use in removing babbitt or any other soft bearing metal from locomotive cross-head shoes. It is designed to accomplish its purpose in such a manner as to save time and insure the thorough removal of all loose metal so that the metal which replaces that removed will not be loosened after the shoe has been relined. Referring to the illustration, it will be noted that the tool shank or holder *A* is offset at the lower end. The cutter which is attached to the offset end of the holder by bolts *B* has its horizontal and vertical cutting edges approximately on the center or fulcrum line of the tool. This feature has a tendency to prevent chatter or "digging in."

The cutter is preferably made by electrically welding pieces of metal together that have been previously formed to the required shape. The pieces which are welded together consist of the base *C*, the two carbon steel tool bits *D*, which form the vertical cutting edges that project from the base of the cutter, and the horizontal bit *E* that projects from the end of the cutter base. The cutter is ordinarily hardened or tempered to a degree which permits it to be sharpened by a fine mill file.



Tool for removing Babbitt from Cross-head Shoes

The tool here described, which is the patented invention of the writer, has been especially designed to take cuts from 4½ to 6 inches wide.

* * *

MEETING OF SOCIETY FOR TESTING MATERIALS

The twenty-sixth annual meeting of the American Society for Testing Materials will be held at the Chalfonte-Haddon Hall Hotel, in Atlantic City, N. J., June 25 to 29, when the following subjects will be taken up: Non-ferrous Metals and Alloys; Corrosion and Fatigue of Metals; Magnetic Analysis; Wrought and Cast Iron; Coal and Coke, Heat-treatment; and Methods of Testing Steel. These subjects will all be dealt with during the days June 25 to 27. The later sessions relate to the testing of materials in non-metal-working fields. Further information may be obtained from the headquarters of the society, 1315 Spruce St., Philadelphia, Pa.

Machining Vulcanized Fiber

By A. B. EASTMAN, Sales Engineer, Diamond State Fibre Co., Bridgeport, Pa.

A SHARP tool with plenty of clearance will contribute more to the successful machining of vulcanized fiber than any other one item. Machinists accustomed to working iron and steel are inclined to think that a tool will stay sharp indefinitely on fiber, because it is apparently a softer material. On the contrary, vulcanized fiber is an extremely hard and tough material, and to obtain the best results it is necessary to keep the cutting edges in good condition. As fiber is slightly elastic, it is inclined to crowd against the back of the tool, so that plenty of clearance is essential. As a general rule, tools for cutting fiber should be ground about the same as those used for brass.

Milling Fiber

In milling vulcanized fiber with standard milling cutters, high speeds and feeds will give the best results, both as regards finish and length of time between grinds. As a typical instance, small gears of 8 to 10 diametral pitch can be cut best with a spindle speed of about 550 revolutions per minute and a table feed of about 6 feet per minute. Two-bladed fly cutters for formed work should be run at higher speeds, but with a slower feed. Considering the difference in price, we have found carbon steel cutters better for milling fiber than high-speed steel cutters.

Turning and Threading

When vulcanized fiber disks or rings on arbors are to be turned, high-speed steel bits will give better results than carbon steel. In turning disks 2⅞ inches in diameter by ⅜ inch thick, a spindle speed of 325 revolutions per minute and a feed of 8 inches per minute have been found satisfactory. A double tool-holder is used,. carrying a high-speed steel roughing bit and a diamond finishing tool. The roughing tool leaves about 1/64 inch on a side for the diamond to remove. The finished size is kept within 0.005 inch without difficulty.

In threading vulcanized fiber tubes, rods, and disks, the best results are generally obtained with self-opening dies. When chasers for these dies are to be bought, it is well to specify that no chamfer is wanted at the front, as the omission of this chamfer will prolong the life of the chasers. Chasers with an extension in front can be bought at little additional cost, and will outlast two or three stock chasers.

Drilling and Tapping Fiber

Drills should be run at high speeds for vulcanized fiber; sizes ¼ inch and under should be run at from 2500 revolutions per minute up to 10,000 revolutions per minute, and larger sizes in proportion. The best results are obtained by running at the highest speed that can be used without burning the tool. Dubbing the lip of the drill and giving it plenty of clearance will cause it to cut freely and tend to prevent splitting. Drills should not be forced, as this tends to split the material. If the drills are kept sharp, they will require but a slight pressure to cut. Many of the troubles in drilling are caused by dull tools; if necessary, they should be reground every ten or fifteen minutes. The operator can save time by keeping a half dozen ground tools on hand.

A drill often cuts smaller than itself in fiber, so that it is well to try out the material before ordering jigs. Fiber should be drilled perpendicular to the grain, whenever possible; otherwise the material is likely to split. If it is necessary to drill parallel to the grain, care must be exercised to prevent splitting. The land on a drill, especially in the large sizes, is inclined to wear off and cause smoking and burning; when the drill is sharpened, the worn part should be ground out.

In drilling holes to be tapped, a larger sized drill should be selected than is necessary for iron or steel. This practice will reduce tap breakage and also give a full thread. It is best to experiment before drilling any large quantity of work or making up jigs.

Bending and Forming

Fiber should always be bent parallel to the grain (the long way of the sheet), because it is difficult to bend fiber across the grain without breaking it. The general practice is to soften the material (more or less) by immersing it in hot or cold water until sufficiently tempered, and then drying it in heated forms under enough pressure to keep the shape desired. The fiber should be left in the heated forms long enough so that it will retain the desired shape after cooling. However, heated forms are not always necessary.

If the material can be steamed, instead of immersed, it will require less time to set. Angles can be bent in bending brakes fitted with electric, gas, or steam heat. Special pieces can be formed on a hot plate in cast-iron forms, under pressure of a hand-operated spring plunger. In making up the top and bottom forms, some allowance should be made for the fact that fiber swells slightly when it is soaked or steamed. Tubes can be bent by softening in hot water, filling with sand, and clamping in wooden or metal forms, after which it is necessary to dry them at about 150 degrees F.

Punching Fiber

Fiber can be easily blanked, pierced, and shaved on ordinary punch presses. For blanking and piercing thin material, the punch should be a neat fit in the die, while for stock ¼ inch thick, a difference of about 0.008 inch will give the best results. When a rough edge is not objectionable, fiber can be blanked out up to ¼ inch thick. When heavier stock is blanked, it is likely to "check in" too far and cause considerable wastage, although some material up to 7/16 inch in thickness can be blanked.

Smooth edges can be obtained by forcing blanked or sawed fiber blocks through a hollow shaving cutter of the desired shape. The edges of the cutter should have a slant of about 45 degrees. Sharper angles will often give smoother edges, but the cutter will not last so long as otherwise. A better finish can be had by using a roughing and a finishing cutter. It is generally necessary to allow from 1/16 to ⅛ inch all around for shaving, according to the shape of the pieces. When trouble is encountered by checking of the stock while blanking or shaving, softening the fiber by heating will often overcome the difficulty.

Dies and cutters for fiber can be made without any clearance for ½ inch or more below the cutting edge. The bottom of the die may be counterbored within ½ or ¾ inch of the top to facilitate machining. Such a die will not change its size in grinding and will give better results than a die with clearance to the cutting edge. If the cutting edge of a shaving cutter is mouthed out very slightly with a fine oilstone, the stock will bind slightly in passing through, which will tend to polish the edges smoothly.

Sawing Fiber

Vulcanized fiber can be sawed to a smooth polished edge with a hollow-ground circular saw, without set to the teeth. A 14-inch saw, from 1/8 to 5/32 inch thick, and with 110 to 120 teeth, is a good saw for general use. This saw should be run at at least 2500 revolutions per minute, to obtain the best results. Band saws with 5½ points per inch and 19 gage thickness are generally used for fiber. The widths vary from ¼ inch for scroll-sawing to 1¼ inches for heavy sheet sawing. A saw should run at about 4000 linear feet per minute, or from 350 to 500 revolutions per minute for a 36-inch wheel.

Machining Fiber in Automatic Machines

Vulcanized fiber tubes and rods can be successfully machined in automatic screw machines. When tubes of the correct size can be obtained, they will generally give better results than rods. It is our practice to use the following feeds on automatic screw machines:

Drilling	0.007 to 0.010 inch per revolution
Turning	0.010 to 0.015 inch per revolution
Forming	0.0015 to 0.002 inch per revolution
Cutting off	0.002 to 0.003 inch per revolution

For trial purposes and for short jobs, the cams for Brown & Sharpe machines can be band-sawed from vulcanized fiber.

The data given in the foregoing is the result of over twenty years experience which the Diamond State Fibre Co. has had in developing the best methods for machining vulcanized fiber.

FURTHER INFORMATION ON MACHINING FIBER

Another manufacturer specializing in fiber products states that in punching fiber it is best to use a punch and die with flat surfaces on the top of the die and on the bottom of the punch. The punch should be made a certain amount greater in diameter than the hole required in the fiber, because the material "comes back" a certain amount after punching; it has been found satisfactory to make the piercing punch 0.008 inch larger in diameter than the hole required for each 1/8 inch in thickness of the fiber sheet. When washers or disks are punched from sheet stock and the outside dimension of the piece punched out is the important factor, the procedure is reversed, and the punch and die are made about 0.008 inch per 1/8 inch in thickness of the fiber sheet smaller than the diameter of the piece required. It has been found impracticable to use solid punches on fiber sheets over ¼ inch in thickness, because the material "checks" badly when punched.

Ordinary twist drills are suitable for drilling fiber, high-speed steel drills being preferred when quantity production is required. The drills must be sharpened more often than when metal is drilled. If the drill is not kept sharp and does not have plenty of clearance, it will bind and burn. Feeds of from 0.010 to 0.020 inch per revolution of the drill are about right for drilling fiber, depending on the size of the hole to be drilled. No cutting lubricant is necessary. The speed of the drill should be about equal to the maximum recommended for drilling steel.

The best cutting speed for turning fiber has been found by the firm quoted to be about 500 feet per minute, using a fairly light feed so as not to tear the stock. The tools should be ground with a slightly greater clearance than is used for turning metals. No cutting lubricant is required.

In sawing fiber, either a circular saw or a band saw may be used. A saw with five points to the inch has been found best for this work. When an exceptionally smooth surface is required, circular saws with little or no set to the teeth should be used. These saws should be hollow-ground for clearance. When sawing out rough blocks of fiber, a saw with considerable set to the teeth is used. For rough work, fiber can be cut with an ordinary squaring shear.

DIES FOR PRODUCING METAL SPOOLS

By S. A. McDONALD

The dies shown in Figs. 2 and 3 were designed to produce the flanges and the hub, respectively, of the metal spool shown in the upper sectional view of Fig. 1. This spool is used to hold adhesive tape, and is made from sheet tin. The lower view in Fig. 1 shows the flanges and hub of the spool in position on the assembling dies ready for the assembling operation. The die shown at the left in Fig. 2 blanks and punches the hole in the spool ends, and flanges and draws the outer edge preparatory to the curling operation, which is performed in the die shown in the view at the right-hand side of Fig. 2. It will be noted that a slight taper is given to the punch *C*. The corresponding taper produced on the blank tends to cause the edge of the blank to make contact with the tapered portion of the curling punch, as shown in the enlarged view at *A*, so that it is properly guided up into the curling portion of the punch. If the blank were not given this taper, the edge would be likely to spring back, as indicated at *B*.

Another advantage gained by tapering the die and the punch as shown is that it eliminates the need for a stripper ring to force the work up from the punch *C*. The piercing punch *D* is driven into the blanking punch *E*. The knock-out pad *F* is actuated by the knock-out *G*. The die-plate *H* is turned to fit the forming punch *C*, which also acts as the piercing die for the central hole in the spool end or flange. The cutting or blanking die *J* is held in alignment by the forming punch *C*. Both the forming punch and die *J* are secured by fillister-head screws *K*. The curling punch shown in the view at the right-hand side of Fig. 2 is provided with a pilot *L* which is a loose fit in the hole in the blank to be curled. This centralizes the blank in its nest *M*. After the edge of a blank has been curled, the blank is pushed out of the way by the succeeding piece. A guard (not shown) prevents the operator from placing his fingers under the punch.

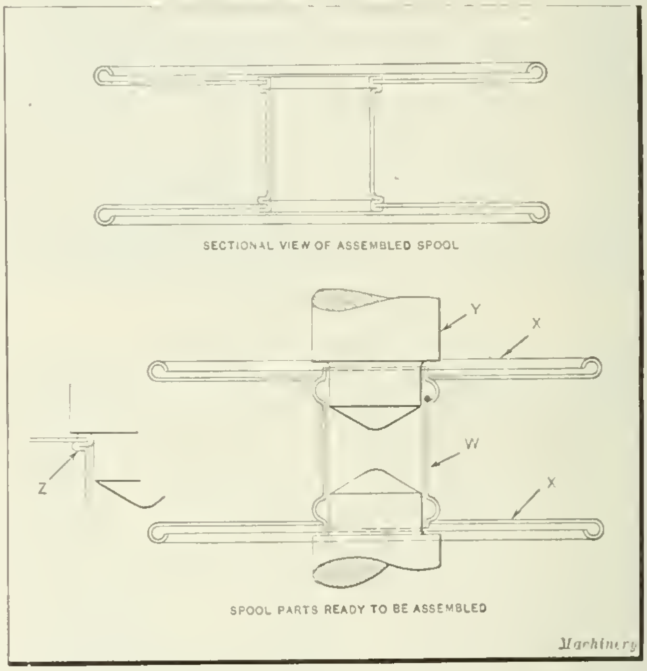

SECTIONAL VIEW OF ASSEMBLED SPOOL
Y
X
W
Z
X
SPOOL PARTS READY TO BE ASSEMBLED
Machinery

Fig. 1. Views showing Assembled and Unassembled Metal Spool

The stock from which the hubs are made is fed in strips into the die shown in the view at the left-hand side of Fig. 3. The cutters *N* and *O* cut off the stock to the correct length when the strip is located against the stop *P*. The blank is carried down into the forming die *Q* by the punch *R* so that the ends are bent up to form quarter circles having a radius equal to that of the hub. Two beads are also formed in this operation running the entire length of the piece. A spring pad *S* brings the stock up to the feeding position when the punch has cleared the die.

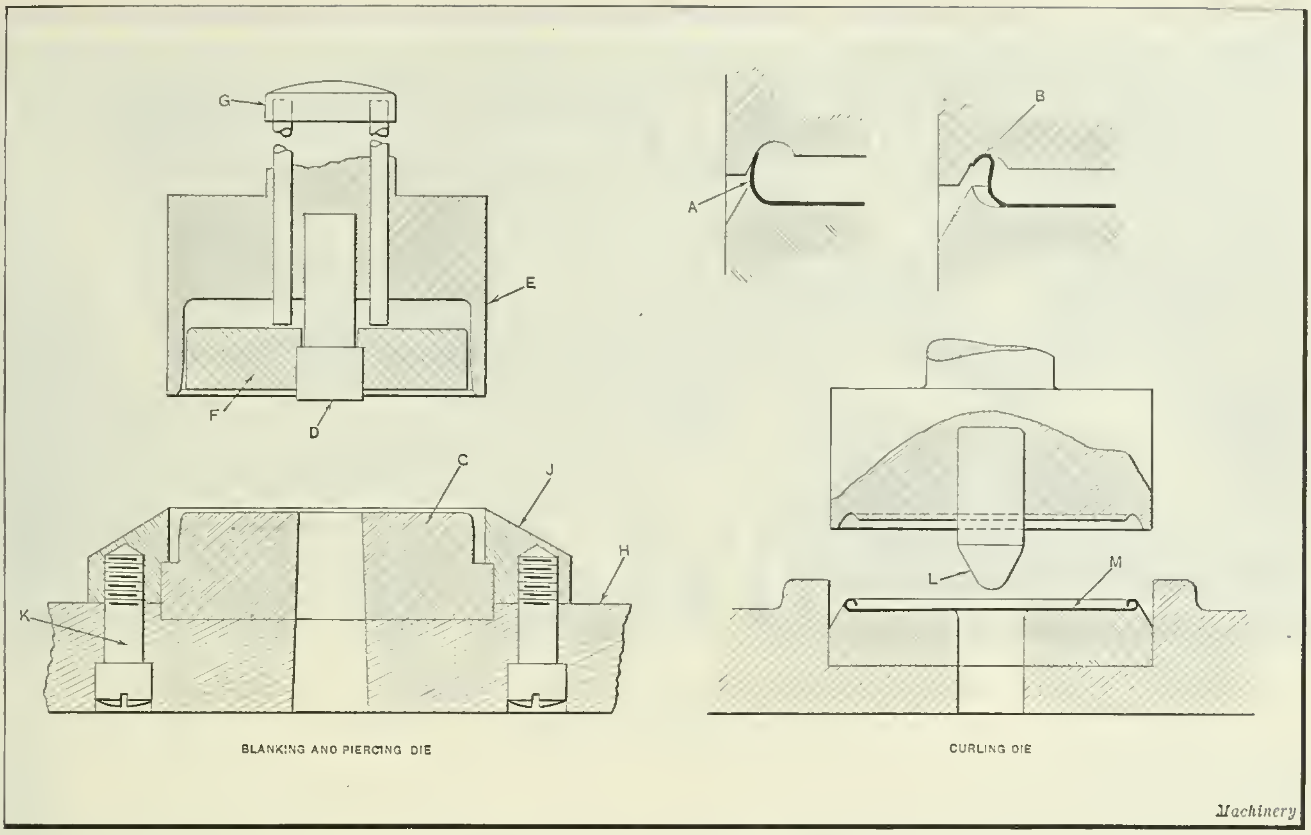


Fig. 2. Dies for blanking and curling Ends of Metal Spool shown in Fig. 1

The second operation on the hub is performed in the die shown in the front and side views at the right-hand side of Fig. 3. The beadings formed in the preceding operation are located in grooves cut in die *T*. A mandrel *U* is secured to a holder *V* which fits the slide of the press. The mandrel bends the blank into a semi-circular shape, and throws up the ends around the mandrel so that the hub is completely formed to the shape indicated at *W*, Fig. 1. The hub is pulled off the mandrel at the end of the stroke, the open seam allowing the piece to be sprung sufficiently to permit it to be drawn over the beads. The assembling of the hub *W* and ends *X* is done in a foot press. When the upper pilot *Y* is brought down, it aligns the three parts that make up the spool. A continued movement of the pilots causes the ends of the hub to collapse so that they clinch the flanges or spool ends in place, as indicated in the detail view at *Z*.

* * *

An interesting use is being made of motion pictures in advertising American bridges abroad. The Rothacker Film Co. of Chicago, Ill., has produced a motion picture for the Strauss Bascule Bridge Co. of the same city, which shows the development, step by step, of different types of swing bridges, and finally the latest type of highly developed bascule bridges, such as are in use, among other places, on the Jackson Blvd. in Chicago. A number of other designs of new bascule bridges are also shown.

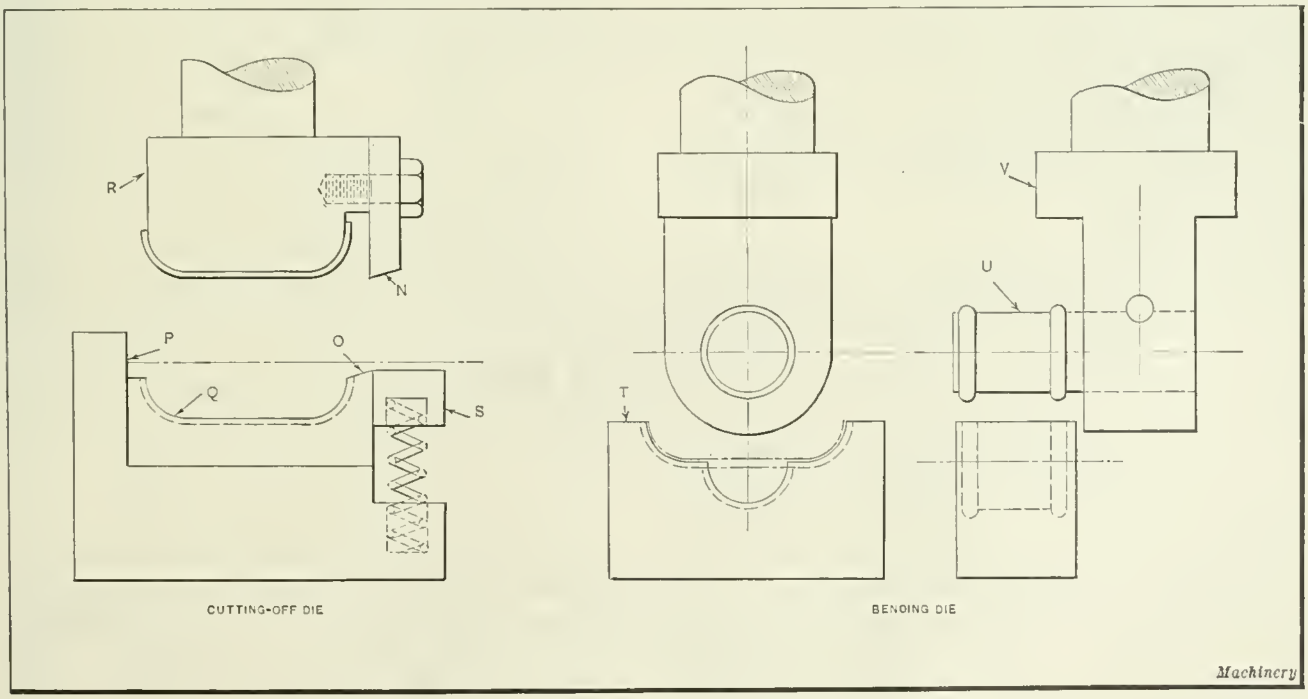


Fig. 3. Dies employed to produce Hubs for Metal Spool shown in Fig. 1

Cutting Worm-Gears

Use of Ordinary Hob and Radial In-feed—Fly-cutter Method—Use of Tapering Hobs

By FRANKLIN D. JONES

WORM-GEARS are usually cut by a generating process, although the formed cutter method has been used to a limited extent for such special operations as cutting certain classes of dividing wheels. The machines used for cutting worm-gears include ordinary milling machines, gear-hobbing machines of the type adapted to cutting either spur, spiral, or worm gearing, and special machines designed expressly for cutting worm-gears. The general methods employed are (1) cutting by using a straight hob and a radial feeding movement between hob and gear blank; (2) cutting by feeding a fly cutter tangentially with relation to the worm-gear blank; and (3) cutting by feeding a tapering hob tangentially. These three methods will now be considered.

Use of a Straight Hob and Radial Feeding Movement

When worm-gear teeth are generated by a straight or cylindrical hob, the latter is centered relative to the curved throat of the worm-gear blank, as shown by the end view of diagram *A*, Fig. 1; then as the gear blank and hob rotate together at the proper ratio, the hob is fed inward radially just far enough to form teeth of the right height. These worm-gear teeth on the mid-section x–x correspond to the teeth of an involute spur gear of the same pitch and diameter. The hob represents a standard rack for involute gearing, and generates the teeth the same as in hobbing a spur gear, except that a radial feeding movement is employed in order to form concave teeth.

When worm-gears are hobbed on an ordinary milling machine the teeth are first formed roughly by a gashing operation, performed preferably by means of an involute gear cutter of a number and pitch corresponding to the number and pitch of the teeth in the worm-gear. A hob is then placed in mesh with this gashed blank, and the rotation of the hob causes the blank to revolve as the hob is gradually fed in to the required depth. In using a gear-hobbing machine, this preliminary gashing is unnecessary, because the hob- and work-spindles are connected indirectly through gearing, so that the rotation of one relative to the other is positive and at the proper ratio.

A hob used for worm-gears should have the same lead and helix angle at the pitch circle as the worm that the worm-gear is to be driven by. Hob teeth, however, should preferably differ from the worm thread in regard to the height of the teeth above the pitch line and the depth below this line. The hob tooth addendum should be made equal to the worm dedendum, and the hob tooth dedendum equal to the worm addendum. In other words, the hob is made the reverse of the worm, as far as height above and below the pitch circle is concerned, so that the hob diameter is larger than the worm diameter an amount equal to twice the clearance space required between the worm and wheel. In using such a hob, the worm-gear teeth will be given the proper clearance at the root, and if the throat diameter of the blank is too large, the tops of the teeth will be trimmed off to the correct height. The hob is a duplicate of the worm as regards the number of threads; that is, single-threaded hobs are used for worm-gears intended for single-threaded worms, and multiple-threaded hobs for worm-gears that are to be driven by multiple-threaded worms.

Cutting Worm-gears by Fly-cutter Method

Worm-gears are frequently cut by using a fly cutter, which is shaped like a hob tooth of corresponding pitch. This fly cutter is set to the full-depth position (unless allowance is made for a finishing cut) and it is given a tangential feeding movement relative to the worm-gear blank, as indicated by diagram *B*, Fig. 1, at the same time revolving at the proper ratio relative to the rotation of the worm-gear blank. A common method of obtaining this tangential movement is to mount the cutter-bar on a slide which is given a slow feeding movement, so that the cutter passes from one side of the gear blank to the other. If the worm-gear has, say, 40 teeth, then the cutter-bar will make 40 revolutions to one of the wheel, plus or minus a slight variation referred to later. As the cutter begins to work on one side of the blank, forty shallow grooves are formed during the first revolution, and these are gradually made wider and deeper as the fly cutter feeds across the blank from one side to the other, thus completely forming the teeth, unless a light finishing cut is taken afterward.

Now in order to cut worm-gear teeth of correct shape, the fly cutter must be made to advance along a helix (see diagram) or as though it were moving along the thread of a worm similar to the one that the worm-gear is intended for. When a straight hob is used, as shown at *A*, each tooth of the hob rotates in a fixed plane, but as quite a number of teeth are spaced along a helix, the action of the hob is like that of a worm, and the successive cutting teeth keep in step with the worm-gear teeth as the hob and gear are revolved together at the correct ratio. When a fly cutter is used it is evident that it must perform the work done by a series of hob teeth. To accomplish this, the fly cutter, as it feeds tangentially, is revolved at such a rate relative to the worm-gear, that the cutter gradually passes the positions which successive hob teeth would occupy; consequently, the same general effect is obtained with a fly cutter as with a hob, although the worm-gear teeth are shaped somewhat differently, as compared with a straight hob.

To further illustrate the action, assume that successive hob teeth are designated by numbers 1, 2, 3, etc. Then when the fly cutter is in the position occupied by hob tooth No. 1, it will perform the work of this hob tooth. Similarly, when the fly cutter has advanced to coincide with the position of hob tooth No. 2, it performs the work of this tooth, and so on for the entire series. This feeding movement is necessarily very slow, because the fly cutter has to take heavy cuts, especially in passing the center or full-depth position.

While the fly-cutter method is slow, as compared with hobbing, it has two decided advantages which account for its general use: First, a very simple and inexpensive cutter may be used instead of an expensive hob. This is of great importance when the number of worm-gears is not large enough to warrant making a hob. Second, with the fly-cutter method, it is possible to produce worm-gears having more accurate teeth than are obtainable by the use of a straight hob, provided, of course, that the fly-cutter method is properly applied.

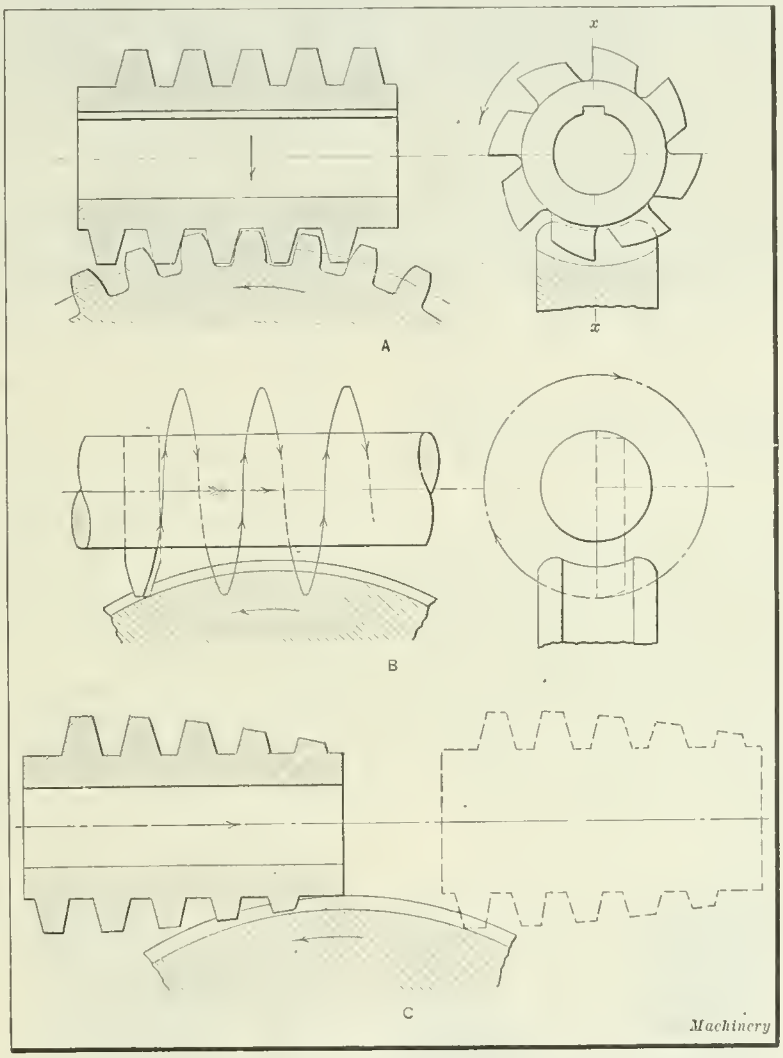


Fig. 1. Different Methods of cutting Worm-gears illustrated diagrammatically

Taper Hob with Tangential Feeding Movement

Another tangential method of cutting worm-gears involves the use of a taper hob, which is set to the full-depth position at one side of the blank, and fed tangentially across it as illustrated by diagram *C*, Fig. 1. The use of a taper hob makes it possible to cut worm-gears more rapidly than by means of a fly cutter, and also very accurately, provided the hob itself is accurate. The taper hob method also increases the rate of production as compared with the use of straight hobs which are fed in radially.

In the taper-hob method, the rotation of the hob relative to the blank, as the hob moves tangentially, is such as slowly to advance or screw the hob along its own thread. The action of the hob is the same as that of a fly cutter, and machines adapted for the fly-cutter method may also be equipped with taper hobs. The leading teeth on the hob are tapering, as indicated by the diagram, and they should be designed to increase progressively in width as well as in height from the small to the full size end. The tapering or leading end performs a roughing operation, whereas the full sized teeth take light finishing cuts, thus preserving their accuracy and insuring well-formed teeth. The tangential feeding movement continues until the large end of the hob passes out of contact on the side opposite the starting point, as indicated by the dotted lines of the illustration.

Taper hobs are especially adapted for cutting worm-gears that are to mesh with worms having large helix angles; they are also preferable for worm-gears having large face widths in proportion to the worm diameter. Worm-gear teeth are generated more accurately with a taper hob than with a straight hob that is given a radial feeding movement. This is because the radial method brings the worm-gear teeth into contact first with the outer ends of the hob teeth and then with the inner portions which have smaller helix angles; consequently, the hob removes parts of the teeth on the sides which would bear upon the worm thread if they were of perfect form. Therefore the bearing is theoretically at the center, although notwithstanding this fact, worm-gears cut by the radial method are extensively used and are satisfactory for a great many applications of worm-gearing. If a taper hob is used, a better bearing contact is obtained, especially for large helix angles and face widths, because such conditions are particularly unfavorable to the radial straight-hob method.

When a worm-gear is cut by using a straight hob and a radial feeding movement, the machine is geared so that the hob and work revolve according to the ratio of the number of threads in the worm and the number of teeth in the worm-gear. For instance, if a worm-gear has 50 teeth and is to mesh with a single-threaded worm, the machine will be so geared that the hob makes 50 revolutions to one of the worm-gear blank.

If a fly cutter or taper hob is used, however, it is necessary to take into account the tangential feeding movement, and to so alter the ratio as to cause the cutter to follow a helical path. If the worm-gear is to have, say, 50 teeth, then the ratio must be a little greater than 50 to 1, assuming that the feeding movement of the cutter is against the direction in which the work is rotated, as shown by diagram *B*, Fig. 1. If the tangential feeding movement and the rotation of the work are in the same direction, then the ratio would be somewhat less than 50 to 1.

In order to illustrate the action more clearly, suppose the ratio is exactly 50 to 1 and that the tool is moved to the right until the point begins cutting a series of shallow grooves around the rim. It is apparent that if the tool is not moved farther to the right, it will simply rotate in unison with the blank and pass through the grooves without any further cutting action; but if the cutter-bar is again given a tangential feeding movement without changing the 50 to 1 ratio, the tool will no longer match with the grooves, but will begin to widen them by cutting away the right-hand sides in feeding to the right as indicated by the diagram. A continuation of this feeding movement would simply cut away the blank without forming teeth.

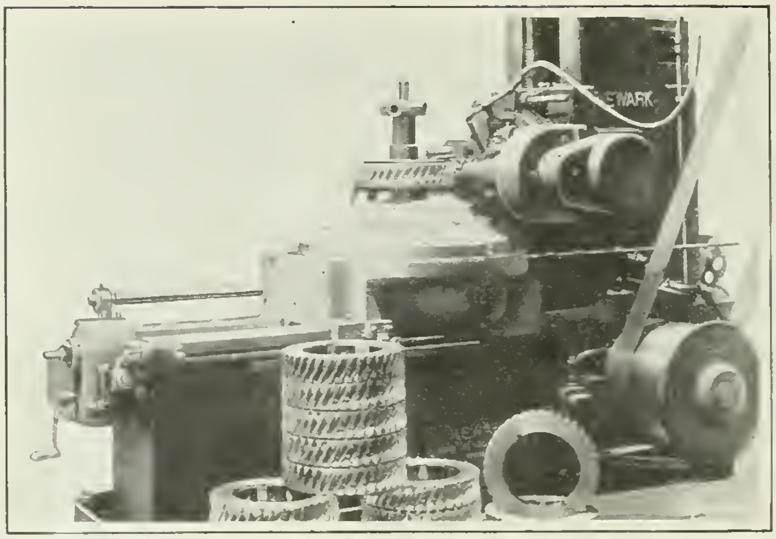


Fig. 2. Hobbing Worm-gears to be used with Five-threaded Worms

This side-cutting action is due to the fact that a given tooth groove comes around to the same position each time the cutter makes fifty revolutions, but the cutter, owing to its advancing movement is continually arriving at different positions relative to the work. This may be prevented (assuming that the cutter is advancing against the direction of rotation) either by decreasing the speed of the work or by increasing the speed of the cutter, which produces the same result.

For instauce, the cutter shown by diagram *B* should, for the movements of the tool and work indicated, revolve somewhat faster than the 50 to 1 ratio for cutting a 50-tooth worm-gear. On the contrary, if the feeding movement were in the same direction as the rotation of the work, the ratio should be decreased. This change in ratio varies according to the relation between the rotary and feeding movements of the cutter and the rotation of the work, and its practical effect is to cause the cutter to change its position successively relative to the work, the same as though it were moved to numerous positions along a helical curve.

How the Actions of the Cutter and Work are Controlled

The proper relative movements of the work and cutter may be obtained in different ways, but as a rule they are controlled by means of change-gears in conjunction with a differential mechanism. The latter is not indispensable, but is generally considered desirable. According to one arrangement, motions from the shaft driving the cutter-bar and the shaft driving the tangential feed-screw are combined by the use of differential gearing to rotate the work at a rate that compensates for the tangential feed.

If a differential is not used, the mechanism of the machine can be simplified somewhat, but since the feeding movement of the cutter-bar and its rotation relative to the work-spindle are controlled by positive gearing, any change of gearing to give a different rate of feed must be accompanied by a corresponding change in the gearing that determines the ratio of rotation between the cutter- and work-spindles. This is not the case when a differential is used.

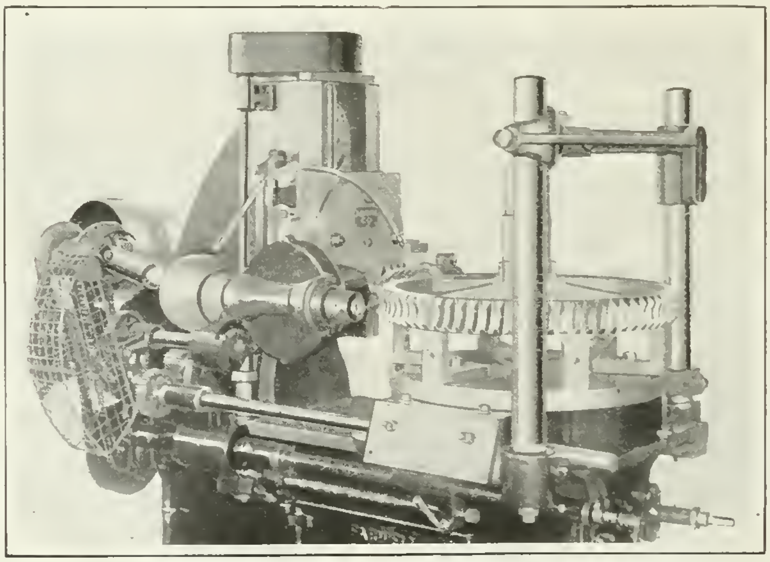


Fig. 3. Hobbing Worm-gear having 76 Teeth of 3 Diametral Pitch

Examples of Hobbing with a Straight Hob

An example of worm-gear hobbing on one of the machines built by the Newark Gear Cutting Machine Co., is shown in Fig. 2. The worm-gears are made of bronze and have 38 teeth of 1⅛ inches circular pitch, and a 3-inch face width. These gears are to be used with five-threaded worms, which accounts for the fact that the teeth have an inclination, relative to the axis, of 26 degrees. Ordinarily, in cutting a worm-gear having a large axis angle, the hob is fed tangentially to obtain a nice finish and prevent forming flats on the teeth. An interesting feature of the operation shown is that it was possible to feed the work straight into the hob without a tangential feeding movement, because the number of teeth in the gear, the number of threads on the worm, and the number of hob flutes were all prime to each other.

The heading illustration shows an example of worm-gear hobbing at the plant of the Philadelphia Gear Works. This is a cast-steel worm-gear having 47 teeth of 2¼ inches circular pitch and a 4½-inch face width. The machine used has a horizontal cutter-spindle and a vertical work-spindle which are revolved together at the proper ratio through change-gears. The work-spindle is carried by a slide which is given the necessary feeding movement for sinking the hob in to the full-depth position.

The Farwell gear-hobbing machine which is built by the Adams Co., Dubuque, Iowa, is shown hobbing a worm-gear in Fig. 3. This is a cast-iron worm-gear having 76 teeth of 3 diametral pitch. The hob speed was 57 revolutions per minute, and the inward feeding movement of the work-table 0.050 inch per revolution of the gear blank. This worm-gear was hobbed to the full depth in twenty-four minutes, without preliminary gashing of the gear blank.

The duplex type machine, which is shown in Fig. 4, is employed by Edwin Harrington, Son & Co., Inc., Philadelphia, Pa., for cutting spur as well as worm gears. When it is applied to spur gears the machine may be equipped with two formed cutters which operate on both sides of the gear simultaneously so that the gear is finished after it is indexed a half revolution. For worm-gears a hob is applied to one side in the usual manner, as shown in the illustration. The particular worm-gear

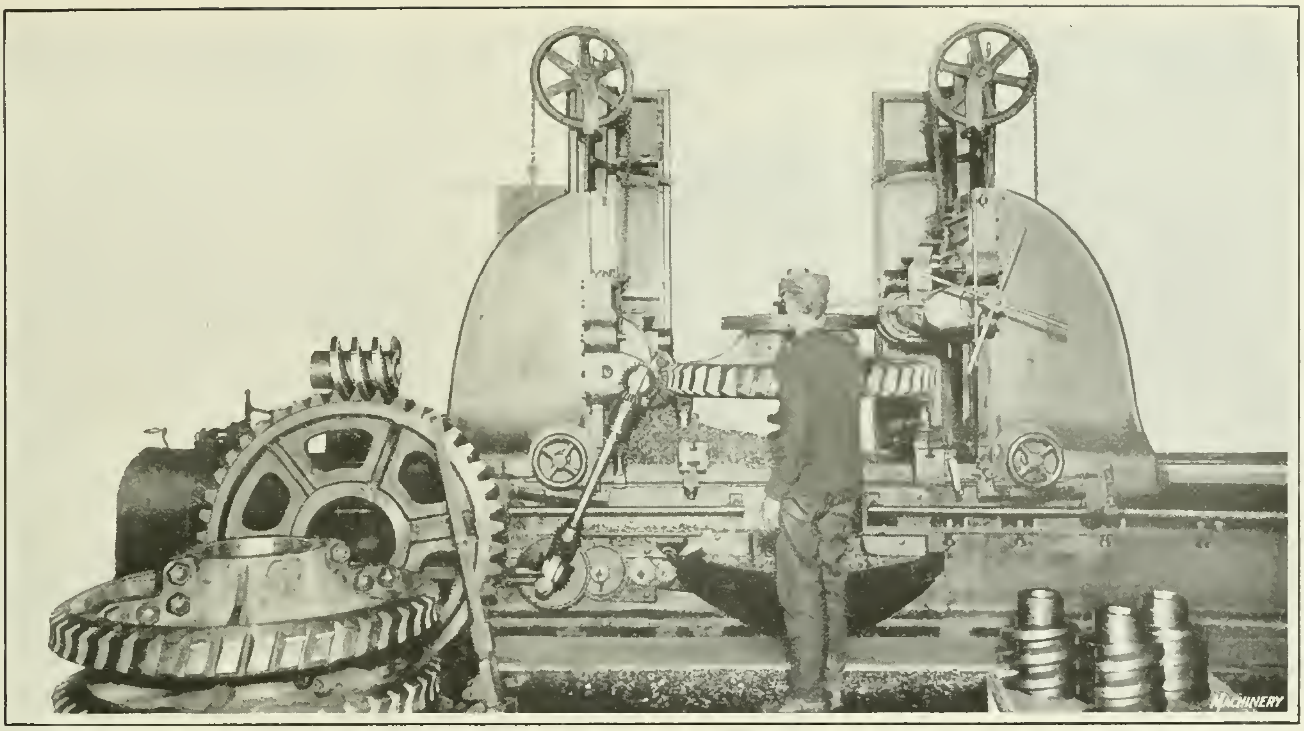


Fig. 4. Duplex Type of Machine used for cutting both Spur and Worm Gears

shown is made of manganese bronze and has 44 teeth of 3½ inches circular pitch.

Application of the Fly-cutter Method

Worm-gears intended either for single- or for multiple-threaded worms may be cut by the fly-cutter method previously described. Fig. 5 shows a close-up view of a Newark machine cutting a cast-steel worm-gear at the plant of the Philadelphia Gear Works. This gear has 47 teeth of 2¼ inches circular pitch. Owing to the size of the fly cutter required for this pitch, it was made with an attached blade instead of being formed in one solid piece. This blade is held in position by a single cap-screw, and the lower end is supported and centered by engagement with a shallow groove and by projections on each side which prevent shifting laterally. The machine is the type having differential gearing for combining in the work-spindle a rotation modified by the rotation of the cutter-bar and its lateral feeding movement.

The cutting of a bronze worm-gear on a Newark hobbing machine equipped with a tangent-feed cutter-slide is shown in Fig. 6. This is another example of worm-gear cutting by the fly-cutter method. This particular worm-gear has 57 teeth of 1¾ inches circular pitch, a pitch diameter of 31.751 inches, and a 4-inch face width. This gear is to mesh with a right-hand double-threaded worm. As the fly tool representing a section of the worm thread passes through every point that the worm would occupy, the teeth generated by this method are theoretically correct. This worm-gear was completed by taking two cuts. While it is possible to finish worm-gears of fairly coarse pitch by taking a single cut, better results are obtained when two cuts are employed.

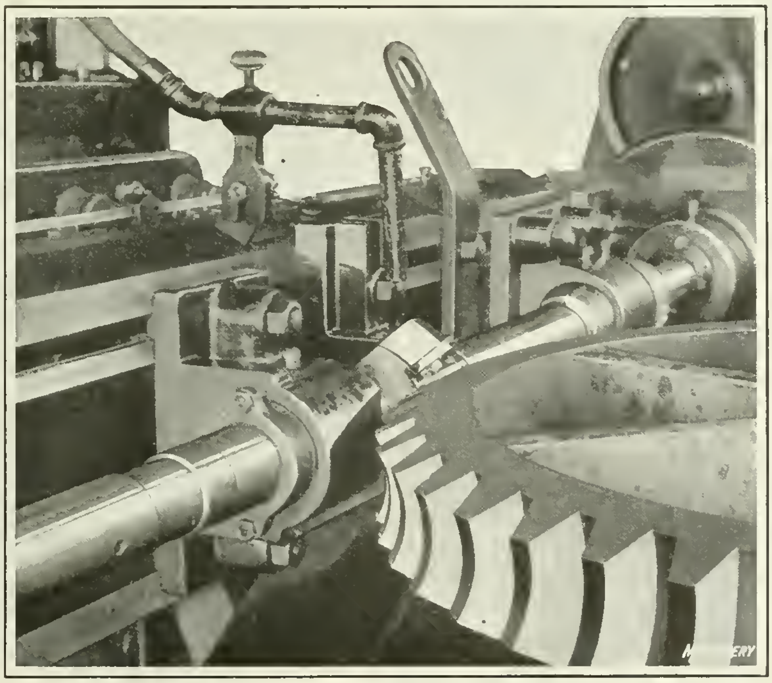


Fig. 5. Cutting a Worm-gear by the Fly-cutter Method

Use of Multiple Cutters as Substitutes for Multiple-threaded Hobs

Worm-gears intended for use with multiple-threaded worms may be generated by using a cutter-bar having as many cutters as there are threads in the worm. For instance, if the worm is double-threaded, two duplicate fly cutters spaced 180 degrees apart could be used for cutting the worm-gear, whereas for a triple-threaded worm three equally spaced cutters might be employed. While a single fly cutter may also be used for multiple work by indexing the cutter-bar, there is an advantage in having a cutter for each worm thread in that all the worm-gear teeth are formed during one passage of the cutter-bar. This may be impracticable, if the worm has quite a large number of threads, and sometimes only part of the number of threads in a worm are represented by fly cutters. In this case, the work is indexed for finishing the remainder of the worm-gear teeth, the principle being the same as when using a single fly cutter for cutting a worm-gear for a double-threaded worm.

Some of these multiple-threaded worms resemble helical gears, and such worm-gearing is frequently used instead of helical or spiral gears. The application of multiple-threaded worm-gearing in preference to helical gearing is particularly desirable when there is considerable power to be trans-

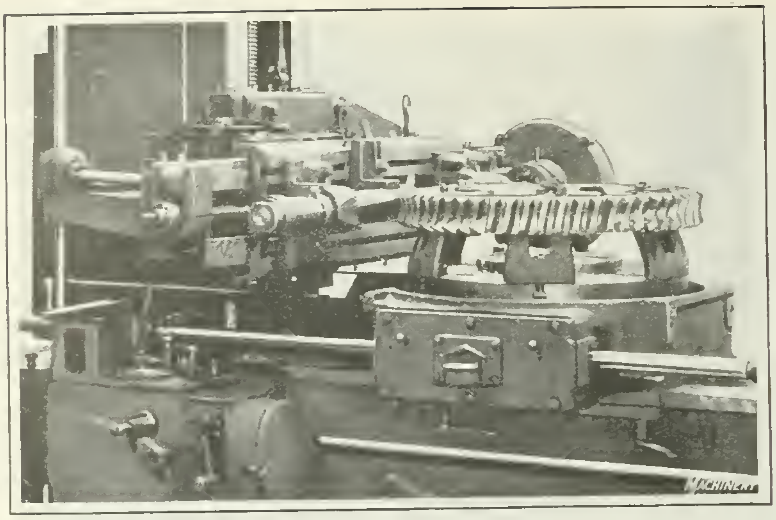


Fig. 6. Another Example of Worm-gear Cutting by Means of a Fly Cutter

mitted because worm-gearing has larger bearing surfaces and a greater power transmitting capacity for gearing of the same ratio and size.

In some cases when worm-gears for multiple-threaded worms are to be cut, it may not be economical to use a multiple fly cutter, because the number of worm-gears to be cut is not large enough to warrant the making of more than one cutter. For instance, if a single worm-gear intended for a double-threaded worm, is to be cut, a single fly cutter would be used ordinarily instead of a double fly cutter. However, if five or six of these worm-gears were needed, it might be advisable to use two fly cutters, because then the cutting time would be reduced one-half.

When more than one cutter is used, it is essential to have each cutter of the correct shape and accurately located in the bar or holder. When there are two or more cutters, all are usually located in a plane perpendicular to the axis of the cutter-bar. Worm-gears for double-threaded worms may also be cut by using two cutters located on the same side of the bar like adjacent teeth on a hob. This is done sometimes to facilitate locating the two cutters accurately, but there is the disadvantage of having both cutters working at the same time, which tends to cause excessive deflection of the cutter-bar. For ordinary pitches, two cutters are usually held by inserting them in a hole passing through the center of the bar, and each cutter is inclined so that the cutting face will be at right angles to the sides of the worm-gear teeth. If there are several cutters, a head arranged for holding them in the proper position is mounted on the cutter-bar. These multiple fly-cutter heads are similar to the section of a hob, as far as the shape of the cutting edges is concerned.

The machine is geared so that the work and cutter-bar run together just as though the worm-gear were in mesh with a worm, or, in other words, according to the ratio of the worm-gearing. If the number of teeth in a worm-gear is a prime number, the use of more than one cutter will result in a "hunting tooth" action between the cutters and worm-gear. Assume, for example, that the worm-gear is for a double-threaded worm, and that it has an even number of teeth; then a given cutter will cut every other tooth space and it will continue to pass through the same tooth spaces. The intervening spaces will be finished by the other cutter. Now, if the number of teeth is prime, a given cutter will cut every other tooth space as before, but it will not continue to operate in these same spaces each time the gear revolves. The result will be that each cutter will only pass through the same tooth spaces every other revolution, in this particular instance.

This progressive action is obtained not only when cutting worm-gears having prime numbers of teeth, but also when there are odd numbers not divisible by the number of fly cutters used. For instance, if a 21-tooth gear for a double-threaded worm were cut with a double fly cutter, the spaces cut by cutter No. 1 during the first revolution of the gear blank would be cut by cutter No. 2 during the second revolution; during the third revolution the cutters would again be in step with the spaces cut during the first revolution. On the other hand, if a 21-tooth gear were cut for a triple-threaded worm and three fly cutters used, these cutters would always keep in step with their respective tooth spaces since 21 is divisible by 3. If a 21-tooth gear for a quadruple-threaded worm were cut by using four equally spaced fly cutters, then each cutter would pass through the same series of tooth spaces after every fourth revolution. The hunting tooth or progressive action obtained as described is desirable in so far as it tends to equalize any inequalities that may exist in the different cutters, thus insuring the formation of more uniform teeth.

Application of Tapered Hobs to Worm-gear Cutting

When worm-gears of a good grade are required on a quantity basis, the tapered hob method is recommended. A Gould & Eberhardt automatic gear-hobbing machine having a cross-feed attachment for the cutter-head is shown in Fig. 7 cutting a bronze worm-gear by means of a tapered hob. This worm-gear has 32 teeth of 5 diametral pitch, and it is to mesh with a five-threaded worm. The total cutting time is one hour and fifteen minutes.

Another example illustrating the application of tapered hobs to worm-gear cutting is shown by the detailed view, Fig. 8. The Gould & Eberhardt machine used for this operation is designed especially for generating worm-gears. This machine may be used either with tapered hobs which are fed tangentially or with straight hobs having a radial feeding movement.

The cutter-spindle is carried by a heavy slide, which is adjustable along the bed to suit the diameter of the worm-gear. This slide also receives the feeding movement when using straight hobs and an automatic stop in conjunction with a graduated dial enables the operator to set the mechanism to stop at any predetermined point. When either a tapered hob or a fly cutter is used, this slide is set to give the proper tooth depth, and is then securely bolted to the base of the machine to obtain a rigid support as the cutting tool feeds tangentially across the blank. A differen-

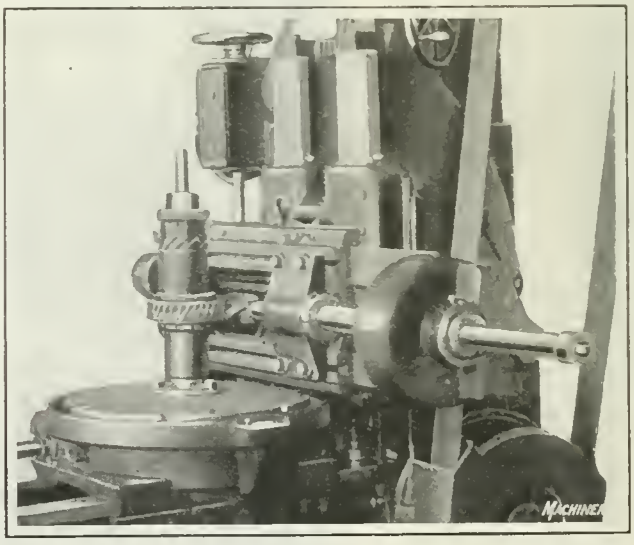


Fig. 7. Gear-hobbing Machine with Cross-feeding Attachment for cutting Worm-gears by the Taper-hob Method

tial mechanism is provided on this machine. One advantage of such a mechanism is that it enables the operator to take a second cut for finishing without "losing the lead." Moreover, the differential makes it possible to change the feed without changing the lead gears. As this differential is not required when a straight hob is used, provision is made for locking it.

The worm-gear generator shown in Fig. 9 is cutting a bronze worm-gear for a truck drive. This is another example of the taper-hob method. The cutting time for this gear is fifteen minutes. The generator used is made by the Lees-Bradner Co., Cleveland, Ohio, and is applicable either to the taper-hob or fly-cutter methods, as well as to the use of straight hobs and a radial in-feed. The taper hob is multiple-threaded, and differs from most taper hobs in that the teeth have very little relief at the large end; in fact, there is practically no relief, so the finishing end of the hob gives a certain amount of burnishing action. Moreover, sharpening the hob does not reduce the diameter appreciably nor change the helix angle, as in the case of a hob having considerable relief.

The main pulley shaft of this machine drives an auxiliary shaft, from which, by change-gears, the work-table worm is driven at a speed depending upon the ratio of the hob and worm-gear to be cut. The cutting speed of the hob, or the number of revolutions per minute, is also controlled by change-gears independently of the number of teeth to be cut, and in accordance with the hob diameter and the kind of material to be cut. The hob-spindle is driven through worm-gearing from the same auxiliary shaft that drives the work-table. The worm-shaft for the work-table drive connects with a differential controlled by change-gears to give the work-table an independent rotary motion to suit the tangential feeding movement of the hob, so that the work and hob rotate in unison regardless of the rate of feed. These change-gears are selected according to charts furnished with the machine.

The axial or tangential feeding movement is controlled by quick change-gears, giving twenty-two different rates of feed, and the arrangement is such that the work may be fed toward the hob to a given depth, and then the axial feeding movement may be started for finishing the teeth. The hob-spindle and arbor support are carried by adjustable bearings on a slide which is traversed in the main column by a screw and adjustable bronze nut. This movement is disengaged automatically at any predetermined point by an adjustable collar and trip-lever. When the hob is feeding axially across the gear blank, the work-table should be clamped to the bed by the binder handles provided on each side. An index on the machine may be used to locate the work in a rotary direction to suit the hob teeth when "catching the lead," as in recutting. This index is also used when a gear intended for a multiple-threaded worm is cut with a fly tool.

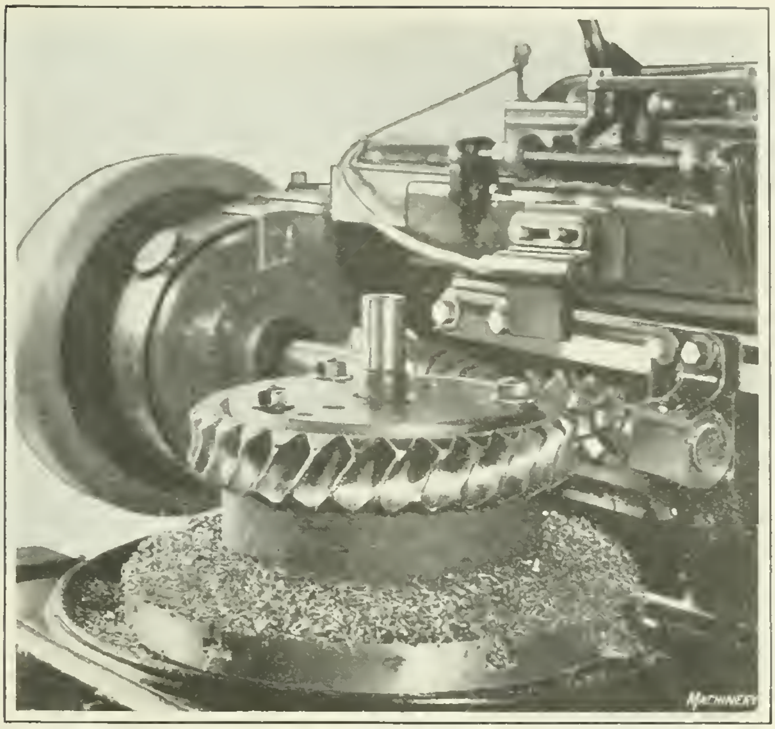


Fig. 9. Another Example illustrating Application of the Taper-hob Method

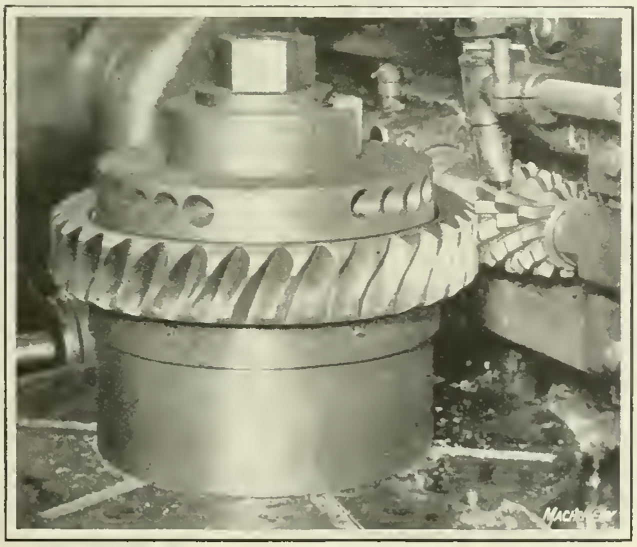


Fig. 8. Detail View of Taper Hob cutting a Worm-gear as it feeds tangentially

The handwheel for adjusting the table along the bed has an adjustable dial graduated to thousandths, and the radial in-feed may be disengaged automatically by a stop on the rim of this micrometer handwheel. A scale on the bed and a pointer on the work-slide may be used for checking the center distance between the axes of the hob and work.

Avoiding Under-cutting on Small Worm-gears

The under-cutting of the teeth of small pinions that occurs under certain conditions has already been referred to in connection with spur gears. The teeth of small worm-gears will also be under-cut, provided a wheel blank of standard size is cut in the usual manner with a 29-degree hob. In the case of spur gears there is only slight interference when a 12-tooth pinion of 14½ degrees pressure angle is in mesh with another 12-tooth pinion, but pronounced interference occurs if one of these pinions is run in mesh with a large gear, and maximum interference takes place when the pinion is engaged with an unmodified involute rack. Now, since the worm that engages a worm-gear is similar to a rack as regards sectional shape, interference or under-cutting occurs when the worm-gear has less than 30 teeth, assuming that a 29-degree worm is used.

One way to avoid this under-cutting is to enlarge the worm-gear blank, as is done frequently when making small spur pinions. The following Brown & Sharpe formula gives the throat diameter of an enlarged worm-gear blank. In this formula, O = throat diameter; D = pitch diameter; and S = addendum.

$$O = \cos^2 14\tfrac{1}{2} \text{ degrees } D + 4S$$

If the same center distance is to be maintained, the worm diameter is reduced as much as the throat diameter is increased. Another method of avoiding under-cutting is to increase the angle of the worm thread. The following formula in which N equals the number of teeth in the worm-gear is used for determining this increased angle:

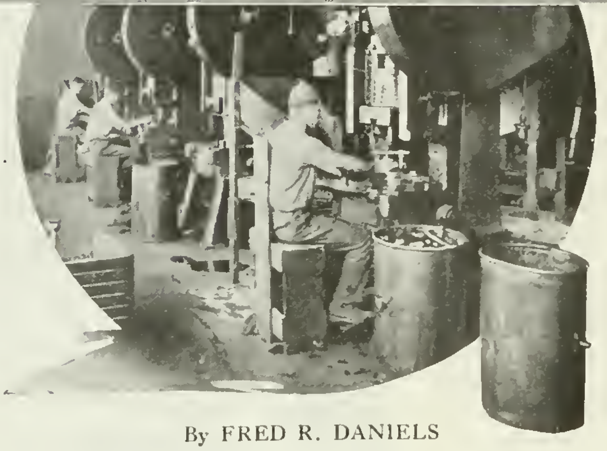
$$\text{Cos } 1/2 \text{ worm thread angle} = \sqrt{1 - 2 \div N}$$

This change would involve making either a hob or a fly cutter of corresponding angle.

Practice of a Pressed Steel Plant

Sheet-metal Drawing Performed by Dies of Unusual Design

Methods Employed by the New England Pressed Steel Co.



By FRED R. DANIELS

IN any collection of sheet-metal drawing work, the examples shown in this article would doubtless be classified as unusual. They include a broom-holder shell, involving very unusual tooling equipment, and a muffler housing for motorcycles, produced by dies of interesting design. The practice described is that followed in the plant of the New England Pressed Steel Co. at Natick, Mass.

The pressed-steel broom-holder shown in Fig. 1 is used on a new type of broom which has recently been placed on the market. The making of this piece involves some rather unique press work. The shells are made from a hot-rolled and pickled sheet steel, especially intended for deep drawing operations, which is produced by the Allegheny Steel Co. An elliptical blank having a major diameter of 11 inches and a minor diameter of 10¼ inches is used; the thickness of stock is 0.042 inch.

Drawing Operations on a Sheet-steel Broom-holder

The broom corn used in this type of broom is arranged in four bundles, each fastened together with the ends cut square so as to rest evenly against a thrust plate which is assembled within the broom-holder. The thrust plate is located so that the end of the wooden handle, which fits in the ⅞-inch hole in the rounded end of the shell, may extend through about 1½ inches, and be gripped by spurs projecting from the under side of the thrust plate, where it is fastened by a wood screw. This construction furnishes a sufficiently rigid backing for the broom corn. The front of the shell is cut out as shown, so that the bundles of straw may be replaced or altered in position. The bundles are prevented from falling out by a cover which may be slid snugly into place over the opening, where it is secured by a lug which engages the ⅛-inch square hole in the holder. As a further support for the broom, a tapered ferrule or sleeve is slipped over the end of the handle which extends into the shell. The operations on this ferrule and on the thrust plate and cover are of minor importance, and will not be dealt with in this article.

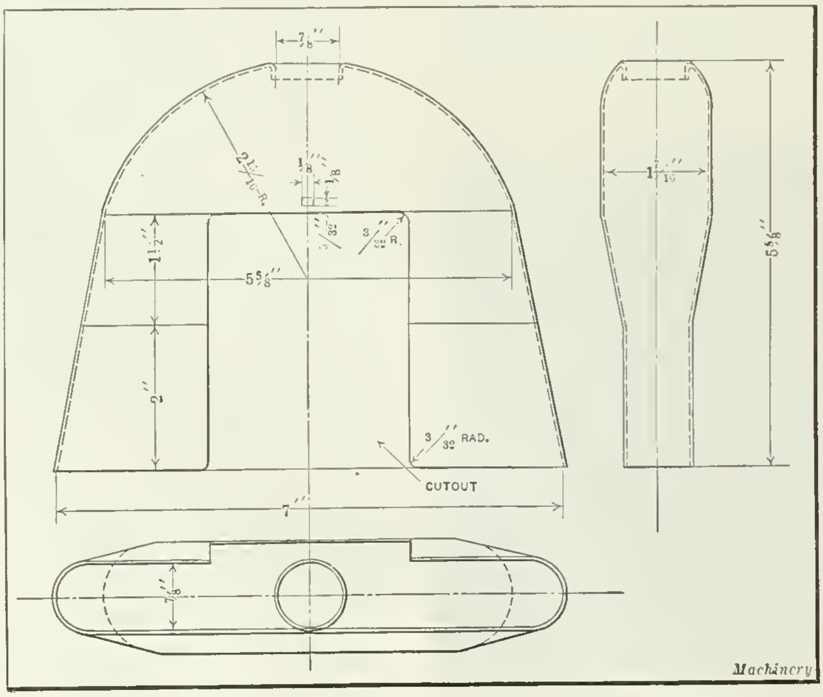


Fig. 1. Pressed-steel Broom-holder Shell

The evolution of the broom-holder, step by step, is shown in Fig. 2, and this illustration also gives the important dimensions on each shell. The stock is first blanked to an elliptical shape and drawn to the dimensions shown for the first operation, after which two redrawing operations are performed, which bring the shell to the size and shape indicated for Operation 3. For the average quality of stock, it is necessary to anneal the shell after the second operation and each succeeding alternate operation in which a reduction takes place. The inequalities in a consignment of sheet steel, no matter what the specifications may be, are often such that it is necessary to anneal even oftener than this, on account of the impossibility of making the required reduction without fracturing the stock. On the other hand, it sometimes happens that more than two reductions can occur before it becomes necessary to anneal.

Necking and Final Drawing Operations

The straight reductions are followed by two necking operations, which are in reality reducing operations in which the maximum reduction permissible is obtained. It is not practicable to reduce the shell on its complete depth to the dimensions which it has after Operation 5, because the stock will not stand such a reduction. These five operations are regularly performed on a Toledo No. 164½ toggle drawing press, it being necessary to have about a 13-inch stroke of ram. This press, with the dies used in Operation 4, is illustrated in Fig. 3, which also shows two shells before and after necking.

The final drawing operation, or tapering, produces the final shape shown in Fig. 2, the work being performed on a No. 56 Toledo back-geared press having a 13-inch stroke. This operation is illustrated in Fig. 4; here a shell before and after being tapered is shown lying on the bolster plate of the press. The seventh operation—trimming the flange —is done on a 6-inch stroke Consolidated

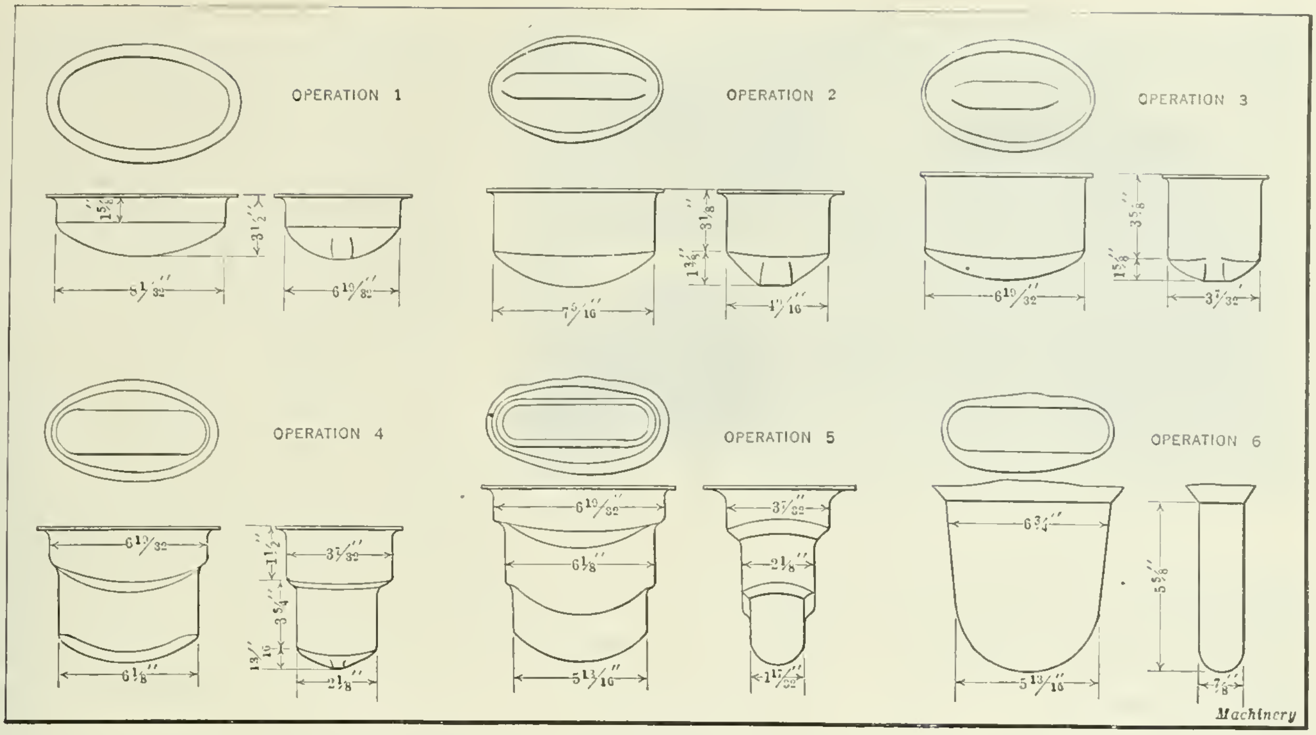


Fig. 2. Graphic Representation of the Various Drawing Operations Necessary to produce the Broom-holder Shell

press equipped with suitable trimming dies. The eighth and ninth operations are piercing the handle hole 9/16 inch in diameter, and turning in the neck to form a 7/8-inch diameter bearing for the broom handle. (See Fig. 1.) These two operations are performed on a No. 47 Consolidated back-geared press with a 6-inch stroke.

Dies for Flattening Shell and Cutting out Cover Opening

In the next two operations the shell is flattened to the final shape shown in Fig. 1, and the square lock hole and cover opening are pierced. For these two operations, special dies of more than ordinary interest are employed, as shown in Figs. 5 and 8, respectively. The die used in the flattening operation and the condition of the work after flattening are shown in Fig. 5. The faces of the lower and upper die members *A* and *B* are shaped to produce the desired flat and to meet on the horizontal center line of the shell.

The most unique feature of the die is the expanding unit which is shown lying against the lower die. This unit, when in use, rides on posts *C* which extend through two holes in the expanding member so that the floating members *D* (of which there are two) will extend to the front, in the reverse position of that shown. The floating members are expanded by a wedge *E*, which is advanced or receded by means of the handle. The shell is slipped over the expanding unit until it abuts against stops *F*, after which the handle is pulled forward to advance the wedge *E* between the floating members. This results in gripping the shell from the inside and holding it in the correct position. The wedge is connected to strip *G* by long connecting-rods, and the floating members are tied together in tension by two coil springs.

The vertical movement of the floating members is made possible by special headed pin keys which operate in the T- and L-slots shown. When the upper die member *B* contacts with the shell on the downward stroke of the press ram, it forces the expanding unit down on posts *C* against the pressure of four coil springs until the shell is sufficiently flattened. During this movement, post *H* on the upper member bears against the expanding unit between the two holes through which the lower posts *C* extend, thus assisting in

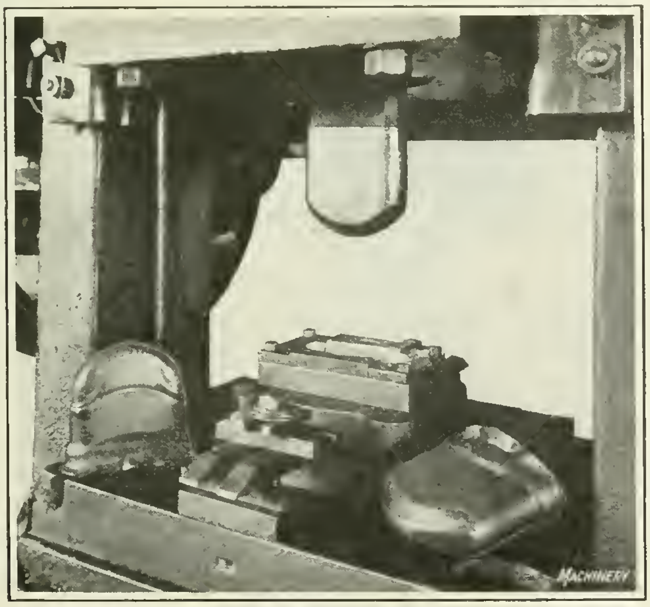


Fig. 3. The First Necking Operation, showing the Dies and the Work

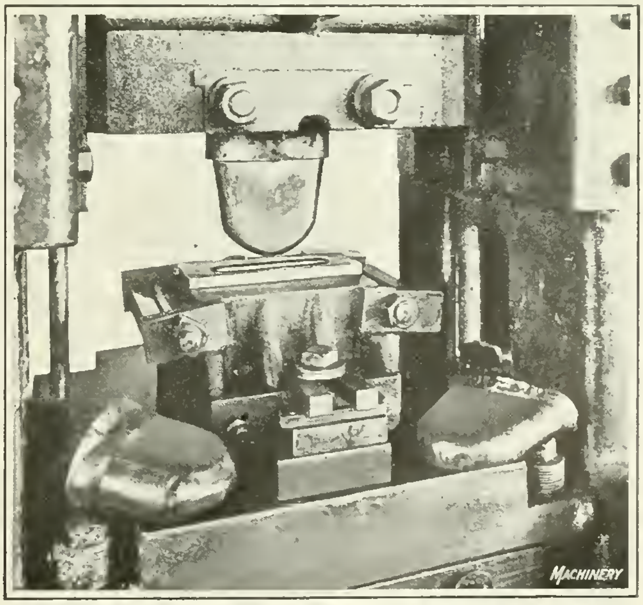


Fig. 4. Dies used for tapering or rounding the Ends of the Shell

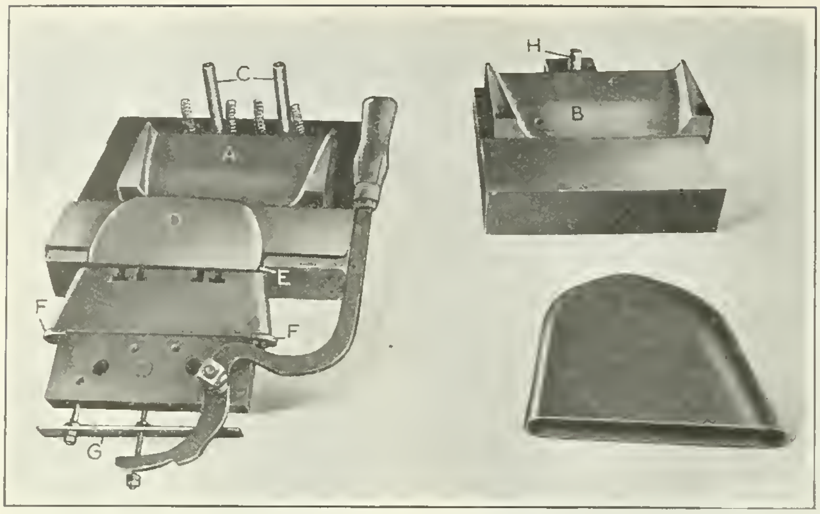


Fig. 5. Specially Constructed Flattening Dies of the Expanding Type

the depression of the expanding unit and eliminating the possibility of this unit sagging from its overhanging weight and binding on the posts. The flattened shell can be quickly released after the press ram has ascended, by simply pushing back the handle, which withdraws the expanding wedge and permits the two coil springs that hold the floating members together to contract.

The cutting out die, Fig. 8, is so designed that both the operations of piercing the small lock hole and cutting out the large square opening can be accomplished at the same time. The square punch *A* is made removable, so that it can be readily replaced. It will be realized that the amount of wear and the likelihood of breakage in using such a slender punch is considerable. With the upper die member constructed in this manner, the two operations can be successfully performed simultaneously. The work fits over die *B*, and is located transversely by the two stops shown on the side of the die. The scrap is permitted to drop through the die, and plate *C* strips the punch on the upward stroke of the ram. A shell, as it appears after this operation, is shown at the right of the die.

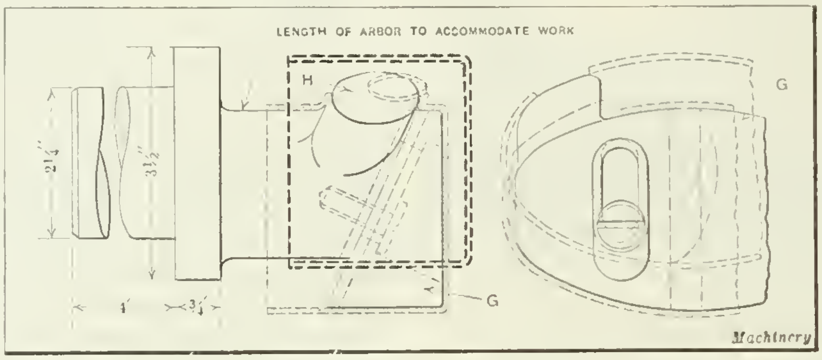


Fig. 6. Arbor over which Flange surrounding Side Hole in Muffler Housing is drawn

In describing the manufacture of the muffler housing illustrated in Fig. 7, only those operations that involve special equipment will be considered. This shell, which is the muffler front-head used on a well-known motorcycle, is drawn to shape in three straight drawing operations and one necking operation. The shell is made of No. 15 gage pressed steel, 0.070 inch thick. It was found necessary in the reduction process, to anneal the stock after each operation. The necking operation is followed by a finish-drawing operation to size the shell, after which the uneven edge produced in the reduction processes is squared off. After squaring the end, the side hole *A*, and the end hole *B* are punched. The shell then has the appearance shown at *A* in Fig. 9.

The punch and die used to pierce the side hole are shown in the upper right-hand corner of Fig. 10. The die is an arbor, held in a block carrying a steel bushing *A* and an end plate *B*. Plate *B* is provided with suitable clearance to accommodate the depression *C* in the shell, and thus aid in locating it on the arbor during the piercing operation. Incidentally, it may be mentioned that this depression in the shell is gradually formed in the series of drawing operations. A No. 4 Consolidated short-stroke press is employed in punching this hole. The punch is of simple construction, and is shown at *D*.

By inspecting the shell shown in this illustration, as well as in the detail view, Fig. 7, it will be seen that the drawing up of the flange around this hole presents a condition which involves unusual drawing work. Not only is the hole located unsymmetrically on a curved surface, but also the flange is at a 25-degree angle with the vertical. The abrupt change in the direction of the steel fibers produced by this operation makes it necessary to anneal the shell with great care before this step, and sometimes two annealings are required to prevent fracture, particularly at the acute angle which occurs at about point *E*, Fig. 10.

Side- and End-hole Drawing Dies

The arbor employed for drawing up the stock around the side hole is illustrated at the left in Fig. 10; this is substituted in the die-block for the arbor used in the hole-punching operation. The arbor carries a specially formed sliding shoe *G* which rides on the end of the arbor

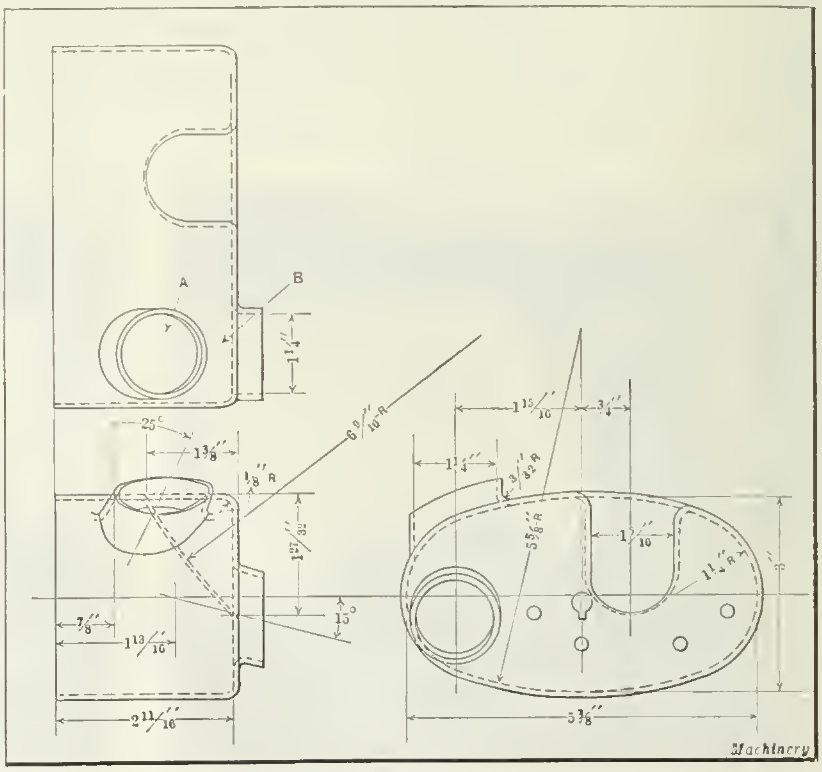


Fig. 7. Front Head of a Motorcycle Muffler Housing

at an angle with the horizontal equal to the angularity of the flange to be drawn. The construction of the arbor will be understood by reference to Fig. 6; the position of the work when first slipped into place is indicated in dotted outline, and the position after the flange has been drawn by broken sectional lines. The shoe *G* is guided in its angular movement by a key in the end of the arbor, and it is loosely held to the arbor by a flat-headed screw. The shoe has an elongated screw slot to allow for its movement.

To locate the shell on the arbor preparatory to drawing, the shoe *G* is slid upward by hand to permit the shell to clear horn *H*, at which position the lower side of the shoe will coincide with the corresponding portion of the arbor. When the ram descends, carrying the specially formed face punch shown in Fig. 10, the shell is carried down with the shoe until the stock is drawn around the horn *H*, as shown in Fig. 6. At this point, the downward movement of the shoe is limited by the length of the elongated slot. The shell may be readily removed by simply raising it until it clears the horn. It will be evident that the face of the punch is shaped to conform to that part of the shell on which it is to seat, and also that it has a hole of suitable size to accommodate the drawn flange, being nicely rounded at the edge to produce the filleted surface which joins the flange to the shell proper. The press used for drawing up the side-hole flange is a Waterbury-Farrel, 10-inch stroke.

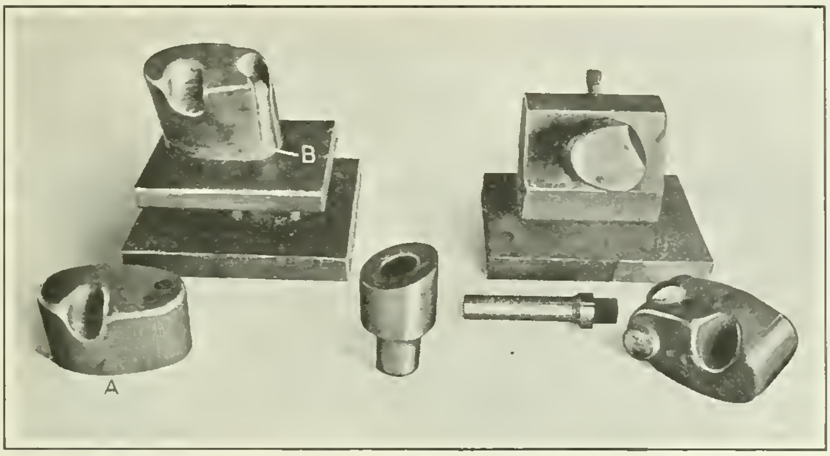


Fig. 9. Tools used to draw the Flange surrounding the End Hole in the Muffler Housing and to size the Side Hole

The specially designed dies required for drawing up the flange for the end hole *B*, Fig. 7, are shown at the left of Fig. 9. The shell before the flange is drawn is shown at *A* in this illustration. This die is set at a 15-degree angle on the bolster plate of the press so as to position the lower punch *B* vertically. This punch extends through the upper die-plate at an angle of 15 degrees. The upper plate which carries the die is spring-supported, and has four dowel-pins to guide it when depressed by the descent of the punch. This plate then acts as a stripper, lifting the finished shell from its seat on the die as soon as the ram ascends. A movement of about 1¼ inches is obtainable. It will be evident that the face of the punch is angular to agree with the 15-degree angle at which the die is set on the machine. For drawing up this end hole, a 10-inch stroke Waterbury-Farrel press is used, the same as in the drawing up operation on the side hole.

The finished shell is shown at the right in this illustration; also the die and plain punch used in sizing the side hole. It will be evident that in drawing this flange at the angle required it would be almost impossible to maintain a round hole. Hence a final sizing operation is employed, using the simple equipment shown at the right of the illustration, as previously mentioned.

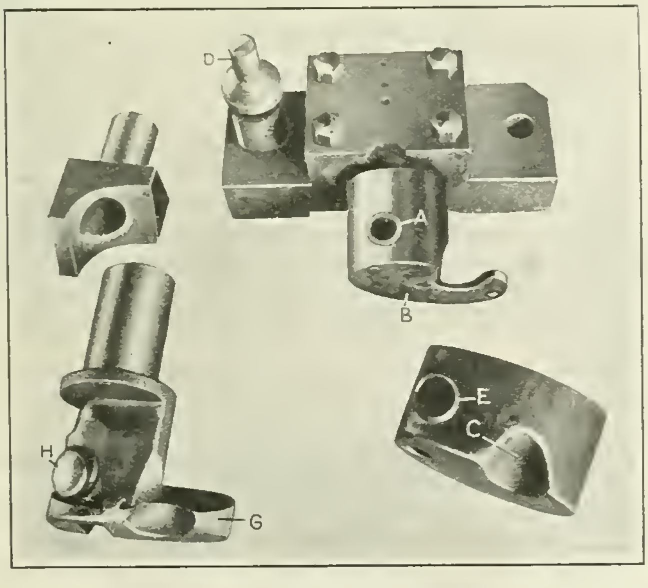


Fig. 10. Punches and Dies used to punch the Side Hole and to draw up the Flange which surrounds this Hole

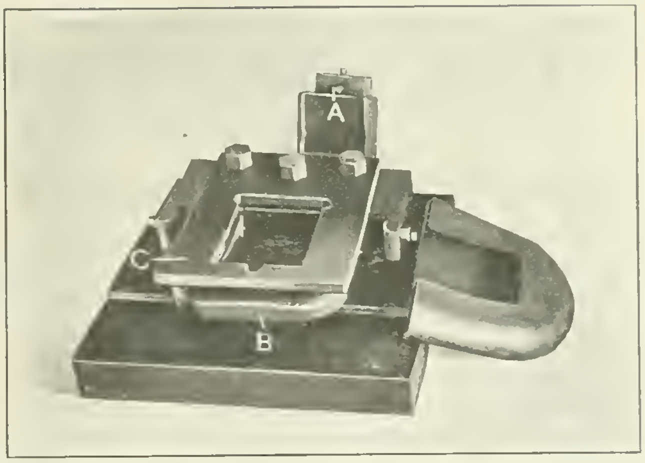


Fig. 8. Die and Punch used to cut out a Section in one Wall of the Broom-holder Shell and pierce a Small Square Locking Hole

* * *

SPECIFICATIONS FOR TOOL STEEL

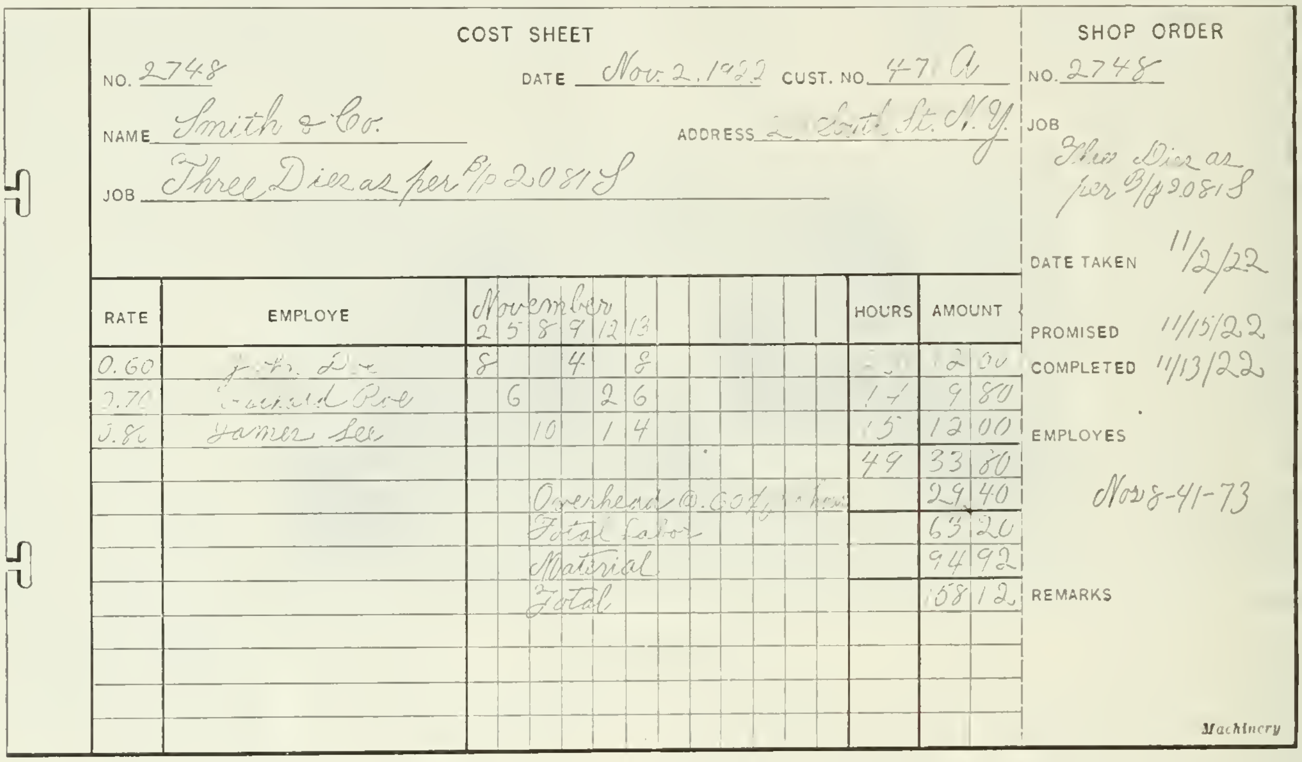
Carbon tool steel specifications have been tentatively approved by a committee of the American Society for Testing Materials. Copies of these specifications, which cover six classes of carbon tool steel as determined by chemical composition, may be obtained from the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. The specifications cover the purposes for which the different kinds of tool steel are most frequently used; the method of manufacture, whether by the crucible or the electric furnace method; annealing; chemical composition; methods of analysis; tolerances on dimensions; finish; marking; and methods of inspection and rejection.

From a practical point of view it does not seem that these specifications fully cover the needs of the industry. As has been pointed out in several articles in MACHINERY during the past year, chemical composition alone does not insure good tool steel (any more than good ingredients alone in a cake insure good cake). There are other factors to be considered, and any satisfactory specifications for carbon tool steel should include actual service tests. No association would be better fitted to sponsor a standardization of the service tests that would determine the quality of tool steels than the American Society for Testing Materials.

Cost Accounting in the Jobbing Shop

By LUDWIG B. PROSNITZ, Certified Public Accountant

NEGLECT in keeping records of labor, material, and overhead costs in jobbing machine and tool shops has frequently resulted in the failure of a business. The owners may have been well qualified mechanically to run it, but they were ignorant of the importance of an efficient cost accounting system as a factor in the success of the enterprise. The present article outlines a simple system of keeping cost records which is especially adaptable to the jobbing shop. It is correlated to the bookkeeping end of the business only to a limited extent, because for the average shop of this kind the cost of conducting a system thoroughly interwoven with the financial records would be prohibitive and of no particular value.



COST SHEET

NO. 2748 DATE Nov. 2, 1922 CUST. NO. 47 A

NAME Smith & Co. ADDRESS 2 South St. N.Y.

JOB Three Dies as per B/P 2081 S

RATE	EMPLOYE	November 2	5	8	9	12	13	HOURS	AMOUNT	
0.60	John Doe	8			4		8	20	12	00
0.70	Edward Roe		6			2	6	14	9	80
0.80	James Lee			10		1	4	15	12	00
								49	33	80
				Overhead @ .60 per hour					29	40
				Total Labor					63	20
				Material					94	92
				Total					158	12

SHOP ORDER

NO. 2748

JOB Three Dies as per B/P 2081 S

DATE TAKEN 11/2/22

PROMISED 11/15/22

COMPLETED 11/13/22

EMPLOYES

Nos. 8-41-73

REMARKS

Machinery

Fig. 1. Form on which Labor Costs for a Job may be itemized, and Shop Order Stub which is torn off and given to the Foreman

Handling Customers' Orders

Only written orders should be accepted; this is not adhered to in some machine and tool shops, as there is a tendency not to bother the customer too much. Customers with experimental work in particular, have a disinclination to issue specific instructions in writing, and many jobbing concerns that have been negligent with regard to requirements in this respect have learned by bitter experience the truth of the old adage, "An ounce of prevention is worth a pound of cure." Orders should contain full particulars concerning the work to be done and a concrete statement as to the ultimate cost. It is customary to undertake jobs at a flat contract price, at a certain rate per hour, or at a stated percentage above cost. Which ever way is followed, the terms of payment should be stipulated at the outset. Some orders are likely to take an indefinite period for completion, and if the shop has insufficient capital to keep going without assistance from those customers whose work is in process, advance payments on account should be provided for in the contracts.

When an order is received, in the system to be discussed, it is entered in the customers' order book in numerical sequence. This record is used only to obviate the necessity of frequent reference to cost sheets which will be described later. The order number of the shop is placed on the customer's order, and the customer's order number and other pertinent data are inserted in the customer's order book. A rubber stamp "Billed" is prominently displayed on each order in this book when the job is completed and charged to the customer. It is urgent that this book be examined at regular intervals, and wherever the "Billed" stamp does not appear, some explanation should be made; a cost sheet may have been lost from the file or a shipment may have been made without notifying the office.

Cost Sheets and Shop Orders

Cost sheets and shop orders are made up from the customers' order book, both being combined in a single form as may be seen by reference to Fig. 1. The sheet is perforated so that the shop order can be conveniently detached. The face of the cost sheet provides for recording and summarizing all labor costs, while the reverse side, shown in Fig. 2, is intended for use in the compilation of material costs and any other expenses applicable to that particular order.

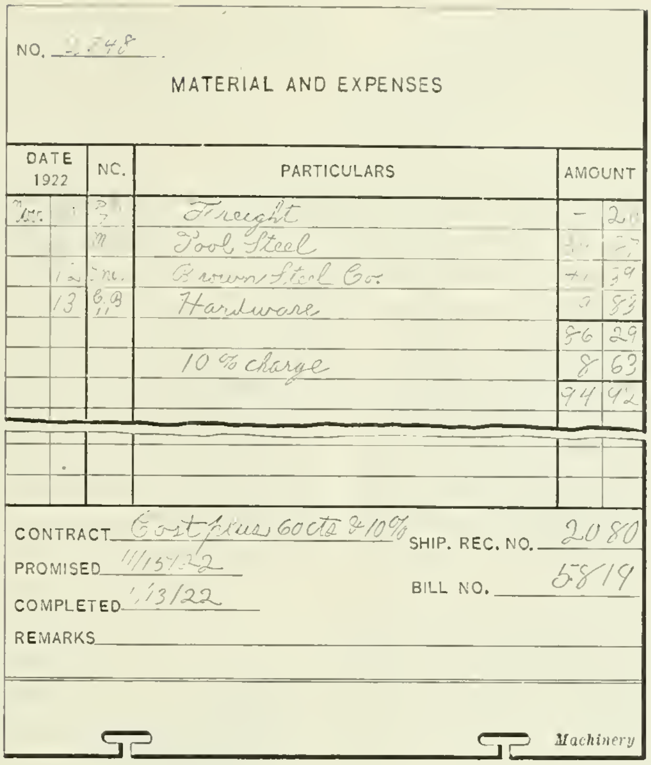
The forms in Figs. 1 and 2 are filled out to show the manner of recording all shop costs in connection with job No. 2748 for Smith & Co. It is assumed that sixty cents per hour for each hour of labor is the charge determined upon to cover overhead costs and profit, and that a charge of 10 per cent is made on the material costs, etc., to cover handling costs in connection with the purchase of materials and other expenses. The labor cost data are gathered from time slips which will be explained later.

The shop order is given to the foreman, together with all the blueprints and sketches marked with the job number, who figures out the material required for the entire order, and requisitions this material from the stock-room. The foreman also decides which men shall be given the job and marks the shop order stub accordingly. By estimating all the material requirements in advance, the number of requisitions is reduced to a minimum, with a consequent saving. The blueprints are usually needed by those working on the order; however, as the shop order stub contains information required by the foreman, it is retained by him.

It cannot be too strongly emphasized that work in process should be inspected at frequent and regular intervals, and the importance of having an efficient, conscientious foreman who will be responsible for such inspection can hardly be overestimated. Failure to inspect products thoroughly from time to time and just before shipment, may result in losses aggregating thousands of dollars.

Upon the completion of an order, a notation to that effect is made on the shop order stub, and it is then turned into the office for billing purposes. In the "No." column of Fig. 2, P. C. 7 refers to a petty cash slip number, M. 9 to a material requisition number, "Inv." to an invoice of steel that was used directly on the order and never entered the stock-room, and C. B. 11 to a special payment made by a check listed on page 11 of the cash book.

It will be noticed that this side of the cost sheet has provision for marking the terms of the contract and other pertinent features of the order. It may be asked why all material does not enter the stock-room so as to eliminate cash book reference, as it would seem better practice to enter invoices for all items through the purchase journal. Suffice it to say that strict accounting is not always practicable in machine shops, and it is frequently advisable to let down the bars in the interest of expediency.



NO. 2748

MATERIAL AND EXPENSES

DATE 1922		NC.	PARTICULARS	AMOUNT	
Nov.	1	P.C. 7	Freight	—	20
		M 9	Tool Steel	[illegible]	[illegible]
	12	Inv.	Brown Steel Co.	41	59
	13	C.B. 11	Hardware	3	83
				86	29
			10 % charge	8	63
				94	92

CONTRACT Cost plus 60 cts & 10% SHIP. REC. NO. 2080

PROMISED 11/15/22

BILL NO. 5819

COMPLETED 11/13/22

REMARKS

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Fig. 2. Reverse Side of the Form in Fig. 1 which is used to record Material and Other Expenses except Labor

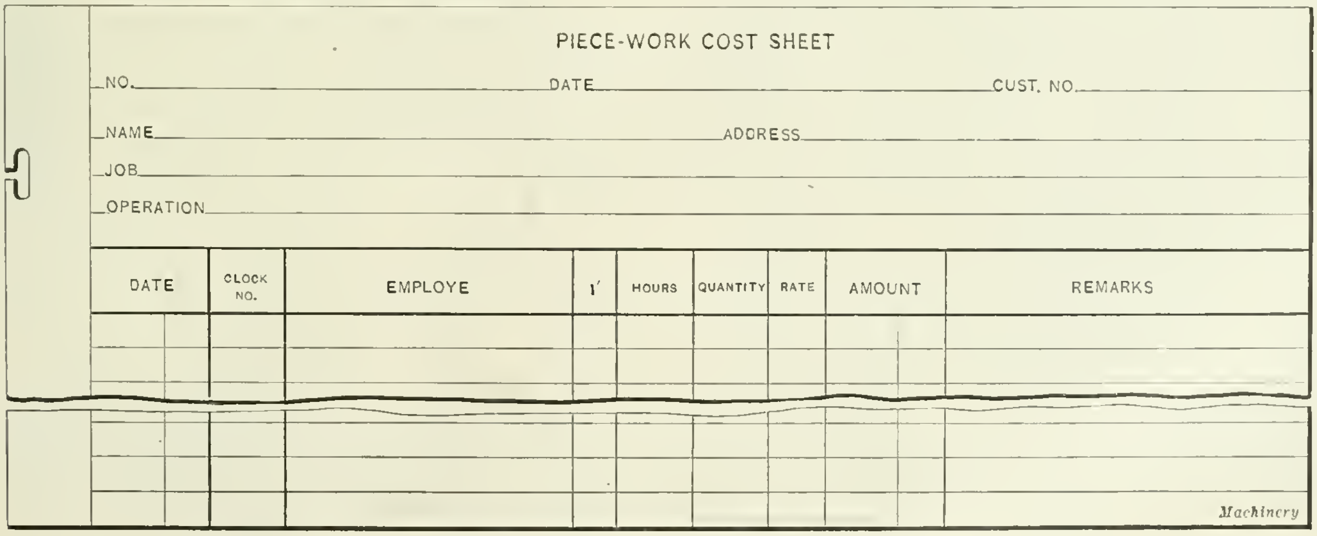
Operations paid for on a piece-work basis may be conveniently recorded on the sheet illustrated in Fig. 3, the headings of which are substantially the same as on the regular cost sheet. The check (√) column is used to indicate the transfer of the wages earned to the employe's clock card for payroll computation. When manufacturing parts on a quantity production basis and several operations such as turning, assembling, etc., are necessary, a separate sheet is desirable for each operation. The reverse side of the piece-work cost sheet is the same as that shown in Fig. 2.

Under no circumstances should the clerk allow a cost sheet to be taken from the binder, because of the difficulties which would occur if one should become lost. The cost sheets should be examined weekly, and a production report compiled to show the progress of orders. With such reports accessible, an executive can check up and facilitate the progress of work. A form that has been used to advantage for this purpose is shown in Fig. 4.

Keeping Time- and Piece-work Labor Costs

All employes should punch clock cards morning, noon, and evening and fill out time slips daily, giving an account of their work on the previous day. In order to have these slips filled out with neatness and accuracy it is best, especially in a large shop, to entrust the clerical details to either a factory or an office clerk. After the slips are collected, they should be checked with the clock cards. The clerk making this check should ascertain that every employe who has punched a clock card has also filled out a time slip, and that the hours on the time slips correspond with the hours credited on the clock cards.

If an employe is absent, his time slip should be filled out for him, as no credit can be inserted on the clock card until a slip is received, and it often happens that the payroll must be computed before the employe returns. This would necessitate the listing of delinquents and such a list



PIECE-WORK COST SHEET

NO. DATE CUST. NO.

NAME ADDRESS

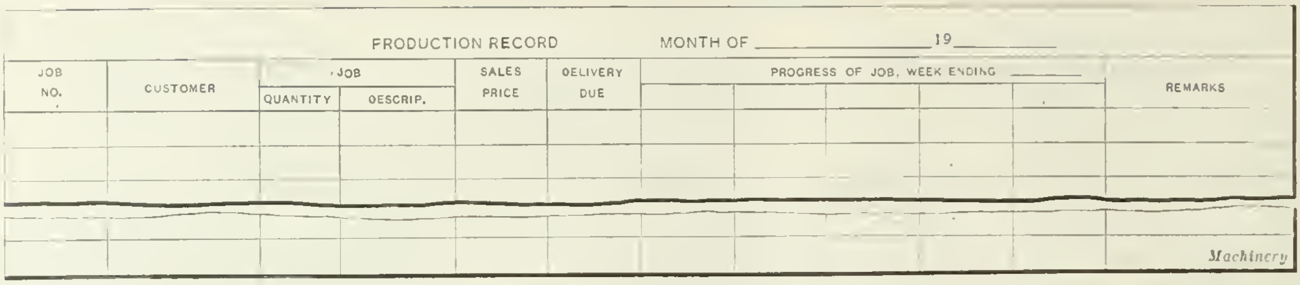
JOB

OPERATION

DATE		CLOCK NO.	EMPLOYE	√	HOURS	QUANTITY	RATE	AMOUNT		REMARKS

Machinery

Fig. 3. Cost Sheet used instead of that shown in Fig. 1, when Employes are paid on a Piece-work Basis



PRODUCTION RECORD MONTH OF ________ 19____

JOB NO.	CUSTOMER	JOB		SALES PRICE	DELIVERY DUE	PROGRESS OF JOB, WEEK ENDING ____					REMARKS
		QUANTITY	DESCRIP.								

Machinery

Fig. 4. Form which should be filled out monthly so that an Executive may readily check the Progress of Orders through the Shop

would have to be followed up persistently. In order to account properly for all labor, it is absolutely essential that a time slip be obtained for every hour of labor that eventually finds its way to the payroll sheets.

Payment on the piece-work basis is especially desirable when the quantity production of uniform parts is undertaken. When this system of payment is followed, the piece-work hours should be separated from the regular time-work hours on the employes' clock cards. It is not usually the best practice to compute piece-work wages on the daily clock cards, because many employes do not want their earning capacity to be known nor is such publicity desirable from the viewpoint of the management. Reference may be made to the cost sheet for this purpose until the end of the week, when the wages may be marked on the clock cards, as they then remain in the office.

A convenient form for reporting both time- and piece-work production is presented in Fig. 5. The last three columns of this slip "Quantity," "Rate" and "Amount," are used only for piece-work. Before posting the time slips on the cost sheets, they should be countersigned by the foreman, who may refer to his shop order stubs for any information that he may desire. This check-up by the foreman serves to visualize in his mind the daily progress of the shop, and enhances the accuracy of the cost records. The time slips, when posted, should be filed according to the date and the clock number of each employe, for ready reference.

Payroll Computation and Distribution

Assuming a weekly payroll, at the end of the week the clock cards already have the hours accredited, and piece-work wages may then be compiled by reference to the customers' cost sheets. A person other than the one who inserted the original figures, should total them, mark the rates, and extend each card. The payroll clerk or bookkeeper in charge should then recheck the cards, after which they are ready for listing in the payroll book. The insertion of all other salaries not covered by the clock cards completes the payroll.

The time slips are entered against the customers' cost sheets, and other sheets which are headed "Unproductive Labor, Plant Order No.—" and similar general ledger divisions. In other words, all labor naturally will not apply to customer's orders. At the end of the month, the sum of labor costs charged to the latter sheets, plus foremen's, officers', office, salesmen's and other salaries not included in the cost sheet entries, are subtracted from the total payroll for the month, to give the charge applicable to "productive labor."

Should it be deemed desirable to subdivide productive labor into component departments, the most practical method would be to have a group of cost sheets known as "general ledger sheets," and distribute all time slips thereon prior to posting on the customers' cost sheets. The payroll should be charged on the books according to the last day of the week, thereby avoiding monthly accruals, which need only be considered on working sheets for the purpose of the financial statement. Thus, if the week ends on the first day of a given month, the entire payroll for that week will be charged against the new month.

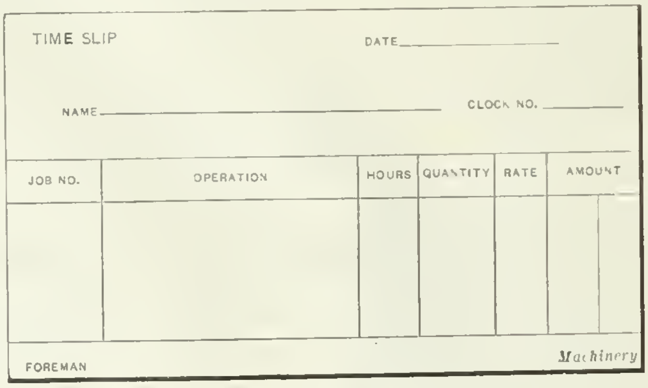
The Stock-room

The stock-room should be centrally located so as to be readily accessible to the majority of employes. Material and tools should be conveniently assorted, and controlled by stock record cards kept in the office or the stock-room, or in both, as the circumstances may warrant. A monthly inventory can be obtained by pricing and listing the stock cards. Materials for current use should be requisitioned on forms.

Tools are usually placed under the control of the stock clerk as they constitute an expensive item and care must be taken to safeguard against their loss. Besides, the tools may be interchanged continually throughout the day by the employes in the course of their work, and it is necessary to keep track of the exact location of a particular tool. Various methods have been devised for this purpose, among which the tool check system has met with considerable favor. Under this system, each employe receives a certain number of checks on which his clock number is stamped, and when a tool is entrusted to his care, he gives the stock-room clerk one of these checks, which is placed on a hook adjacent to the location of the tool in question when it is in the stock-room. At the end of the day the stock clerk can readily ascertain the location of all tools. It is not unusual, unless extreme precautions are taken, to have tools damaged or lost. Monthly reports made by the stock clerk, specifying the cause or origin of damaged or lost tools, will tend to reduce such occurrences to the minimum.

Miscellaneous Bookkeeping Considerations

When purchase orders are issued, at least the copies should contain a reference to the purpose of the requisition, telling whether the material is for a job, stock, or equipment. Space should be provided on the form for answering that question, and if for a job, the job order number should be specified. Every invoice received should be marked to indicate the account to which it is to be charged before being entered in the purchase journal. If the charge is made to "Material Purchases," this should be indicated, and there should be an additional reference showing whether it is applicable to stock or directly to a customer's order. If the lat-



TIME SLIP DATE________

NAME________ CLOCK NO.________

JOB NO.	OPERATION	HOURS	QUANTITY	RATE	AMOUNT

FOREMAN

Machinery

Fig. 5. Convenient Time Slip which is filled out daily

ter is the case, an entry should be made in a special "Job Number" column provided in the purchase journal, from which it may be posted on the cost sheet indicated by the order number.

Special outlays in connection with customers' orders are frequently required. These may be in the nature of petty cash, expenditures or check-book items and, on rare occasions, journal entries involve items affecting customers' orders. All books of original entry should be provided with a job number column, so that no item of cost applicable to a customer's order will be overlooked.

The overhead in a machine jobbing shop is best applied on a productive hour basis. Overhead expenses are more or less uniform from month to month and include the usual factory, selling, and administrative expenses, while the volume of work on hand has a tendency to fluctuate violently, and the labor turnover is high. For these reasons it is advisable to examine the overhead rate monthly. The total number of productive hours per month divided into the standard overhead expense for the month, plus a predetermined rate per hour for profit, will give the rate per hour to add to each order as it is billed, so as to cover overhead and profit. Assuming 5000 productive hours, an overhead expense of $2000, and a desired profit per hour of 10 cents, it would be necessary to add 50 cents per hour in billing all orders. The most satisfactory rate to apply is that determined by averaging the experience of several prior months, provided, of course, that no radical changes have occurred in conditions.

Parts for machines, miscellaneous equipment, etc., are frequently manufactured on the premises, either because they are needed immediately or because such a procedure is the most economical. Such orders should be handled similarly to customers' orders, and upon completion, a journal entry should be made, debiting the asset created and crediting "Productive Labor." Credit should be made to the latter account due to the fact that the payroll account is distributed monthly, regardless of plant orders in process. Charges involving the latter usually find their way into the productive labor account.

Problems such as depreciation of machinery, equipment, tools, dies, etc., are similar to those customary in other manufacturing establishments. In order to obtain monthly operating statements, it is best to adopt standard monthly rates of depreciation, so that the annual depreciation charges will be equitably distributed over the twelve months. Accounting requirements not dealt with in this article are similar to those encountered in other business enterprises.

It is universally understood that the best of systems cannot be dogmatically applied to all machine shops. Every organization has its own peculiar problems. We can, however, proceed on the fundamental proposition that a successful plant must be well regulated, and that a thorough accounting system is a necessary corollary thereto. We formulate general principles in order to establish our foundation, and then build our house according to the individual requirements.

* * *

COMBINING TWO ENGINE LATHES TO INCREASE SWING

Many machinists have had occasion to reverse the headstock of an engine lathe on its bed so that the faceplate would overhang the end in order to increase the swing. The accompanying illustrations show how this expedient was employed in combining two engine lathes to obtain the capacity required in machining an electric motor spider. The work constituted part of a course of training at the Chapman Technical High School, New London. In this case, a five hosepower motor was being built, the spider of which had a diameter of 25 inches. The largest lathe in the school would swing only 14 inches. However, by arranging two of the lathes as shown, it was possible to handle the work satisfactorily.

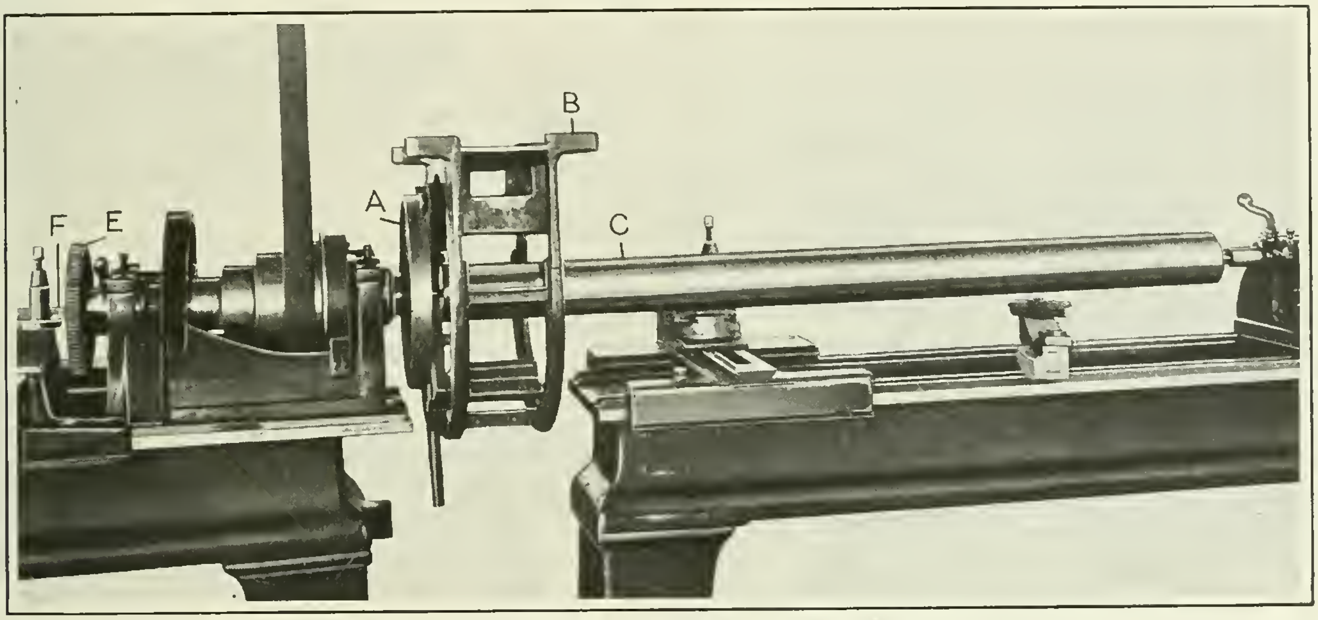


Fig. 1. Making Use of Two Combined Lathes to obtain Increased Swing

The headstock on the lathe shown at the left in Fig. 1 was turned around so that a faceplate *A* could be attached to hold the spider *B*. This allowed the spider to swing clear of the end of the lathe bed over the floor. However, this arrangement made it impossible to employ the toolpost and carriage of the lathe with the reversed headstock. The bed of this lathe was carefully leveled up, and the lathe to the right unfastened from the floor and brought up close to the first lathe, as shown. The toolpost of the second lathe was thus brought into position to be used in machining the spider.

It was necessary, of course, that the beds of the two lathes be in the same plane and in nearly perfect alignment. The over-arm cylinder *C* was taken from a universal milling machine and mounted on centers between the two lathes, one end being held by a center in the reversed head of the first lathe, and the other by a center in the reversed tailstock of the second lathe. Since the first lathe bed was level, it was only necessary to level the bed of the second lathe. The leveling of the second lathe bed was done in the manner described in the following:

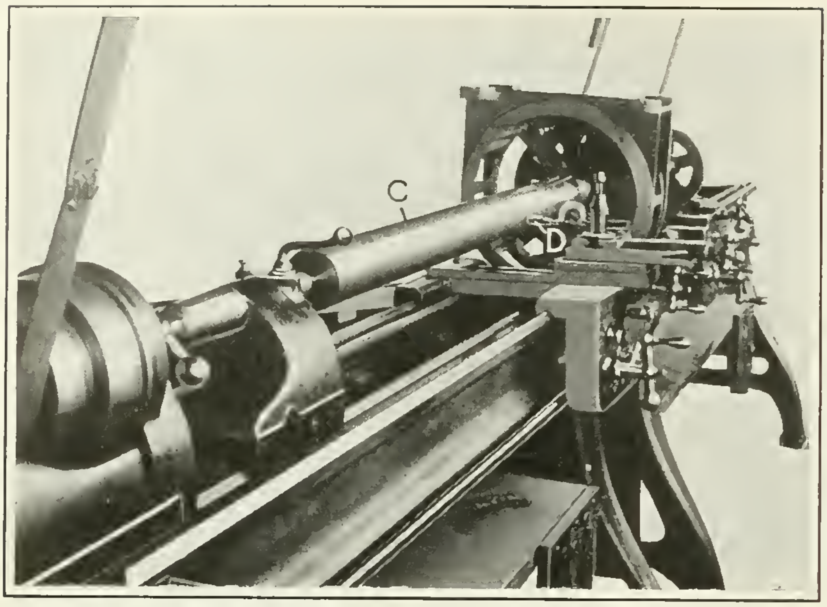


Fig. 2. Using Milling Machine Over-arm and Micrometer mounted in Toolpost to align Lathe Beds

A micrometer *D*, Fig. 2, was mounted in the toolpost of the second lathe, with the axis of the handle level with and pointed toward the axis of the cylinder *C*. By taking a reading when the handle was in contact with one end of the cylinder, and then moving the carriage to get a similar reading from the other end, the error in alignment was readily obtained. Many hours of labor were required to correct this error. The jar of the machinery was sufficient to make the testing unreliable, so that most of the work had to be done when the power was off. When the error in alignment had been reduced to one-quarter of a thousandth inch to the foot, the machining work was started.

The problem was to machine eight equally spaced slots in the inside of the spider. For this work, a heavy tool-holder was made from a piece of wrought iron 2 inches square, and clamped to the lathe carriage. At first the longitudinal power feed was used to plane or shape the slots, but the work progressed so slowly that the feed was thrown out and the carriage fed back and forth by hand, different members of the class taking turns at the work until it was completed. In order to make the spacing equal, a 120-tooth gear *E*, Fig. 1, was rigidly fastened to the spindle head and used as a graduating or indexing device. Every fifteenth hole was left open, and all the others were filled with beeswax. This gave eight equally spaced notches. A bar *F*, held in the toolpost, served as an indexing pin, so that when it was fitted into one of the open spaces, it held the spider in position while a slot was being cut. The work was indexed by withdrawing the bar, making an eighth revolution, and again pushing bar *F* into the open space. C. T. H. S.

* * *

TOOL-HOLDER FOR CUTTING IN BOTH DIRECTIONS

A tool-holder designed for cutting on both the forward and return strokes is shown in the accompanying illustrations. This holder may be used on either a planer or a shaper. It is the patented invention of Ivar Ericksen, shop foreman of the Stierlin Machine & Die Works, Chicago, Ill. In the illustrations, *A* is a roughing tool and *B* a finishing tool. On the forward stroke of the shaper ram, tool *A* takes a cut, while tool *B* rides over the work. On the return stroke of the ram, tool *A* rides over the work while tool *B* takes a second or finishing cut. Thus when the tool-holder has been fed all the way across the work from right to left, the surface of the casting or work will have been completely finished by a roughing and a finishing cut.

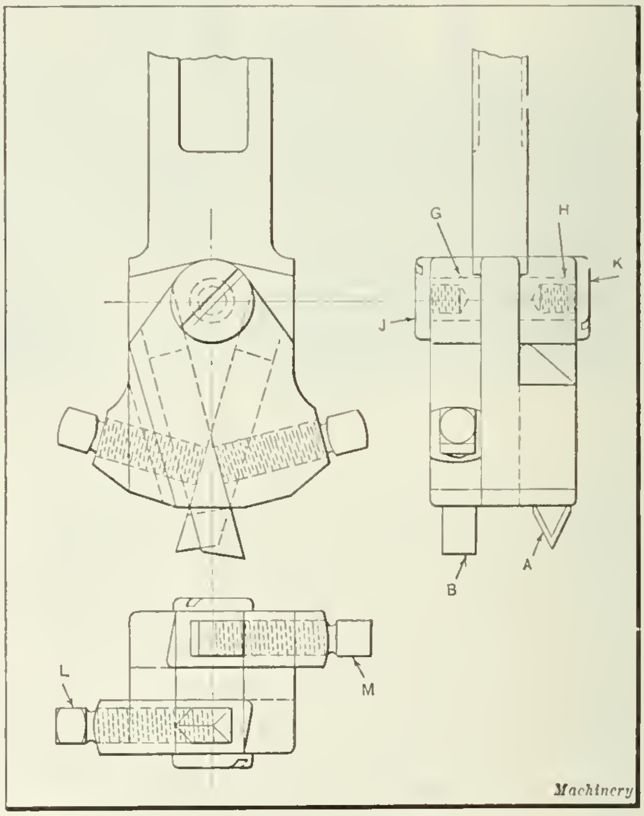


Fig. 2. Details of Tool-holder shown in Fig. 1

The tool consists essentially of a shank *D* and the two clappers *E* and *F*. These clappers are pivoted on hubs machined on the shank *D*, as indicated at *G* and *H*, Fig. 2, and are held on these hubs by screws *J* and *K*. The tools *A* and *B* are held in slots in the clappers by means of set-screws *L* and *M*. The shaper clapper is fastened down by means of a cap-screw *C*, as shown in Fig. 1, when this tool is in use.

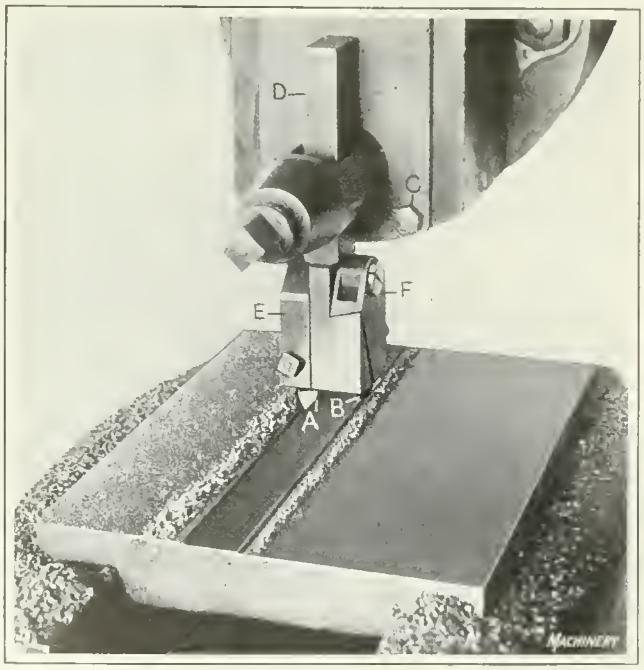


Fig. 1. Tool-holder equipped with Cutters designed to take Roughing Cut on Forward Stroke and Finishing Cut on Return Stroke

Designing Change-gears for Fixed Centers

By H. H. MANNING

THE practice of making the speed and feed changes of modern machine tools in geometrical progression is now almost universal. In designing production tools there seems to be an increasing tendency toward the use of the so-called "pick-off" type of change-gears, which consist of gears that are interchangeable on pins or shafts having a fixed center distance. The writer has found that the computations entering into the design of such gears are troublesome to many draftsmen and designers, and that the cut-and-try methods commonly employed generally consume considerable time. The tables and formulas here presented deal with the design of gear sets of this type, and should enable the gears required to be selected readily without resorting to cut-and-try methods.

TABLE 1. NUMBER OF GEARS REQUIRED IN GEAR TRAINS

Gear Trains Consisting of Two Gears									
Number of changes	2	3	4	5	6	7	8	9	10
Number of gears required	2	4	4	6	6	8	8	10	10
Gear Trains Consisting of Four Gears									
Number of changes	6	8	10	12	14	16	20	..	..
Number of gears required	8	6	12	8	16	10	12	..	..

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The first step in designing a gear set is to decide just what speeds or feeds are required, the number of changes, the ratio of progression, etc. Usually certain factors are known or assumed at the start, and the others must be calculated from them. These known or assumed factors and the factors that are to be found are in general included in one of the three following cases:

(1) When the known factors are the lowest speed, ratio of progression, and number of changes, and the unknown factors are the successive speeds.

(2) When the known factors are the lowest speed, the highest speed, and the number of changes, and the unknown factors are the ratio of progression, and the intermediate speeds.

(3) When the known factors are the lowest speed, highest speed, and ratio of progression, and the unknown factors are the number of changes and the intermediate speeds.

The solution of Case (1) is very simple, it being only necessary to complete the geometric series, which involves nothing but the process of multiplication. For instance, assuming that the lowest speed is 120 revolutions per minute and the ratio of progression 1.10, it is only necessary to multiply 120 by 1.10 to obtain the second speed. To obtain the third speed the result obtained for the second speed is multiplied by 1.10, and so on until the successive speeds for the whole number of changes has been obtained.

The first step in the solution of Case (2) is to find the ratio of progression. This is accomplished by the use of the following formula, found on Page 717 in MACHINERY'S HANDBOOK:

$$r = \sqrt[n-1]{\frac{t}{a}} \qquad (1)$$

in which

r = ratio of progression;
n = number of terms;
a = first term of progression; and
t = last term of progression.

After the ratio has been found by the use of this formula, the intermediate speeds are determined by completing the series the same as for Case (1).

The first step in the solution of Case (3) is to find the number of changes. This is accomplished by the use of the formula

$$C = \frac{\log t - \log a}{\log r} + 1 \qquad (2)$$

in which

t = last term of progression;
a = first term of progression;
r = ratio of progression; and
C = number of changes.

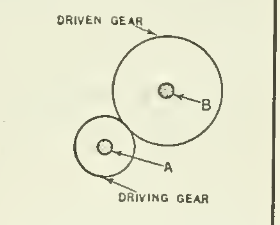
After the number of changes has been found, the intermediate speeds are obtained by completing the series the same as for Case (1).

Before deciding definitely on the number of changes to be employed in any gear set, factors presented in Table 1 should be considered. This table shows the number of gears required to obtain a certain number of feed or speed changes. It is apparent that in a two-gear train (simple gearing using only two change-gears) two, four, six, eight, and ten changes are the most economical as regards the number of gears required, and that in a four-gear train (compound gear using four gears) eight, twelve, sixteen, and twenty changes are the most economical in this respect. Inspection of this table may show how the ratio can be cut down or how the range of speeds can be increased without increasing the number of gears originally provided for.

In determining whether a two-gear or a four-gear train should be used, a great deal depends on the number of changes, the center distance between the driving and driven shafts, the amount of space available, the maximum diameter of gear that can be used, and limitations introduced by the general design of the machine. Generally speaking, a two-gear train should be used when the number of changes is below eight, as this requires fewer gears than a four-gear train for such a small number of changes. The two-gear train can be used for any number of changes, but when the number of changes is eight or over, more gears are required than in a four-gear train, and the gear set will also be more cumbersome. For instance, in a two-gear train giving eight changes in a geometrical progression ratio of 1.414, it is necessary to use eight gears. In this set the diameter of the largest gear will be 3.68 times the diameter of the smallest gear in the set, while a four-gear train giving the same number of changes with the same ratio would require only six gears, and the diameter of the largest gear would only be 1.999 times the diameter of the smallest gear in the set. It is often well to compute gear sets for both two-gear and

TABLE 2. CHANGE-GEAR DATA FOR SET OF TWO GEARS

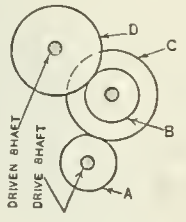
Feed No.	Required Feeds	Gear Ratio	Gear on Shaft A	Gear on Shaft B
1	3.00	1.7469	20	35
2	3.75	1.3975	23	32
3	4.68	1.1180	26	29
4	5.85	......	29	26
5	7.32	......	32	23
6	9.15	......	35	20



Machinery

TABLE 3. CHANGE-GEAR DATA FOR SET OF FOUR GEARS

Feed No.	Feed Required	Ratio A and B	A	B	C	D	Ratio C and D
1	1.00	2.406	20	48	29	60	2.0785
2	1.34	....	..	..	35	54	1.5511
3	1.79	....	..	..	41	48	1.1576
4	2.40	....	..	..	48	41	.....
5	3.22	....	..	..	54	35	.....
6	4.32	....	..	..	60	29	.....
7	5.79	....	48	20	29	60	.....
8	7.75	....	..	..	35	54	.....
9	10.39	....	..	..	41	48	.....
10	13.93	....	..	..	48	41	.....
11	18.66	....	..	..	54	35	.....
12	25.01	....	..	..	60	29	.....



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four-gear trains, and then select the train that best meets requirements.

In Table 4 is given ratios for use in the computation of two-gear trains for two, four, six, eight, and ten changes, and for ratios of progression from 1.10 to 1.60. Tables 5, 6, 7, and 8 give ratios for the computation of four-gear trains, for eight, twelve, sixteen, and twenty changes. The following examples show how these tables and formulas are used in the computation of a two-gear and a four-gear train.

Change-gears of Two-gear Type

Assume that it is required to compute a two-gear train for six changes of feed. The ratio of progression is to be 1.25, and the slowest feed 3 inches per minute. This combination of known factors comes under Case (1), and the first thing that must be done is to complete the series and determine what the successive feeds will be. Doing this, the feeds required are found to be 3, 3.75, 4.68, 5.85, 7.32, and 9.15 inches per minute. The data for the gear set should then be set down as shown in Table 2, the required feeds being placed in the second column. Next a horizontal line should be drawn through the table to divide it into two equal parts, there being as many feed numbers above the line as there are below it. It is only necessary to calculate the gears for the feeds above the line, those feeds below the line being obtained by reversing the order of the gears listed above the line.

Referring to Table 4, we find five gear ratios in the column headed 1.25, but in the left-hand column headed "Number of Changes" we find that only the first three ratios are to be used in a gear set giving only six changes. These three ratios are placed in an inverted order in the third column of Table 2. In order to make Table 4 more compact, the gear ratios therein are given in inverted order, or in just the opposite order in which they are to be set down, as illustrated in Table 2.

The first of these ratios to be taken from Table 4 is 1.7469. Now using a slide-rule, set the left index of the C scale over 1.7469 on the D scale, and then look along the C scale until a whole number is found that exactly or nearly coincides with some whole number on the D scale. It will be found that 20 almost coincides with 35, 23 with 40, 24 with 42, 27 with 47, 28 with 49, etc. Any of these pairs of numbers may be used as the number of teeth in the two gears required to secure the first feed, but in order to keep the gear set as compact as possible, the first two, namely, 20 and 35, are chosen as the numbers of teeth in the first pair of gears. These numbers are entered in columns 4 and 5 of Table 2.

The total number of teeth in these two gears is 55; hence the total number of teeth in the gears of each succeeding pair must also total 55. In order to find the number of teeth in each of the two gears for the second feed, set the slide-rule to the second ratio, namely, 1.3975, and find the two numbers that most nearly coincide, whose sum is 55. These numbers, which are found to be 23 and 32 are entered in the table, the same as the first two were. Following the same method of procedure, the number of teeth in the driving and driven gear for the third feed are found to be 26 and 29, respectively, and these numbers are also entered in Table 2.

We now have the number of teeth required in each of the six gears to give the six changes of feed. Referring to Table 2, it will be seen that the six gears have 20, 23, 26, 29, 32, and 35 teeth, respectively. The gears for feed No. 3 when reversed will give feed No. 4, those for No. 2 reversed will give feed No. 5, and No. 1 reversed will give No. 6. With the gears thus calculated, it only remains to connect the driving and driven shafts of the gear train to the driving and driven members of the machine so that when the gears for any feed are in place, the driven member of the machine will move at the rate demanded by that feed. If this connection is right for one feed, it will be correct for all of them, and any of the six feeds desired may be obtained by using the gears as shown in Table 2.

TABLE 4. GEOMETRICAL PROGRESSION RATIOS FOR CHANGE-GEAR SETS (TWO-GEAR TRAIN)

Number of Changes	Ratio of Geometrical Progression									
	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.189
2	1.0488	1.0536	1.0583	1.0630	1.0677	1.0724	1.0770	1.0816	1.0863	1.0904
4	1.1537	1.1695	1.1853	1.2012	1.2172	1.2333	1.2494	1.2656	1.2818	1.2965
6	1.2690	1.2981	1.3276	1.3574	1.3876	1.4182	1.4493	1.4807	1.5125	1.5415
8	1.3959	1.4408	1.4868	1.5339	1.5818	1.6310	1.6812	1.7324	1.7848	1.8330
10	1.5355	1.5993	1.6653	1.7332	1.8032	1.8757	1.9502	2.0027	2.1060	2.1792
Number of Changes	Ratio of Geometrical Progression									
	1.20	1.21	1.22	1.23	1.24	1.25	1.26	1.27	1.28	1.30
2	1.0955	1.1000	1.1045	1.1090	1.1135	1.1180	1.1225	1.1270	1.1314	1.1402
4	1.3145	1.3310	1.3475	1.3642	1.3810	1.3975	1.4143	1.4312	1.4481	1.4822
6	1.5774	1.6105	1.6440	1.6780	1.7122	1.7469	1.7820	1.8176	1.8536	1.9269
8	1.8930	1.9488	2.0057	2.0639	2.1230	2.1836	2.2454	2.3083	2.3726	2.5049
10	2.2715	2.3580	2.4470	2.5386	2.6326	2.7296	2.8292	2.9322	3.0370	3.2564
Number of Changes	Ratio of Geometrical Progression									
	1.32	1.34	1.36	1.38	1.414	1.45	1.50	1.55	1.60	
2	1.1489	1.1576	1.1662	1.1747	1.1891	1.2041	1.2247	1.2450	1.2649	.....
4	1.5165	1.5511	1.5860	1.6211	1.6814	1.7460	1.8371	1.9297	2.0239	.....
6	2.0018	2.0785	2.1570	2.2372	2.3775	2.5320	2.7557	2.9910	3.2382	.....
8	2.6423	2.7850	2.9335	3.0874	3.6818	.....	.....	.....	.....	.....

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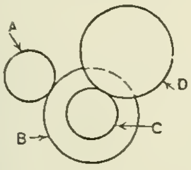
Change-gears of Four-gear Type

As an example illustrating the computations required in designing a change-gear set of the four-gear type, assume that a gear set providing for twelve changes of feed is to be designed. The slowest feed is to be 1 inch per minute and the highest 25 inches per minute. This combination of known factors comes under Case (2), and the first step is to find the ratio of progression. By employing Formula (1), the ratio of progression will be found to be 1.34. Completing the series, the twelve changes of feed required are found to be 1, 1.34, 1.79, 2.40, 3.22, 4.32, 5.79, 7.75, 10.39, 13.93,.18.66, and 25.01.

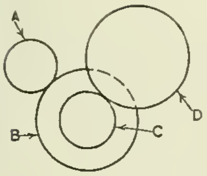
TABLE 5. CHANGE-GEAR RATIOS FOR EIGHT CHANGES IN GEOMETRIC PROGRESSION



Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progreasion	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progreasion	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
			1.150	1.3225	1.2333 1.0724	1.230	1.5130	1.3642 1.1090	1.340	1.7956	1.5510 1.1576
			1.160	1.3456	1.2494 1.0770	1.240	1.5377	1.3810 1.1135	1.360	1.8496	1.5860 1.1662
			1.170	1.3690	1.2656 1.0816	1.250	1.5625	1.3975 1.1180	1.380	1.9044	1.6211 1.1747
1.100	1.2100	1.1537 1.0488	1.180	1.3924	1.2818 1.0863	1.260	1.5876	1.4143 1.1225	1.414	1.9994	1.6812 1.1890
1.110	1.2321	1.1694 1.0535	1.189	1.4137	1.2965 1.0904	1.270	1.6130	1.4312 1.1270	1.450	2.1025	1.7460 1.2041
1.120	1.2544	1.1853 1.0583	1.200	1.4400	1.3145 1.0955	1.280	1.6384	1.4481 1.1314	1.500	2.2500	1.8371 1.2247
1.130	1.2770	1.2012 1.0630	1.210	1.4641	1.3310 1.1000	1.300	1.6900	1.4822 1.1402	1.550	2.4025	1.9297 1.2450
1.140	1.2996	1.2172 1.0677	1.220	1.4884	1.3475 1.1045	1.320	1.7424	1.5165 1.1489	1.600	2.5600	2.0239 1.2650

Machinery

TABLE 6. CHANGE-GEAR RATIOS FOR TWELVE CHANGES IN GEOMETRIC PROGRESSION



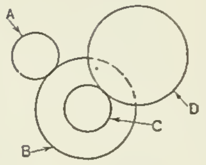
Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A aod B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
			1.150	1.5209	1.4182 1.2333 1.0724	1.230	1.8610	1.6780 1.3642 1.1090	1.340	2.4060	2.0785 1.5511 1.1576
			1.160	1.5609	1.4493 1.2494 1.0770	1.240	1.9066	1.7122 1.3810 1.1135	1.360	2.5155	2.1570 1.5860 1.1662
			1.170	1.6017	1.4807 1.2656 1.0814	1.250	1.9531	1.7469 1.3975 1.1180	1.380	2.6280	2.2372 1.6211 1.1747
1.100	1.3310	1.2690 1.1537 1.0488	1.180	1.6430	1.5125 1.2820 1.0863	1.260	2.0004	1.7820 1.4143 1.1225	1.414	2.8271	2.3775 1.6814 1.1891
1.110	1.3676	1.2981 1.1695 1.0536	1.189	1.6810	1.5410 1.2965 1.0904	1.270	2.0483	1.8176 1.4312 1.1270	1.450	3.0487	2.5320 1.7460 1.2040
1.120	1.4050	1.3276 1.1853 1.0583	1.200	1.7280	1.5774 1.3145 1.0955	1.280	2.0970	1.8530 1.4481 1.1314	1.500	3.3750	2.7557 1.8370 1.2247
1.130	1.4429	1.3574 1.2012 1.0630	1.210	1.7710	1.6105 1.3310 1.1000	1.300	2.1970	1.9270 1.4822 1.1402	1.550	3.7238	2.9910 1.9297 1.2450
1.140	1.4815	1.3876 1.2172 1.0677	1.220	1.8160	1.6440 1.3478 1.1045	1.320	2.2999	2.0020 1.5165 1.1489	1.600	4.0960	3.2382 2.0239 1.2649

Machinery

Table 3 should next be prepared for a train of four gears, the twelve feeds being entered in the second column. In this case, three horizontal lines should be drawn across the table to divide it into four equal parts. It is only necessary to calculate the gears for one of these parts, the other feeds being obtained by reversing and interchanging these gears. Referring to Table 6, it is found that for a ratio of progression of 1.34, the ratio of the *A* and *B* gears is 2.406, and the three ratios for the *C* and *D* gears are 2.0785, 1.5511, and 1.1576. These ratios should be entered in the third and eighth columns of Table 3.

Now by setting the slide-rule to 2.406, as described in the preceding example, it is found that gears with 20 and 48 teeth may be used for the *A* and *B* gears. These numbers are entered in the fourth and fifth columns of the table. Similarly, the number of teeth in each of the three sets of *C* and *D* gears are found to be 29 and 60, 35 and 54, and 41 and 48. These numbers are entered in the sixth and seventh columns of the table, as shown. The *C* and *D* gears for feed No. 3 reversed will give feed No. 4. The *C* and *D* gears for No. 2 reversed will give feed No. 5, and those for No. 1 reversed will give feed No. 6. Feeds 7 to 12, inclusive, are obtained by reversing the *A* and *B* gears, and using the *C* and *D* gears in the same combinations as for the first six feeds.

TABLE 7. CHANGE-GEAR RATIOS FOR SIXTEEN CHANGES IN GEOMETRIC PROGRESSION



Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
			1.16	1.8107	1.6812 1.4493 1.2494 1.0770	1.240	2.3642	2.1230 1.7122 1.3806 1.1136
			1.17	1.8740	1.7324 1.4807 1.2656 1.0816	1.250	2.4414	2.1836 1.7470 1.3975 1.1180
1.10	1.4640	1.3960 1.2690 1.1537 1.0488	1.180	1.9387	1.7848 1.5125 1.2818 1.0863	1.26	2.5205	2.2454 1.7820 1.4143 1.1225
1.11	1.5180	1.4408 1.2981 1.1695 1.0536	1.189	1.9986	1.8330 1.5415 1.2965 1.0904	1.27	2.6014	2.3083 1.8176 1.4312 1.1270
1.12	1.5736	1.4868 1.3276 1.1853 1.0583	1.200	2.0736	1.8930 1.5774 1.3145 1.0955	1.28	2.6844	2.3726 1.8536 1.4481 1.1314
1.13	1.6305	1.5338 1.3574 1.2012 1.0630	1.210	2.1437	1.9488 1.6105 1.3310 1.1000	1.30	2.8560	2.5049 1.9269 1.4822 1.1402
1.14	1.6890	1.5818 1.3876 1.2172 1.0677	1.220	2.2153	2.0057 1.6440 1.3475 1.1045	1.32	3.0359	2.6423 2.0018 1.5165 1.1489
1.15	1.7490	1.6310 1.4183 1.2333 1.0725	1.230	2.2890	2.0639 1.6780 1.3642 1.1090	1.34	3.2240	2.7850 2.0785 1.5511 1.1576

Machinery

The number of teeth in each of the eight gears required to secure the twelve changes are 20, 29, 35, 41, 48, 48, 54, and 60. With these gears provided, it is only necessary to connect the driving and driven shafts of the gear train to the driving and driven members of the machine, so that when the gears for any feed are in place, the driven member of the machine will move at the rate intended for that feed. If this connection is right for one feed, it will be right for all of them, and any of the twelve feeds desired may be obtained by using the proper gears as given in the table.

The general procedure for the computation of gear sets for a different number of changes than those dealt with in the preceding examples is substantially the same. The main point to be observed is that the table giving the feed numbers in the first column should be divided into two or four equal portions, according to the type of gear train used, that is, whether a two- or four-gear train is to be used, the gears for one of these parts are calculated by means of the ratios in the tables, remaining changes being obtained by reversing these gears. The procedure is very simple, and when once understood is not easily forgotten.

It should be understood that these tables and formulas refer primarily to change-gears mounted on shafts or studs having fixed center distances. As the center distances are fixed, the exact speed or feed desired is not always obtainable; however, this error will rarely exceed 1 per cent. If greater exactness is desired, a four-gear train will be required, and the stud carrying the idler gears must be mounted on a swinging arm so that it will not be necessary to maintain a fixed center distance. The ratios given in the tables apply to this type of construction as well as to that of the fixed-center type.

The ratios given in the tables are also applicable to certain types of quick change-gears. For instance, they apply to that type which consists of two intermeshing nests of cone gears having a sliding key in the shaft that supports one of the cones. With this type of gearing any gear may be made to act as the driver by sliding the key into such a position that it meshes with that particular gear. The computation of this type of gearing is the same as that for a two-gear train of the "pick-off" type, the only difference being that it is necessary to use double the number of gears.

* * *

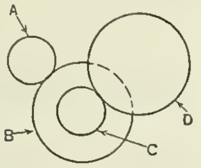
LEARNING THE PATTERNMAKING TRADE

By M. E. DUGGAN

The writer has often been asked to advise young men as to where and how they can learn the patternmaking trade. Perhaps the best way to answer this question would be to cite the case of a young man who began his patternmaking apprenticeship under the direction of the writer when the latter was engaged as foreman patternmaker in a small manufacturing plant.

The young man was employed in the drafting department, and his frequent visits to the pattern shop, where he closely observed the work of the patternmakers, gave him a desire to learn the trade. Accordingly, he took the matter up with the master mechanic, who granted him permission to make the change. The pattern shop was a small one, employing at most not more than three journeymen patternmakers. The patterns were made only for the company's own use, and the plant was located at a considerable distance from any foundry.

TABLE 8. CHANGE-GEAR RATIOS FOR TWENTY CHANGES IN GEOMETRIC PROGRESSION

Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
			1.14	1.9253	1.8032 1.5818 1.3876 1.2172 1.0677	1.200	2.4883	2.2715 1.8930 1.5774 1.3145 1.0955
			1.15	2.0114	1.8757 1.6310 1.4182 1.2333 1.0724	1.210	2.5940	2.3580 1.9488 1.6105 1.3310 1.1000
1.10	1.6104	1.5355 1.3959 1.2690 1.1537 1.0488	1.160	2.1004	1.9502 1.6812 1.4493 1.2494 1.0770	1.22	2.7027	2.4470 2.0057 1.6440 1.3475 1.1045
1.11	1.6750	1.5993 1.4409 1.2981 1.1695 1.0536	1.170	2.1925	2.0027 1.7324 1.4807 1.2656 1.0816	1.23	2.8155	2.5386 2.0639 1.6780 1.3641 1.1090
1.12	1.7624	1.6653 1.4868 1.3276 1.1853 1.0583	1.180	2.2877	2.1060 1.7848 1.5125 1.2818 1.0863	1.24	2.9316	2.6326 2.1230 1.7120 1.3810 1.1135
1.13	1.8424	1.7332 1.5339 1.3574 1.2012 1.0630	1.189	2.3763	2.1792 1.8330 1.5416 1.2965 1.0904	1.25	3.0518	2.7296 2.1837 1.7465 1.3972 1.1178

Machinery

It was evident that the opportunities at this plant for studying the methods of different patternmakers were limited. The variety of patterns made was also limited, and there was no opportunity to study practical molding methods in the foundry in connection with patternmaking practice. For these reasons, the writer did not care to advise the young man to take up the patternmaking trade in this plant, but thought it would be better for him to go to a larger plant, if possible. However, arrangements were made for him to enter the patternmaking shop. He proved to be a hard worker and a student, and each day became more attached to his work.

One morning a notice was received from the master mechanic of the plant to the effect that the existing business conditions made it necessary to lay off the apprentice patternmaker. This was a hard blow to the young man, who had then been at work in the pattern shop for nearly a year. After thinking the matter over, he came to the writer and offered his services for just one-half the wage he was then receiving. As he had a good home with his parents, it was possible for him to do this.

Now the young men who are learning, or thinking about learning, the patternmaking trade would do well to seriously consider the writer's answer to the proposal made by the apprentice patternmaker. This answer was: "No. The time is ripe for you to make a change into a larger and more modern shop, employing from ten to twenty first-class patternmakers. There should be a foundry connected with it. If it is your good fortune to connect with a company having a pattern shop and foundry combined, arrange with your employer to be allowed to spend the first six months in the foundry, and the following six months in the core-room. Win the good will of the workmen in this department, because it is from these men that you will obtain practical information on molding and core-making practice. In this foundry you will see hundreds of patterns of all kinds and construction, made by hundreds of different journeymen and apprentice patternmakers. Study the construction of these patterns and note whether they meet the requirements of the molder and core-maker satisfactorily. Also study the patterns that prove impractical in the molding room or foundry, so that you may be able to avoid the mistakes made in the construction of these patterns."

Continuing, the writer said: "Go into the pattern shop as an apprentice at the end of the year spent in the foundry and core-room. Here it is necessary to study the methods of the journeymen patternmakers and note how they construct their patterns. It is essential to gain the friendship of these men also, as it is principally from them that instructions and information are to be obtained, and not exclusively from the foreman, as some apprentices are led to believe. At the end of the four-years' apprenticeship, if you have not become a practical patternmaker, then the fault is your own.

Do not think, however, that in four years it is possible to have learned all there is to know about molding, core-making, and patternmaking. Become a reader of technical journals. In them many articles that are both interesting and instructive are to be found. The student who reads the best technical journals relating to his work will learn that some other fellow often has a way of doing things that he can employ to good advantage in his own work."

The foregoing advice was followed by the young man, and today he is in charge of the pattern department in one of the largest manufacturing plants in the country.

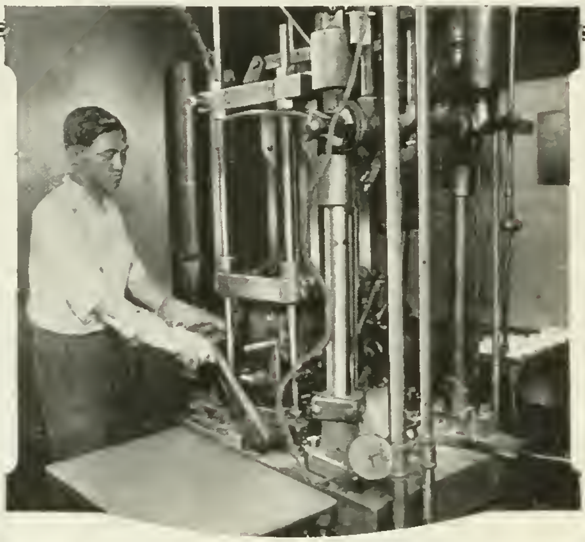
* * *

CARELESSNESS AND ACCIDENTS

A brief analysis of the accidents in a number of textile mills revealed the fact that at the present time most accidents do not occur in connection with the operation of machinery at all. In a woolen mill in Lawrence, Mass., 78 per cent of the lost time due to accidents was from causes that had no connection with machinery. In a cotton mill in the same city, over 82 per cent were due to other causes, and in three other mills, accidents due to machinery were only 15, 16, and 18 per cent, respectively, of the total. Even the comparatively small percentage of accidents due to machinery could be considerably reduced, because from 20 to 25 per cent of these accidents were caused by attempts to clean machinery while it was in motion—an inexcusable carelessness. Accidents due to machinery are becoming comparatively less and less frequent, because most modern machinery is now equipped with gear guards, interlocking safety devices, belt shifters, and other devices that automatically prevent accidents, and those accidents that still occur are very largely due to lack of care on the part of the operator, and can be guarded against only by continued vigilance and instruction.

Die-casting Dies and their Design

BY CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



IN previous articles on this subject, the author has discussed the principles affecting the construction of dies for die-casting, and has described recommended practice in the production of die-castings. The next logical step is to present examples showing the application of the principles stated. This is done in the present article, which contains a description of the most important points of design and construction in a number of die-casting dies. These designs are intended to show, as completely as possible, the methods that may be employed for die-casting white metals into parts of various designs. Practically all die-cast parts contain some special problem, and each must be worked out with the aid of knowledge gained by long experience in the art.

Casting Produced by Sectional Coring

Dies for the fan case of a vacuum sweeper, shown in Fig. 1, form an interesting example of sectional coring. This fan case is an aluminum casting and it will be recognized among the collection of parts shown in Fig. 2. A plan view and sectional view of the ejector die are shown in Fig. 1, as well as a partial view of the cover die through the die impression that produces the angular spout *A*. The problem in this case is the coring of the interior. This is accomplished by a cylindrical core *B* on the end of which is the sprue-cutter; core *B* also embodies sectional cores to form the remainder of the interior. This central core has a key for locating the master section *C*, which, after the central core has been removed, can be drawn radially toward the center. This permits the other core sections to collapse and fall from the casting.

After the central core has been brought into position, the various sections are located around it (including the angular core for the spout), and locked by slides *D* and *E*, which engage grooves in the sections. The pinion for withdrawing the angular core is located at *F*. The ejector die is built out so that the locking projection on the cover die will have a bearing surface on the ejector die at *G*. The dies as well as the central core, are water-cooled. The cooling of the core is accomplished by passing a water pipe into a central hole that is larger in diameter than the pipe, so that the water can drain out around the outside, as shown in the left-hand sectional view.

The assembled sections which fit around the central core also produce a large hole in the fan case. The smaller hole,

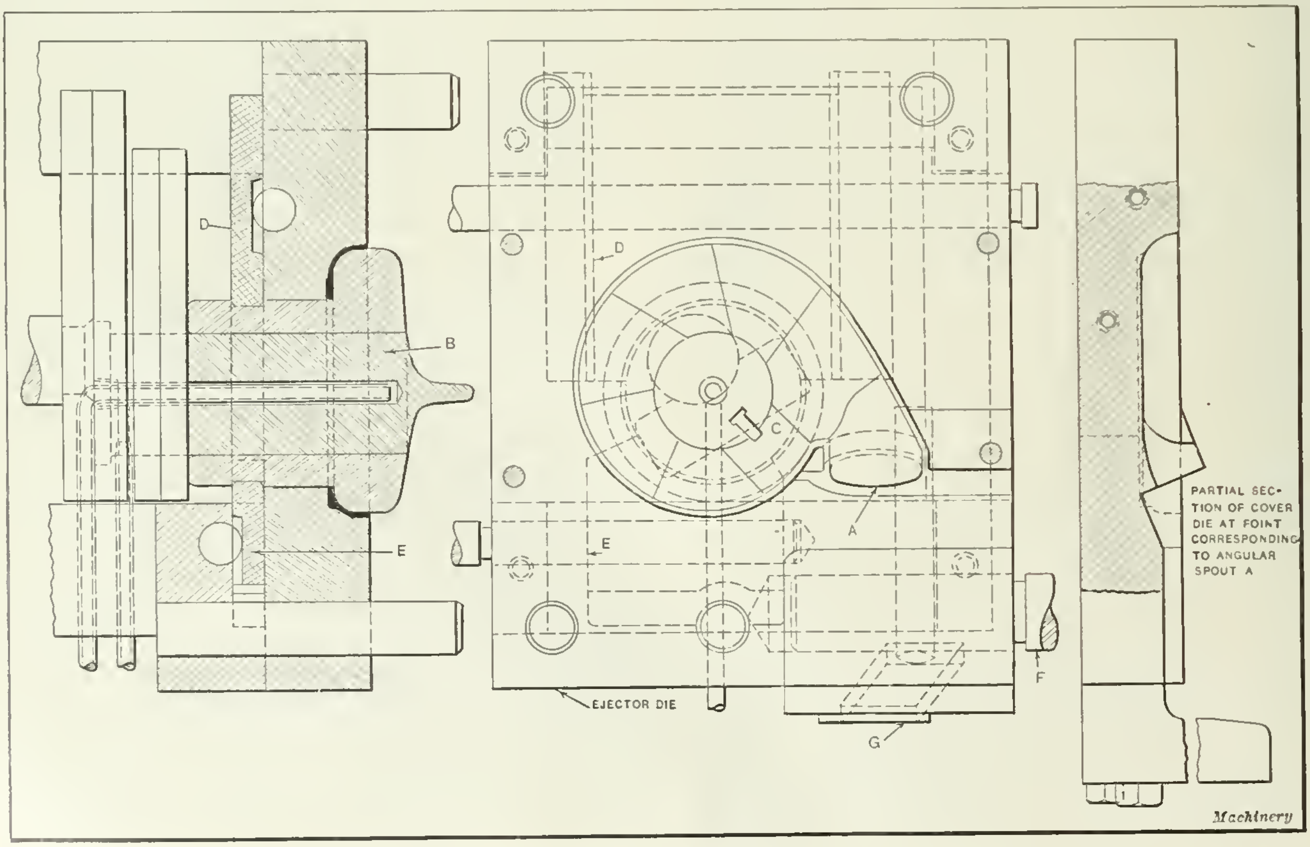

D
B
E
D
C
A
E
F
G
EJECTOR DIE
PARTIAL SECTION OF COVER DIE AT POINT CORRESPONDING TO ANGULAR SPOUT A
Machinery

Fig. 1. Plan and Sectional Views of Die for casting Aluminum Fan Case for a Vacuum Sweeper

however, at the front, is not cast through, but its location is indicated in the casting by a slight projection (not great enough to show in the illustration) on the end of core *B*. This thins the metal at the center of the piece so that the hole can be easily punched out in a subsequent operation.

Curved and Angular Coring

An example of core drawing and arrangement that may prove of interest is that used in casting an attachment nozzle for a well-known make of vacuum sweeper. A view of this nozzle is shown at the left in Fig. 2. A detailed drawing of the nozzle is shown in Fig. 3, as well as sectional views of the ejector and cover dies, arranged in the correct relation to each other. The interior of this aluminum casting is produced by two cores, one of which *A* is drawn at an angle by the pinion shown, and the other *B* on a curve, also by a pinion. This special curved core and the angular core are dovetailed together. The shape of the two cores at different portions of this tongue and groove is indicated by sections *C–C*, *D–D*, and *E–E*.

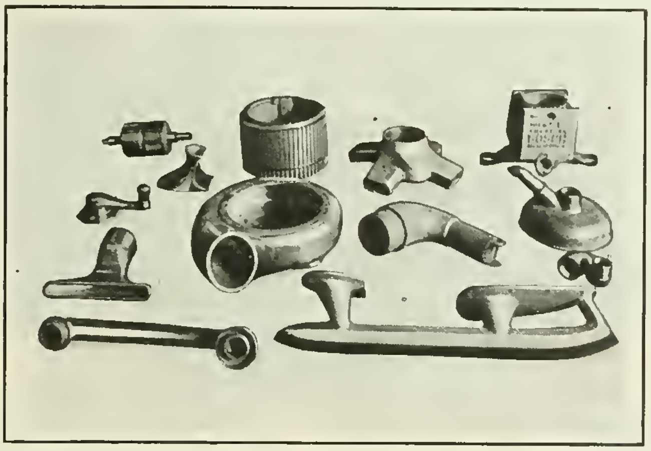


Fig. 2. Interesting Examples of Die-casting

The circular core *B* is locked in position after being slid over core *A* by a wedge *H*, which is operated by a pinion to advance it against the lower end of the curved core. This is the position shown in the illustration. The sprue-cutter *J* is located in back of the angular core, and the metal is fed to the dies through a gate *G* formed by both die members at the end of the casting. This is a case where the location of the gate must be such that the removal of the connecting metal will not impair the appearance of the casting. The cover die is cut out at *F* to fit over the ejector die and seal the mold, the two halves of which are aligned by posts in the regular way.

Dies for Aluminum Skate with Steel Blade Cast in

The skate shown in Fig. 4 is a unique design of die-casting construction in which a steel blade *A* is cast in place. An insert of this kind is rather unusual. The blade is machined with dovetailed slots for anchorage purposes. The location of the two large cores for forming the heel and toe may be seen in the illustration, as well as the position of the gate for feeding metal to the runner portion, heel, and toe. The proportionate size of the feeders to these parts of the skate should be noted.

The dies for casting these skates contain other special features besides the insert, as shown in Fig. 5. They are adjustable for three sizes, insert pieces being used to make up the difference in length. A partial section view of the ejector die and a sectional view of the cover die are shown, these two views being placed in the relation to each other that they would occupy just before closing. As indicated in Fig. 4, there are two large cores used to form the heel and the toe, and the section of the ejector die is taken through the heel core which is designated at *A*. These two large cores are operated in the regular way by a rack and pinion, but they have a special arrangement for casting the small screw holes. This is done by means of cores *B*, which are operated in conjunction with the large cores in the manner described in the following:

When the pinion *C* is turned, the small cores, the large conical core, and the steel piece *D* are withdrawn. The construction provides for an independent movement for the small cores to permit withdrawing them below the surface of the main core, at which time a shoulder on the piece *D* is locked against a corresponding shoulder on the main core which is then withdrawn as the pinion continues to be turned.

The parting line of the die is cut away to provide a seat for the insert blade *E*, which, when properly located, is clamped from the end by a suitable slide. The two dies are aligned by two posts, and a shoulder formed on the two members seals the cavity. This arrangement keeps the dies in accurate alignment, after which they are clamped together by a handle extending from the cover die. The

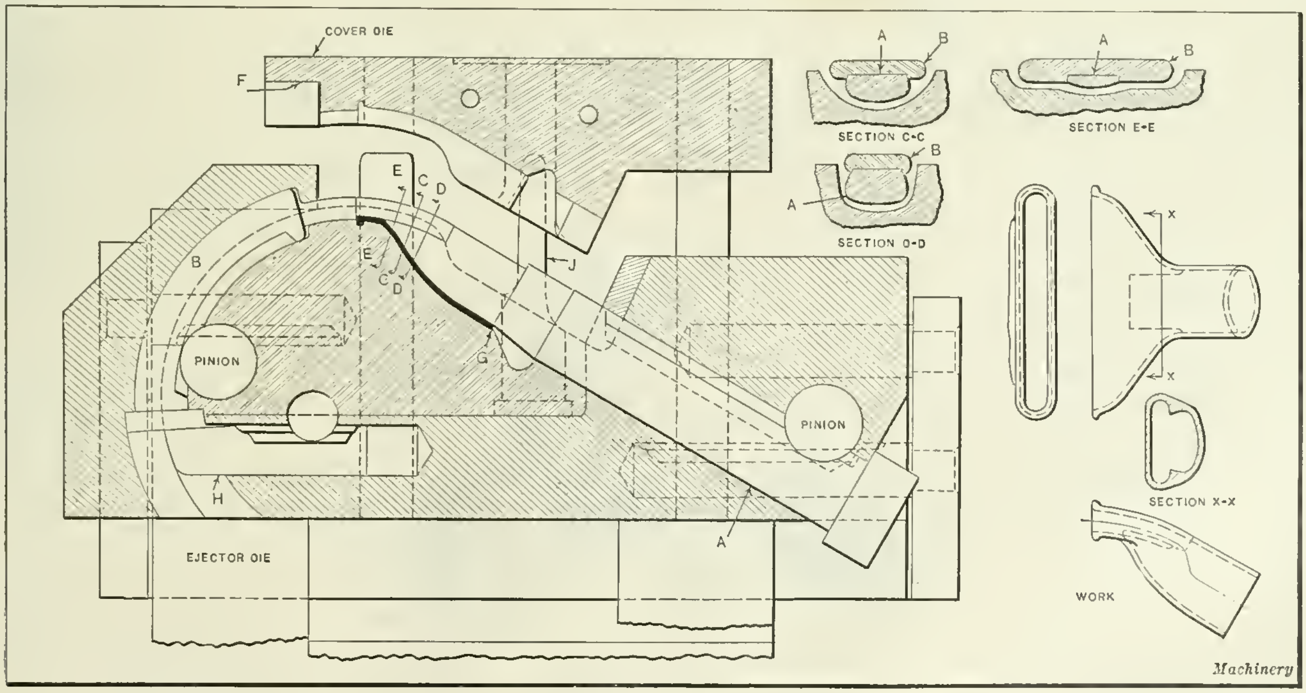


Fig. 3. Sectional Views of Ejector and Cover Dies for casting an Aluminum Attachment Nozzle for a Vacuum Sweeper; also Views of the Work

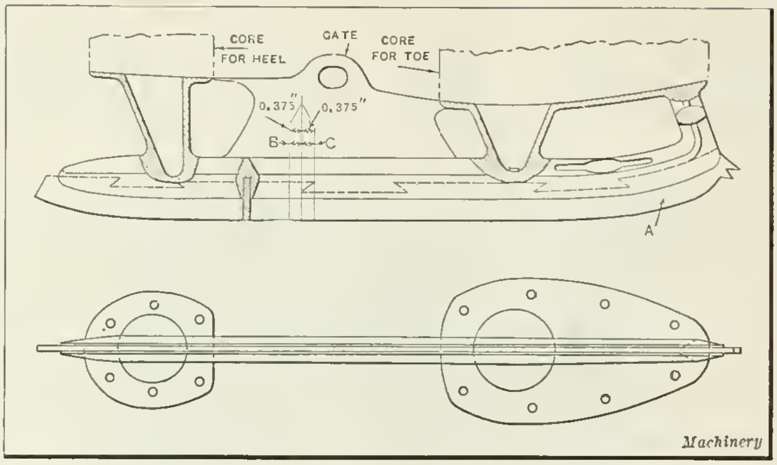


Fig. 4. Aluminum Hockey Skate with Steel Blade cast in Place

adjustable pieces for changing the over-all length of the die impression are 3/8 inch wide, and are set in at *B* and *C* (Fig. 4), elongated slots being provided in the die for properly clamping the adjustable heel sections for different sizes.

In locating the ejector-pins for this casting, several are arranged to bear against the blade, two oval-shaped ones against the thin edge of the toe portion, and one oval-shaped one *H* (see Fig. 5) against the thin edge of the heel portion. Ejector-pins are also used to bear against the gate, and they all move in unison from a common ejector-plate. The sectional view at the right indicates by the space around the base of the sprue-cutter *F*, the sectional shape of the gate. Two of the ejector-pins are shown at *G*, one bearing against the blade and the other against the gate. This gate, of course, is cut off in a subsequent operation. Both die members are water-cooled, the entrance of the water lines being shown in the sectional view of the die at the left in the illustration.

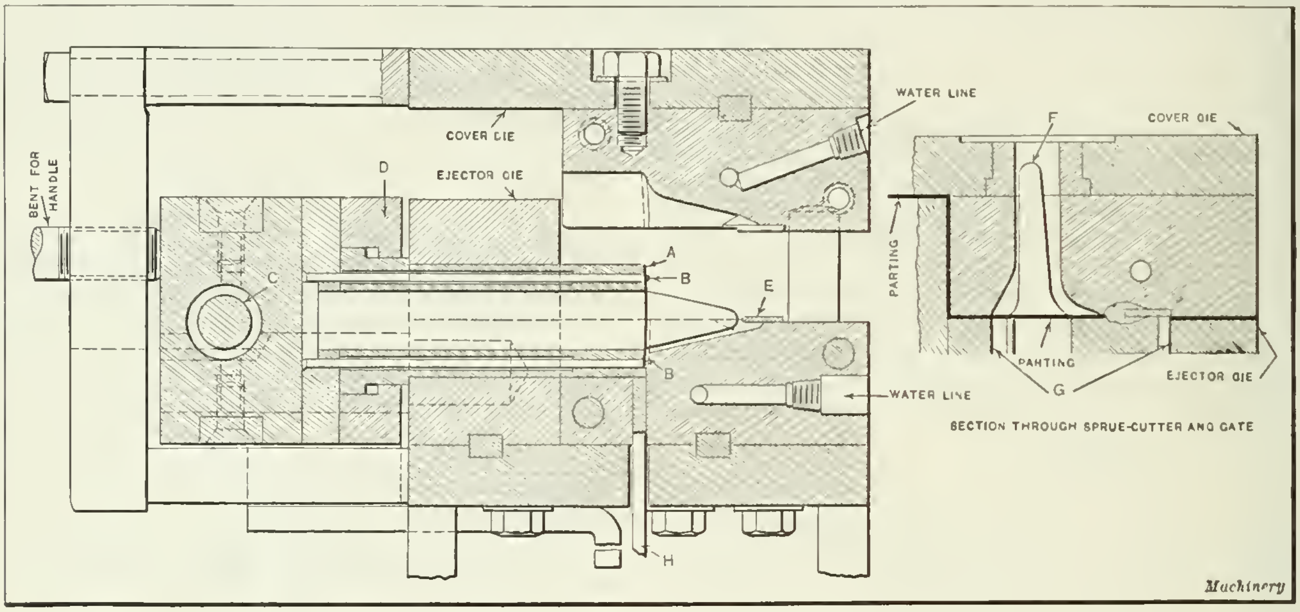


Fig. 5. Sectional Views of Cover and Ejector Dies for Hockey Skate

Other Interesting Designs

The automobile steering wheel hub shown in the collection of parts, Fig. 2, is cast with a bearing insert in the central hole. Four angular cores are employed to form the sockets for the wooden wheel spokes. Another good example of die-casting is the large graphophone tone-arm shown directly beneath this hub. This tone-arm has a tapered elbow, produced by two cores drawn from the ends and a third section at the elbow. The three cores fit together in such a way that as much as possible is cast by each end core, the third section remaining in the casting until knocked out through the large end. This can be done without difficulty because the elbow is tapered.

A third casting of interesting design is the drum for a hand knitting machine shown in the upper row of parts. This knitting machine drum is a good example of the saving that results from die-casting parts that otherwise would involve expensive and difficult machining work. In fact, the saving of machining expense, as is well known, is one of the strongest arguments in favor of die-casting. In the case in question, the drum has a large number of narrow slots which must be of accurate width, as the needles that carry the yarn operate in these slots. The exterior of the drum must also have a good finish. All this machining work is obviated by the successful die-casting of the drum, on which no subsequent machine work is required.

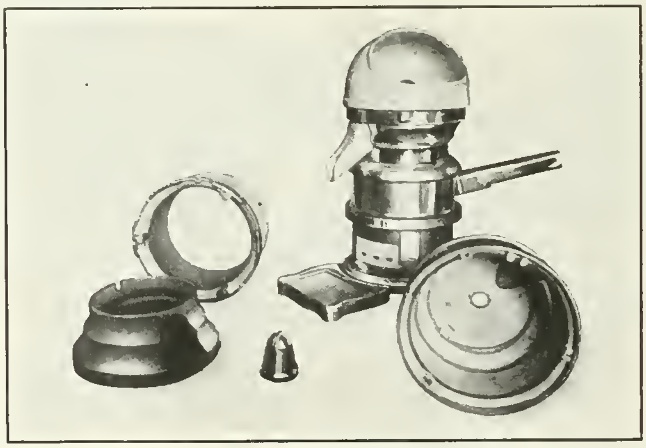


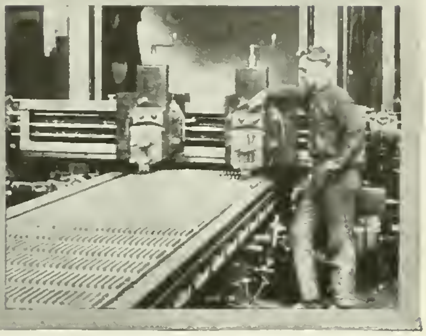
Fig. 6. Fruit Juice Extractor, the Principal Parts of which are Aluminum Die-castings

Fig. 6 shows a good example of what can be done with die-castings. Here, practically all the important parts of an aluminum fruit juice extractor are made by die-casting.

* * *

The Machine Tool Trades Association, having 135 members, and representing about 75 per cent of the machine tool makers of England, has decided to hold the next machine tool exhibition from September 5 to 27, 1924, in Olympia; it is expected that by that time improved trade conditions will make the exhibition even more successful than that held in 1920.

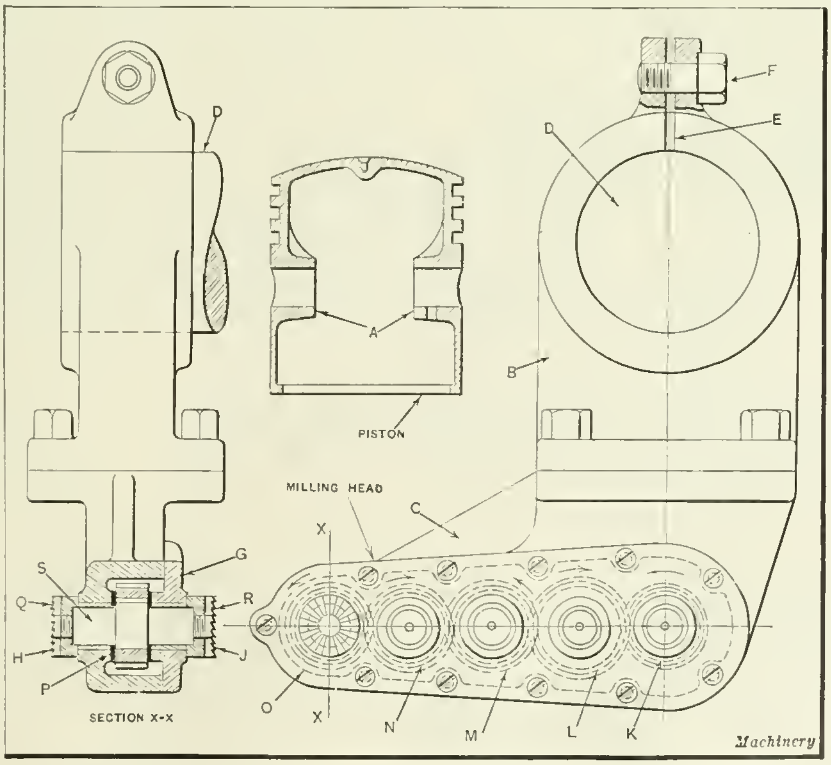
Letters on Practical Subjects



OFFSET MILLING HEAD FOR FACING PISTON BOSSES

The offset milling head shown in the accompanying illustration was designed primarily for facing operations on piston wrist-pin bosses such as shown at *A*. In addition to performing this work satisfactorily, the attachment has also proved useful in facing internal bosses on other automobile parts, such as the bosses cast on the inside of differential gear-cases. Cast-iron bracket *B*, which supports the offset head *C*, is bored to a sliding fit on the over-arm *D*. This bracket is split at *E* and is clamped to the over-arm by means of nut *F*. The offset head *C* is a brass casting which, in combination with the brass cover *G*, entirely encloses the train of gears that drive the cutters *H* and *J*. The elongated bosses on the inner sides of the offset head and its cover *G* are bored out to receive the bushings on which the five gears *K*, *L*, *M*, *N*, and *O* are mounted.

Between the inner ends of the bosses and the sides of the gears are placed bronze washers, such as shown at *P*. The shafts on which the gears rotate are ground to a good running fit in the bushing and are made a tight press fit in the gears. Keys are also used to prevent the gears from slipping on their shafts. The three shafts in the center of the offset head are equal in length to the combined thickness of the head and its cover plate. The shaft that is in line with the over-arm support terminates, on the rear side of the housing, in a tapered shank which fits the spindle of the milling machine. This shaft and its attached gear serve to drive the milling cutters *Q* and *R* through the intermediate gears, *L*, *M* and *N*. A right-hand thread is cut in the hole in cutter *R* and a left-hand thread in cutter *Q*. The cutters are tightened against shoulders on the shaft *S* so that a slight clearance is left between the housing and the inner faces of the cutters. Pin-holes are drilled in the cylindrical bodies of the cutters to facilitate tightening them on the shaft.



Milling Machine Attachment used in finishing the Faces of Bosses such as shown at A

As the thickness of the cutters is reduced by regrinding, shims are placed in back of them so that the required distance between the faces of the milling cutters is maintained. Before assembling cover *G* on the offset head, transmission oil is poured into the housing, and a gasket is placed between the cover and the housing so that the oil cannot leak out when the attachment is in operation.

Brooklyn, N. Y. JOHN A. HONEGGER

MACHINING BUSHINGS ON A VERTICAL DRILLING MACHINE

The writer was recently employed in a factory where large quantities of cast-iron parts were made. In this plant thirty turret lathes were kept in continuous operation on different parts. In fact, the lathes were so crowded with work that they were kept running from twelve to fourteen hours a day. In the department with the turret lathes there were three vertical drilling machines that stood idle most of the time. So the foreman of the department decided to use these machines for some of the work regularly done on the turret lathes. Accordingly, he devised the tools described in the following for machining the cast-iron guide bushing shown at *C* in Fig. 1. The required production on this job was 500 finished parts per day. This necessitated the continuous operation of two turret lathes.

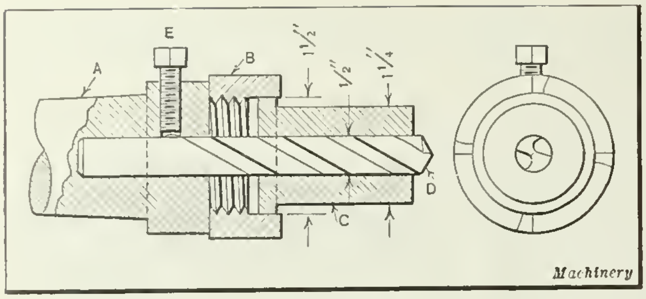


Fig. 1. Tool used on Vertical Drilling Machine for First Operation on Bushing C

The bushing was machined in three operations on the vertical drilling machine, although, by making a slight change in the tool used for the first operation, the work could have been done in only two set-ups, as was the case when machining the part on a turret lathe. It is evident that the facing tool shown in Fig. 2 could have been combined in some way with the tool *B*, Fig. 1. In the first operation, tool *B* turns or hollow-mills the 1½-inch diameter of bushing *C* and drills the ½-inch hole. The tool-holder *A* is made of machine steel, one end being tapered to fit the spindle of the drilling machine, and the other drilled to take a standard twist drill, which is held in place by the set-screw *E*. The hollow mill *B* is made of high-speed tool steel and threaded to fit the end of shank *A*.

In Fig. 2 is shown the attachment used for the second operation, namely, facing the flanged end of the bushing. The same shank *A* as was used in the first operation is employed to hold the cutters *K*, which are made of high-speed steel and held in place by set-screws, as shown. A steel pilot about 0.495 inch in diameter is used to steady this tool and prevent chattering. The tool used to turn the 1¼-inch diameter and face the flange and the opposite end of the bushing is shown in Fig. 3. It consists of two turning tools *I*, one facing tool *J*, two adjusting screws *L*, four set-screws, an upright pilot *H*, 0.495 inch in diameter, and a cast-iron body *F*.

In the first operation, the work is held in a wrenchless three-jaw chuck (not shown) which is attached to the table of the drilling machine. The machine is run on the third speed, the drill *D*, Fig. 1, being used to drill the hole and also to serve as a pilot while the flange is being turned by the hollow mill *B*. In the second operation, cutters *K* are assembled on shank *A*, as shown in Fig. 2. The second speed of the drilling machine is used for this operation, and the chuck employed in the first operation is used to hold the work.

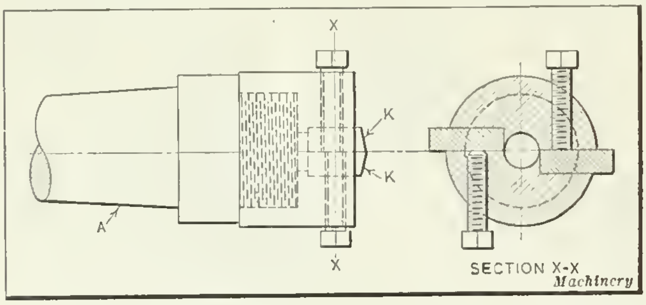


Fig. 2. Tool used for Second Operation on Bushing shown in Fig. 1

In the third operation, the 1¼-inch diameter is turned, the inside of the flange faced, and the opposite end of the bushing faced. A special pair of jaws *G* shown in Fig. 3 is used to hold the work during this operation. The lower face *M* of these jaws serves as a positive stop for locating the work, and the facing stop of the drilling machine spindle is set in the regular way to insure machining all bushings to a uniform length. In this or either of the two preceding operations, it is not necessary to use the power feed, as good results are obtained by using the hand feed only.

The most essential point to bear in mind in operating the tools shown in Fig. 3 is to keep the cutters *I* ground so that each will take the same depth of cut. The sides of these tools have a shaving action that gives a smooth finish. The use of the vertical drilling machine, as described, relieved the turret lathes of some of their excess work, and it was found that the production rate was 30 per cent greater than with the turret lathes. With the latter it was necessary to stop the machines in order to remove a finished part and put in an unfinished piece, whereas with the drilling machines, the work could be removed and a new piece inserted without stopping the machine spindle.

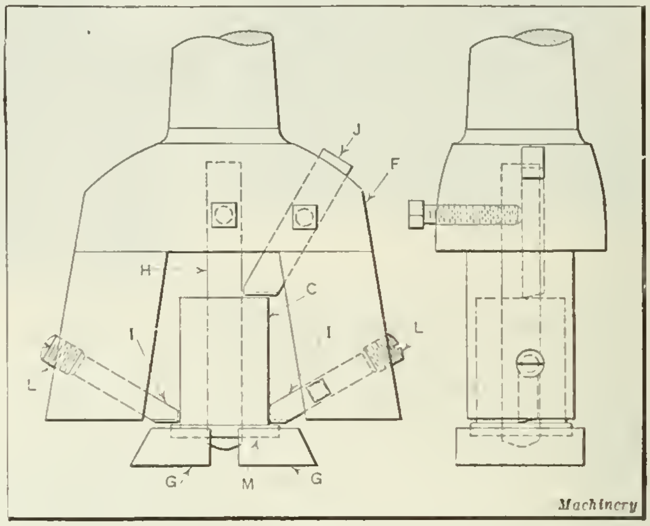


Fig. 3. Facing Tool employed on Vertical Drilling Machine

Cicero, Ill. JOHN J. BORKENHAGEN

SKELETON PATTERNS FOR WATER-PIPE JOINT RING

Skeleton patterns and core-boxes of the type used in making the mold for the water-pipe joint ring shown in Fig. 1 may be used to advantage in the production of a variety of castings. In this case only one casting was required, but it was necessary that it be produced quickly. As no machine work was to be done on the casting, it was required to be quite accurate as to size and form.

To have made a full ring pattern, split through the middle, as was originally intended (the pattern to be molded on edge with the center formed by a core made in a core-box) would have necessitated the use of a large amount of lumber and consumed considerable time. To construct the pattern with the idea of molding the ring on its side in green sand is, in the writer's opinion, both impracticable and a waste of time. Instead of using this method, the ring was molded and cast in dry sand cores.

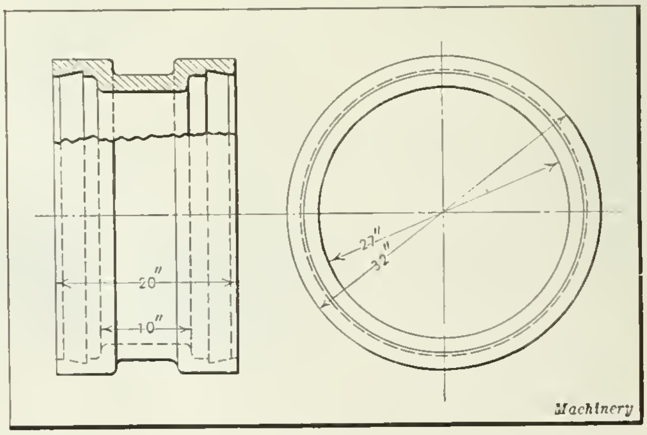


Fig. 1. Water-pipe Joint Ring

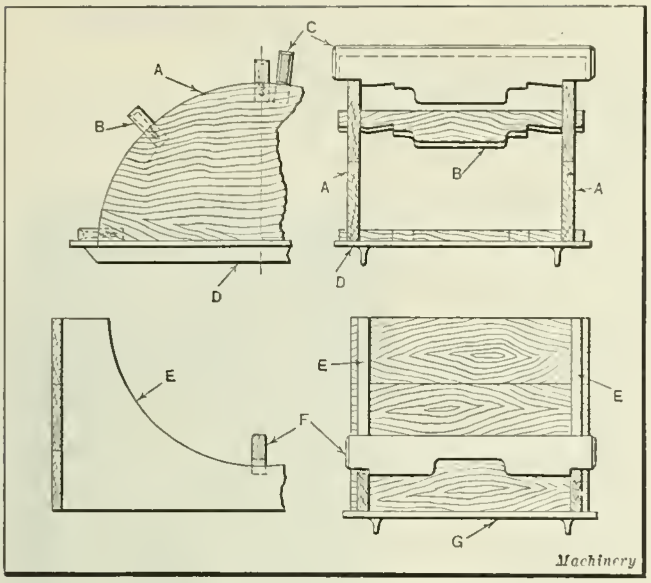


Fig. 2. Skeleton Molds used in making Ring Casting shown in Fig. 1

The skeleton pattern or core-boxes used in making the mold are shown in Fig. 2. Two half-circular sides *A* were used in making the core that formed the inside of the ring. The sides were held together by five tie-pieces like the one shown at *B*. The tie-pieces, together with the strickle board *C*, were cut at one time on the band saw to the same shape as the inside of the ring, and the tie-pieces were fastened in place by screws.

The skeleton half-core box is shown on the dryer plate *D* ready for making the half-core. The procedure in making the core was as follows: Two or three inches of sand was shoveled on the dryer plate and roughly leveled off. On this bed of sand was placed round or square iron rods, which were rammed up and baked in the core to give the mold the necessary strength. Without these pieces, the core would be likely to fall apart when handled. The sand was then filled in between the sides or ends *A* of the skeleton frame, and smoothed off or formed with the strickle board shown at *C*. Two half-cores produced in this manner were baked in the core oven, after which they were pasted and wired together to form the full inside core. Attention should be called to a mistake that was made in constructing the original skeleton core-box, which caused a delay in the work. Instead of cutting the five tie-pieces to the shape of the inside of the ring, the patternmaker made them plain and straight across on their faces. This mistake was discovered, however, and the skeleton box returned to the patternmaker for correction. However, the correction could easily have been made in the core-room by simply removing one tie-piece at a time, filling in sand, going over the spot with the strickle board, and then replacing the tie-piece.

The skeleton box used in making the outside section of the dry sand mold is shown in the two lower views, Fig. 2. The side or end boards *E* were sawed to shape on the band saw, but in this case, the strickle *F* is shaped to correspond with the outside of the work. The two outside half sections required to complete the outer member of the mold were made in the same manner as the inner core, the half members being molded on the core-plate *G*. After being baked, the half members were pasted and wired together to form the complete outer member of the mold.

Kenosha, Wis. M. E. Dugoan

LABORATORY TESTS REDUCE GRINDING WHEEL EXPENSE

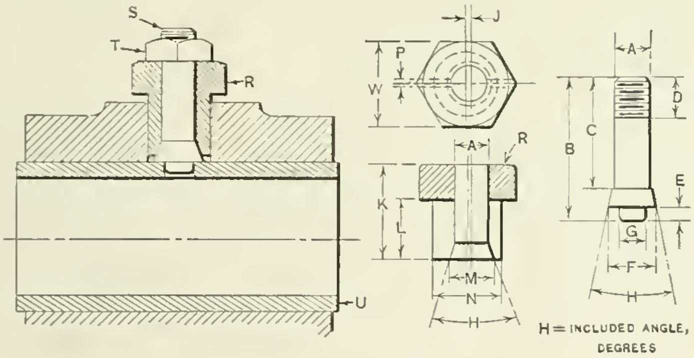
In a certain plant about one thousand grinding wheels (costing $30 apiece) were used each year in performing a special grinding operation. It was found by the cost department that the life of these wheels was far from uniform. While one wheel might be efficient, another would not stand up long enough to pay for setting it up. Realizing that the company was losing money on many grinding wheels, the laboratory was called upon to find out which wheels could be used profitably and which ones should be rejected. The wheels all came from one manufacturer, and all were supposed to be of the same grit, grade, and bond. The laboratory developed a scheme of testing, including visual inspection, screwdriver tests, and microscopic examination. These tests resulted in a saving of $10,000 in the first year. It also made the manufacturer more keenly alive to his responsibilities, and he made a greater effort to make his product more uniform. This is only one of many instances wherein the works laboratory of this plant has cut down expenses by the application of scientific tests to production problems.

Philadelphia, Pa. Arthur L. Collins

END THRUST ADJUSTMENT FOR BUSHING

The wear on the end of a bearing bushing caused by the end thrust of a revolving hub, gear, worm-wheel, or other part often necessitates the provision of some means of adjusting the bushing longitudinally in its housing in order to take up the lost motion. The device illustrated in connection with the accompanying table provides a simple means of obtaining the required adjustment and is particularly well adapted for use on medium weight automatic

TABLE OF DIMENSIONS FOR BUSHING ADJUSTER



A	B	C	D	E		G	H	J	K	L	M	N	P	W
3/16	¾	19/32	¼	1/16	¼	0.132	30	1/32	33/64	21/64	15/64	5/16	1/32	5/16
¼	1 1/16	55/64	5/16	3/32	11/32	3/16	30	3/64	11/16	7/16	5/16	7/16	1/32	⅜
5/16	1¼	63/64	⅜	⅛	27/64	¼	30	3/64	13/16	½	25/64	9/16	3/64	7/16
⅜	1½	1 11/64	7/16	5/32	½	5/16	30	1/16	1	⅝	15/32	11/16	3/64	9/16
7/16	1¾	1 23/64	11/16	3/16	37/64	11/32	30	1/16	1⅛	11/16	35/64	¾	1/16	⅝
½	2	1 17/32	11/16	7/32	43/64	13/32	30	1/16	1 5/16	13/16	41/64	⅞	1/16	11/16
9/16	2⅛	1⅝	¾	¼	47/64	7/16	30	1/16	1⅜	⅞	45/64	15/16	1/16	¾
⅝	2⅜	1 13/16	¾	5/16	51/64	½	30	1/16	1½	1	49/64	1 1/16	1/16	13/16

Machinery

machinery. The dimensions in the table cover a range of sizes that meet all ordinary requirements.

The adjuster consists of a bushing *R*, a stud *S*, and a nut *T*. The small end of the bushing *R*, which fits into a hole drilled in the bushing housing, is slotted. The stud *S* fits an off-center hole in bushing *R*. When stud *S* is tightened, it forces the slotted end of the bushing to expand and grip the housing. On the head of the stud is a small pin, which is a close fit in a hole in the wall of the shaft bushing *U*. The parts *S* and *T* should be made of tool steel and hardened. To take up wear, the nut *T* on the end of the stud is loosened to allow the eccentric bushing to be turned the amount required to take up the space between the end of the bushing and the hub, or whatever part exerts the thrust on the bearing. After the adjustment is made, nut *T* is tightened so that the shaft will be held in a fixed position. The bushing should extend beyond the end of the casting to insure contact with the revolving member on the shaft.

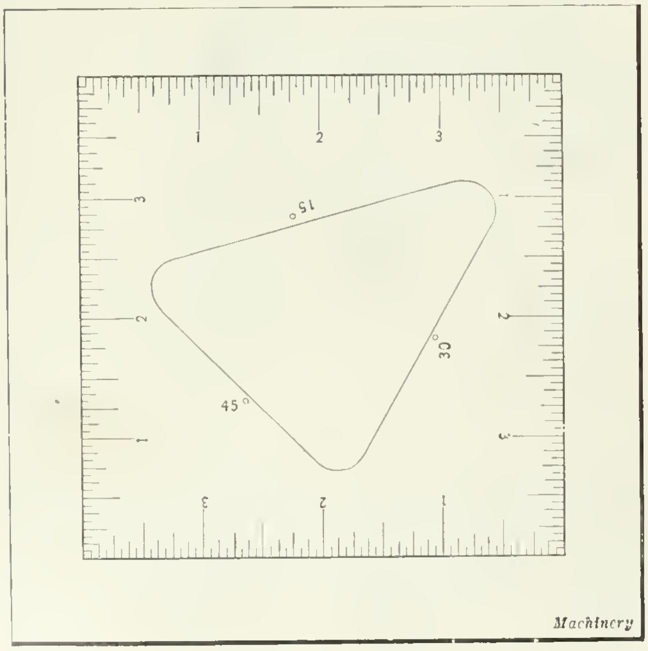
Hempstead, L. I. GEORGE E. HALL

DRAFTSMAN'S COMBINATION SCALE AND ANGLE

The draftsman's combination scale and angle illustrated may be made from celluloid, German silver, or almost any thin sheet metal. It will be noted that the device is square on the outside and is graduated on all four sides. The graduated sides enable the draftsman to measure or lay out dimensions on either a horizontal or a vertical line without the use of a regular scale. In the center of the square, is cut a triangular-shaped opening that will give a combination of 15, 30, 45, 60 and 75 degrees. This in itself is something that the standard draftsman's angles will not give without the combination of the 45- and 60-degree triangles.

The most satisfactory results are obtained by making the instrument of celluloid. In this case, the scale graduations are put on the bottom, and filled in with some kind of blacking. As the celluloid is transparent, it enables work to be drawn up to a very accurate scale. Any line on the bottom of the graduated scale can be made to coincide with any line previously made on the drawing. With this instrument the draftsman can measure along any of the four graduated sides, and does not have to drop his pencil and pick up a scale, in order to lay off a dimension on either a vertical or a horizontal line.

Bridgeport, Conn. GUSTAVE F. BAHR



Combination Scale and Angle

LAPPING JOINTS OF LOCOMOTIVE STEAM PIPES

An improvement over the old hand method of lapping the joints of locomotive steam pipes is described in the following: These joints are of the ball and socket type used to connect the ends of the seamless steel pipes or tubes which lead from the superheater to the locomotive cylinders. The swaying of the locomotive when going around curves, unevenness of the road bed, etc., gives these tubes a "weaving" motion that would quickly cause leakage if the pipe connections were of the usual type employed for stationary engines.

Referring to the accompanying illustration, the end of one of the pipes is shown at *A*. The method of attaching the pipe joint sleeve to the pipe is apparent. The steel joint ring is shown at *B*. The ball and socket surfaces of these two elements are first machined in a lathe to as nearly a perfect fit as can readily be obtained. In order to insure a steam-tight joint, however, it is necessary that the two surfaces be lapped in contact with each other until a practically perfect fit is obtained. The lapping of these elements was formerly done by hand, the parts being rotated together after placing a quantity of abrasive material between the joint surfaces. This was a slow and tedious method, as the workman had to exert the pressure required to hold the parts in contact, besides rotating the ring, and the results were not always satisfactory.

Air-operated Tool used in lapping Joints of Locomotive Steam Pipe

With the improved method of lapping by means of an air-operated machine, the results obtained were all that could be desired. The joint ring *B* is held with a clamp type of chuck to the spindle of the machine shown at *C*. This machine is of a commercial type used extensively for drilling and similar work, and is one of the tools commonly found in railroad repair shops. The ring and pipe are brought in contact after abrasive has been placed on the joints. Air is admitted to the machine, causing the spindle to revolve at a speed of approximately 85 revolutions per minute. The joints are quickly ground or lapped by this process. The ring is next reversed in the holder and placed against the other mating surface located on the superheater. The air-operated machine can be used in any part of the plant, the only requirement being that sufficient rubber piping be provided to connect it with the air supply pipe.

Providence R. I. ROBERT MAWSON

* * *

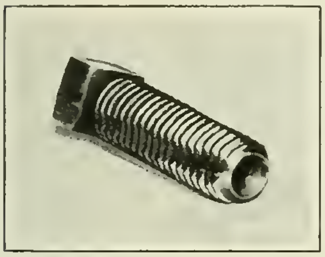
A new development in motor truck transportation is the use made by the railroads of this means of freight haulage for overcoming terminal congestion. Instead of distributing less than carload freight between different terminals by means of shuttle cars, the railroads have found it more feasible to have motor trucks transfer the freight from one depot to another. It is said that not only does this system relieve freight congestion at the terminals, but that this kind of short haul work can be done quicker and at less cost by motor trucks than by the shuttle trains.

Shop and Drafting-room Kinks

CLEANING TAPPED HOLES AFTER HARDENING

It is often necessary to run taps through threaded holes in pieces that have been hardened, in order to clean out the scale or carburizing material left in the threads. This work quickly dulls the tap, and in the case of small holes results in frequent breakage of the taps. The writer has found that an ordinary set-screw with three grooves ground in its sides will do this work as well as a tap, and eliminates the expense due to tap breakage which in some cases amounts to a considerable sum.

In the accompanying illustration is shown a set-screw as it appeared after having been used to clean out over fifty tapped holes in hardened pieces. There are three equally spaced grooves ground in the sides of the set-screw, although only one groove can be seen in the illustration.



Set-screw used for cleaning Tapped Holes

Ypsilanti, Mich. **Floyd Graves**

BEVELED OIL-CAN SPOUT

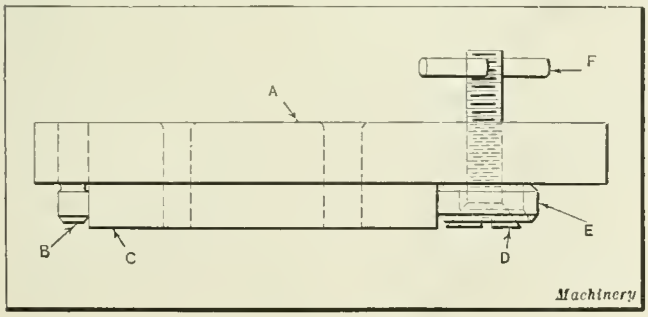
When used in conjunction with the common ball type of oiler, an oil-can spout should be beveled off at an angle of about 45 degrees to permit the oil to flow freely into the oiler. P. R. H.

DRILL JIG FOR SMALL FLAT PIECES

A simple drill jig for holding flat pieces is shown in the accompanying illustration. The writer has found this type of jig particularly well adapted for use in drilling small parts such as are used in the construction of radio equipment. The part *A* is the drill plate, and it may be fitted with drill bushings, or properly located holes may serve as guides for the drills. The work *C* to be drilled is clamped between the stop-pin *B* and the ring *E* by tightening screw *D* so that the conical part of the flat head of the screw will force ring *E* into contact with the work.

Ring *E* is made from a short piece of steel tubing, and is countersunk to provide a good contact surface for the conical part of screw *D*. The screw is provided with a cross-pin *F*, which facilitates clamping and releasing the work. When the jig is loaded, the center of screw *D* is nearer the end of the work than the center of ring *E*; consequently when the screw is tightened, the head tends to center itself in the countersunk end of the ring, thereby forcing the latter over toward the stop-pin, which results in securely clamping the work in the jig.

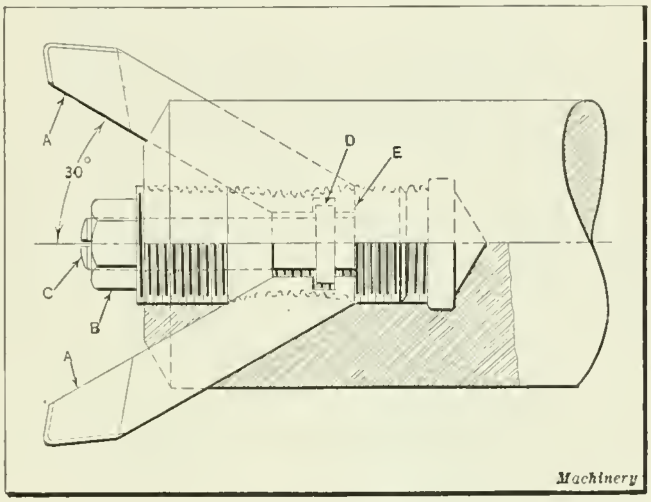
Weehawken, N. J. **O. F. Rothen**



Drill Jig for Small Flat Pieces

ADJUSTABLE BORING-BAR HEAD

The boring-bar head illustrated was designed by the writer for use on a four-spindle boring machine employed in boring automobile truck engine cylinder blocks. The boring head is provided with a means of adjusting the cutters through a distance of 3/16 inch on the diameter. The method of adjustment needs but little explanation. The cutters *A* are set at an angle of 30 degrees, and are made a sliding fit in the square holes in the boring-bar head. The inner end of the cutters is grooved to receive the collar *D* on screw *C*. It will be noted that the inner end of the cutters rests on the shoulder *E* of screw *C*, which forms a substantial stop. By screwing *C* in or out, the cutters are drawn inward or fed outward, thereby decreasing or increasing the cutting diameter. After the cutters have been adjusted to the required diameter, part *B* is screwed down tight, thus clamping the cutters in position.



Double-cutter Adjustable Boring-bar Head

Winnipeg, Canada **J. T. Longdon**

DRAWING-BOARD SLIDE-RULE

There are few designers who cannot use a slide-rule to good advantage in their daily work. However, to obtain the best results, a slide-rule three or more feet in length should be employed. Some years ago, the writer made up a slide-rule that formed an integral part of his drawing-board. It was made 8 feet long or the same length as the drawing-board and was provided with four sets of graduations, universally known as the A, B, C and D scales.

A strip of cherry reglet, such as may be obtained from a dealer in printers' supplies, makes a very serviceable slide for a drawing-board slide-rule. The strip should be about 1/6 inch thick. A channel or groove is planed in the drawing-board to receive the slide, which should be made a smooth sliding fit in the groove. The slide should be fastened in the groove temporarily while the graduations are being made with a sharp-edged tool. The graduations can be laid off to scale by the use of a standard sized slide-rule, or they may be laid off according to mathematical calculations.

New York City **Robert Grimshaw**

Questions and Answers

MANUFACTURE OF COLD-ROLLED STRIP STEEL

B. H. H.—The writer would like information on the manufacture of cold-rolled strip steel, such as is used for light stampings.

A.—To answer this question completely in this column would require too much space, but the subject is quite completely covered in the book entitled "Iron and Steel," published by The Industrial Press. The process is treated from the time the ribbon stock is received for annealing, and covers the various annealing processes, types of furnaces used, descriptions of the pickling and rolling operations, etc. The amount of reduction that is obtainable in each step in the rolling process is given as well as the subsequent operations performed on the strip stock, such as trimming the edges and finishing them, cutting the strips into lengths, hardening and tempering, and final polishing. The furnaces and other equipment used are illustrated.

STANDARD AND SPECIAL TOOLS

H. F. K.—What is the difference between a standard and a special machine or tool, as these terms are generally applied in the machine-building field?

A.—A standard machine or tool differs from a special design, according to the general use of these terms in the machine tool field, in that it is applicable to general work instead of being designed for a special purpose. For instance, standard machine tools may be used for performing operations on miscellaneous classes of work within their range, in an order or sequence that may be varied according to requirements. An engine lathe is an example of a standard machine; whereas a machine designed exclusively for drilling holes in crankcases or some other part illustrates the special or "single-purpose" type of tool, which is found in automobile plants or wherever the production is on a large enough scale to warrant using special machines. While a tool such as a tap is intended to produce a screw thread of given diameter and pitch, it might properly be classified as standard, because the application is not restricted and it can be used in the production of miscellaneous classes of work. A special tool is limited in its use to one specific line of work. A jig designed for drilling a certain part is an example of special tool equipment.

CENTER OF GRAVITY AS RELATED TO VOLUME

B. O.—After finding the center of gravity of the frustum of a pyramid by the formula on page 269 of Machinery's Handbook, the volume on each side of the center of gravity was determined by the use of the formula on page 136, but the volumes were not equal on each side of the center of gravity. Please explain why these volumes do not balance.

A.—Evidently you have assumed that the volume should be equal on each side of the center of gravity, which may not be the case. The center of gravity is the point at which the body may be balanced or the point at which the entire weight may be considered as concentrated, but it does not follow that the center of gravity is a central point dividing the body into two equal volumes. Two balls of unequal diameter mounted on the ends of a pivoted rod, will doubtless serve better as an illustration than the pyramid. If the weight of the small ball is represented by w, the weight of the large ball by W, and the distances to the center of gravity (opposite the pivot) are represented by X and Y, then $w \times X = W \times Y$. In other words, the center of gravity is the center of moments, and in this example there may be considerable difference between the two weights and also between the volumes; consequently the smaller ball will be much farther from the center of gravity than the larger one. The same principle holds true in the case of the pyramid.

DOES A PATENT ASSIGNMENT BECOME VOID IF NOT RECORDED?

L. D. M.—I am the owner by assignment of an undivided one-half interest in a United States patent. The assignment was executed more than six months ago, but it has not been recorded in the Patent Office. I have been informed that my assignment is void, as against the rights of one purchasing a half interest subsequent to the assignment to me, for the reason that I permitted a period of more than three months to elapse after the purchase without recording it in the Patent Office. Will you please advise me whether or not this is correct?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

Your inquiry may be answered "yes" and "no." That part of the revised statutes relating to patents provides that an assignment, grant, or conveyance of a patent or of any interest in one, will be void without notice, against any subsequent purchaser or mortgagee for a valuable consideration, unless recorded within three months of the date of the assignment or prior to the recording of the subsequent purchase or mortgage. In your case, as the assignment is of one-half interest, the assignor was free to dispose of the remaining half interest without in any way impairing the validity of your ownership, unless still another conveyance of a half interest had been made. In any event both of these transfers must be a matter of record in the Patent Office prior to the filing of your own assignment, in order to affect the validity of your assignment. Your assignment should be recorded immediately.

COLORING SHEET BRASS

R. L.—Have you any information on methods of artificially coloring sheet brass for ornamental purposes?

A.—Metal may be artificially colored by mechanical means or by electro-chemical deposition. By the latter method, the colorings are modified by the temperature of the solution used and the strength of the electric current employed. The mechanical method is simply that of applying a paint, lacquer, or bronze powder with a brush, but this would not be applicable for the purpose stated, as by this method no physical combination is formed with the metal to be coated. In a book entitled "Metal Coloring and Bronzing" by Arthur H. Hiorns, it is stated that the ingredients and temperature of the solution and the length of time that the metal is immersed, influence the coloring of brass by the electro-chemical process. For example, a solution of one part copper chloride and one and one-half parts water at various temperatures gives brass colorings ranging from brown to greenish-drab. A solution of ferric chloride and copper chloride, one part each, and twenty parts water gives brass various colorings of a bronze hue. The temperature of this solution may be varied from 59 to 176 degrees F., and the length of immersion should be from one to five minutes, these factors being variously combined to give the desired tone. There are many kinds of solutions used in coloring brass, depending on the color wanted.

NOMENCLATURE OF POWER-PRESS PARTS

The various parts embodied in common machine tools, such as the lathe, drilling machine, shaper, and planer, are almost universally known by the same terms, but when it comes to the power press, misunderstandings are frequent, because the parts are called by different names in different localities. A few of the names applied to the reciprocating member of the power press to which the punch is attached are as follows: Slide, ram, plunger, cross-head, mandrel, gate, sash, sliding head, head, and punch-carrier. While some of these terms are sufficiently descriptive to enable one to realize quickly what part is meant, others give no clue whatever. Obviously, when a term of the latter class is used in correspondence, especially in ordering repair parts; time is lost in ascertaining what part is referred to.

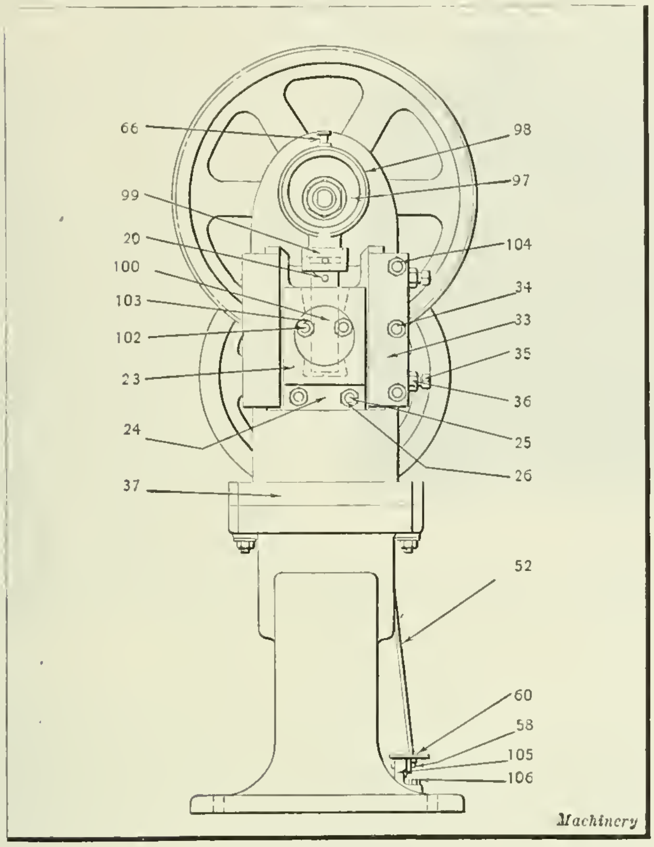


Fig. 1. Drawing of a Power Press in which the Numbers refer to the Accompanying List which gives Names for the Various Parts

Various terms are also used to identify the same style of press, as for instance "straight-column," "straight-sided," and "straight-sided pillar" or "arch" and "inclined-upright pillar." Even the machine itself is sometimes called a power press and sometimes a punch press; in the latter case, it may be confused with a machine for punching holes in plates.

In order to eliminate confusion in ordering parts for replacement purposes and also with a view to standardizing the nomenclature of power presses, the Toledo Machine & Tool Co., Toledo, Ohio, has included in a recent catalogue, line drawings of the more common types of presses on which reference numbers lead to the various parts, as well as halftone illustrations of the principal parts, which are also identified by reference numbers. In connection with these illustrations are lists which give the preferable name for the parts that are numbered. Halftone illustrations and lists of names are also given for the parts contained in the clutch with which Toledo presses are equipped.

Two of the line drawings from this catalogue are reproduced in Figs. 1 and 2, and their identification list is given in the following, this list including every part on the press, whether shown in the illustration or not:

Press Not Geared

No.	Name	Number on Each Press
1	Frame	1
*4	Clutch flywheel	1
5	Crankshaft	1
*6	Brake (and drive) collar	1
8	Brake band complete with lining	1
9	Brake band attaching stud	1
10	Brake band attaching stud nut	1
11	Shaft washer and pin (rear)	1
12	Clutch collar key	1
13	Shaft nut (rear)	1
20	Connection screw	1
23	Slide	1
24	Slide recess cap	1
25	Slide recess cap stud	2
26	Slide recess cap stud nut	2
33	Gib	1
34	Gib stud	3 or 4
35	Gib adjusting set-screw	2 or 3
36	Gib adjusting set-screw nut	2 or 3
37	Bolster plate	1
38	Bolster plate bolt	4
39	Bolster plate bolt washer	4
40	Bolster plate bolt nut	4
52	Treadle connection rod	1
58	Treadle shaft	1
60	Treadle	1
*61	Treadle connection screw adjusting bar	1
*62	Bolster bolt wrench	1
*64	Brake band wrench	1
*65	Set-screw wrench	1
66	Oil-cups	

Press Geared

No.	Name	Number on Each Press
*67	Back-shaft bracket	1
*68	Back-shaft bracket stud	4
*69	Back-shaft bracket stud nut	4
*70	Back-shaft bracket cap	1
*71	Back-shaft bracket cap stud	4
*72	Back-shaft bracket cap stud nut	4
73	Back-shaft or pulley stud	1
74	Pinion	1
76	Balance wheel	1
78	Loose pulley	1
79	End collar	1
80	End collar set-screw	1
81	Clutch gear	1
*82	Gear guard	1
91	Eccentric key	1
92	Crankshaft bushing	1
93	Pulley stud end	1
94	Pinion balance wheel cap-screw	2
95	Crankshaft nut (front)	1
96	Crankshaft nut washer (front)	1
97	Eccentric	1
98	Eccentric strap	1
99	Adjusting lock-nut	1
100	Connection pivot (front)	1
*101	Connection pivot (rear)	1
102	Connection pivot screw	2
103	Connection pivot screw nut	2
104	Gib stud nut	3 or 4
105	Treadle lug	1
106	Treadle lug screw	1

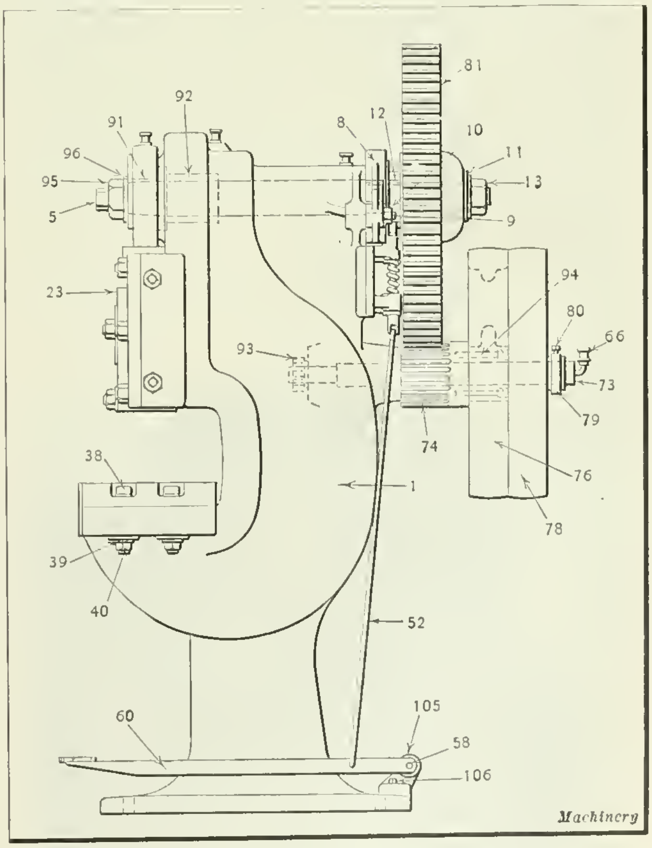


Fig. 2. Opposite View of the Press with Parts numbered

This practice of numbering and naming parts is referred to because it may suggest means for standardizing the names of power press parts. Manufacturers in other fields may also profit by the scheme outlined in this article.

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*Not shown

GRINDING PRACTICE IN RAILROAD SHOPS

Surface grinding has proved an efficient method of machining various parts for locomotives and other railroad equipment. Castings and forgings are finished from the rough in many cases by this method even when a considerable amount of metal is required to be removed. Hard spots, scale, and sand do not slow up production an appreciable amount when the parts are finished by grinding, and this feature is a great advantage in machining certain parts of railway equipment. Very little has been published regarding the results obtained by the use of surface grinders in railroad shops, and the machining operations here described should therefore prove of general interest, as they are typical of the class of work being regularly performed in various shops by the use of Blanchard grinding machines.

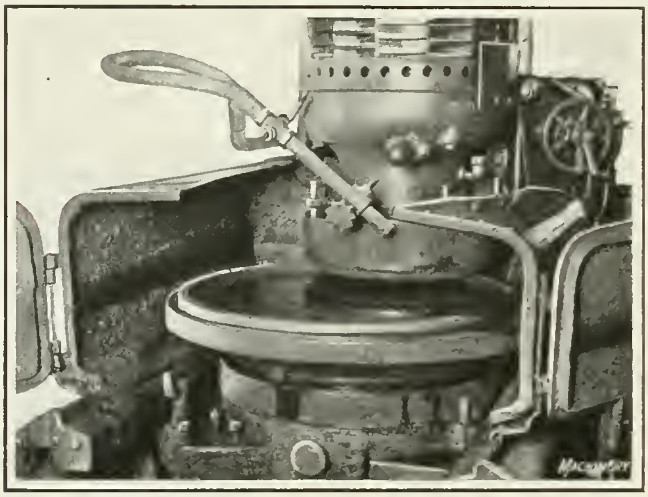

Fig. 1. Surface-grinding Sides of Locomotive Piston-ring

Grinding Piston-rings

Fig. 1 shows an 18-inch wheel surface grinder fitted for finish-grinding cast-iron piston-rings, which are 30¾ inches in diameter, and are held on a magnetic chuck 36 inches in diameter. After removing 0.009 inch of stock from one side, the ring is turned over on the chuck and the same amount removed from the other side; then to insure that the piece will be flat and parallel, it is turned once more and ground the second time on the first side. The thickness or distance between the parallel sides must be held to a limit of plus or minus 0.0005 inch. The average production on rings of this type ranging in size from 19 to 30¾ inches is 20 per hour (60 surfaces) or 3 minutes for each completely ground ring.

Rings larger than 30 inches in diameter can be centered on the chuck by stops, and ground satisfactorily without magnetizing the chuck. Small rings are, of course, grouped in multiple on the magnetic chuck. If rings of different diameters have the same thickness, they may be nested within each other. Small rings such as are used in air pumps are regularly finish-ground from the rough. For instance, air pump rings 9½ inches in diameter and ¼ inch thick are ground from the rough at the rate of 30 per hour in certain railroad shops. In this case 5/32 inch of stock is removed from each side, and the limit on the thickness of the rings is plus or minus 0.0005 inch. Six rings are chucked at one time for this operation.

Grinding Crankpin Washers and Link-block Plates

The machine illustrated in Fig. 2 is employed in grinding crankpin washers. Seven pieces are chucked at one time. These washers are 7¾ inches in diameter and must be ground on both sides, about 1/32 inch of stock being removed from each side. The sides are required to be parallel, and the limit allowed on the thickness is plus or minus 0.001 inch. The production rate is 60 finished pieces (120 surfaces) per hour.

Link-block plates are shown in Fig. 3 arranged on the magnetic chuck of the grinder. In the particular case illustrated, twenty-one plates are held in place on the magnetic chuck. It will be noted that each machine illustrated is provided with large-sized coolant pipes. When the machine is in operation, the doors of the water guards are, of course, closed.

Grinding Locomotive Links

In grinding locomotive links, two pieces are usually held on the magnetic chuck at one time. The production time recorded in one railroad shop on steel locomotive links 24 inches in length was 6 finished pieces (12 ground surfaces) per hour. In this case ⅛ inch of stock was removed from each side. The limits on the thickness of the links was plus or minus 0.006 inch. Links repaired or built up by welding are also easily machined to thickness on the surface grinder.

Grinding Grease Cellars, Main-rod Keys and Slide-valves

Cast-iron grease cellars are being machined regularly on surface grinders in various railroad shops. In one shop six

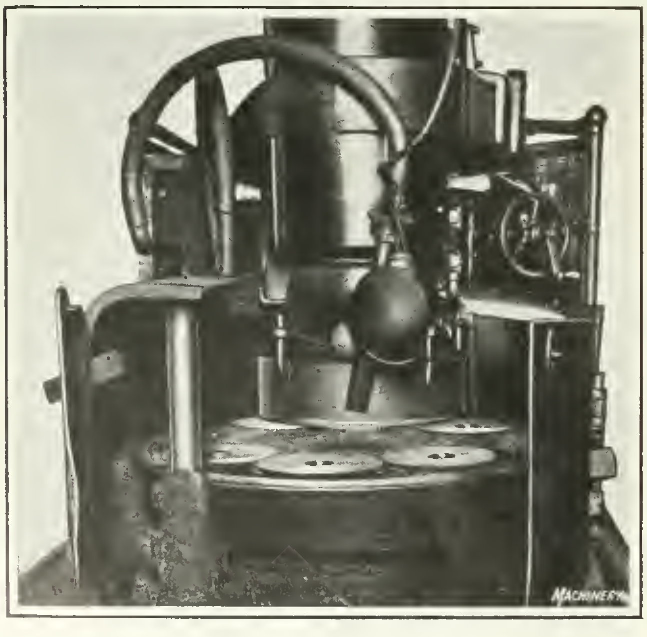

Fig. 2. Grinding Crankpin Washers

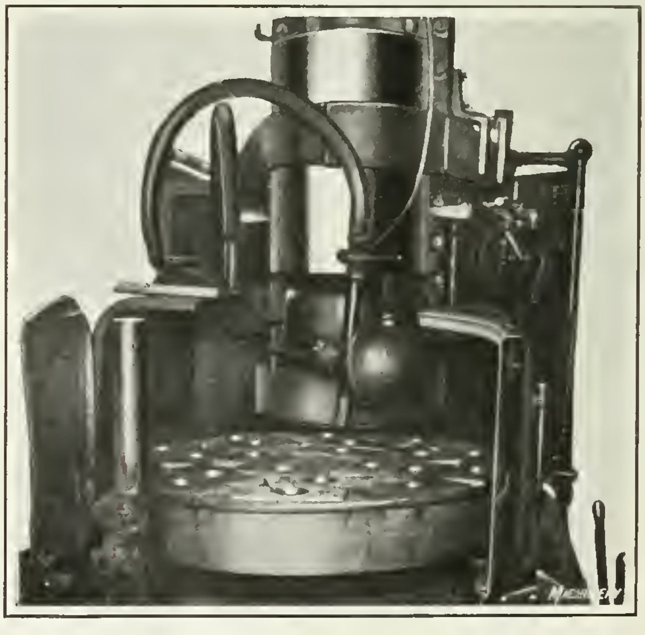

Fig. 3. Link-block Plates Ready to be ground

cellars, arranged radially on the magnetic chuck, are ground at one time. Approximately ⅛ inch of stock is removed from each side of the cellars, and the work is held to limits of plus or minus 0.008 inch. The production time for this job is 18 pieces (36 surfaces) per hour.

The production on steel main-rod keys 18 inches long, removing 1/16 inch of stock from each side, is 30 pieces (60 surfaces) per hour, in one shop. For this operation eight keys are chucked at one time on the magnetic chuck.

Worn slide-valves can be quickly trued up on the surface grinder. When thus trued up, the valves require no scraping. New slide-valves are machined at the rate of 6 pieces (12 surfaces) per hour in one plant. These cast-iron valves are 19 by 8½ inches, and require the removal of ⅛ inch of stock from each side.

* * *

CHART FOR DETERMINING SPEEDS AND FEEDS FOR INTERNAL GRINDING

By R. L. MORGAN, Greenfield Tap & Die Corporation, Greenfield, Mass.

Grinding machines of the reciprocating table type have in the past been limited in their productive capacity by comparatively low table speeds. Recently developed feeding mechanisms, however, have made it possible to successfully employ table speeds up to 50 feet per minute. The production-limiting factor of table feeds has thus been practically eliminated.

This increase in table speeds permits the use of broad-faced wheels in such a manner that their full face widths are used when cutting, whereas with the slower speeds previously available, only the leading edge or end of a grinding wheel did the cutting. With the increased speeds, however, the entire cutting surface of a broad-faced wheel can be presented to an entirely new surface upon the part being ground at each revolution of the work-carrying spindle. In other words, the grinding wheel follows a spiral path on the work and overlaps its path of advance just enough to cover and eliminate feed lines, thus making use of practically the entire cutting face of the grinding wheel. This practice results in increased production together with marked economy of wheel wear, because the entire wheel face, and not merely the front edge, is engaged in cutting.

The chart presented here has been prepared for use in determining the correct combination of table speed, wheel face width and work speed. The following examples will serve to make its use clear. It should be noted that the values given in the chart are the exact theoretical values and do not allow for overlap.

Table Travel in Feet per Minute

Let it be assumed that a wheel having a face 1½ inches in width is to be used in grinding work that is revolved at a speed of 350 revolutions per minute. The problem is to determine the table traverse speed in feet per minute that will permit the entire face of the abrasive wheel to be used in actual cutting. Referring to the accompanying chart, first locate the vertical line which represents a work speed of 350 revolutions per minute. Next, follow this vertical line upward until the point is reached where it intersects the slanting line representing the wheel face width of 1½ inches. From this point the horizontal line is followed to the left until the column giving the table speeds in feet per minute is reached. In this case it is found that the required table speed is 43 feet per minute.

Width of Grinding Wheel Face

As an example, assume that the grinding machine is set for a table traverse speed of 32 feet per minute and that the work-holding spindle revolves at a speed of 425 revolutions per minute. The problem is to find what width of face the grinding wheel should have to give maximum efficiency. In this problem, we first locate at the extreme left-hand side of the chart the point that represents a table speed of 32 feet per minute, and then follow the horizontal line from this point to its intersection with the vertical line that represents a work speed of 425 revolutions per minute. As the point at which the horizontal and vertical lines intersect is just above the line representing a wheel face width of ⅞ inch, it is evident that a wheel one inch wide should be used.

Speed of Work

In this example let it be assumed that a wheel having a face width of ¾ inch is to be used in combination with a table speed of 25 feet per minute. The number of revolutions per minute at which the work should be revolved may be found as described in the following. In solving this problem it is first necessary to locate the point at which the horizontal line representing a table speed of 25 feet per minute intersects the diagonal line representing a wheel face width of ¾ inch. From this point of intersection follow the vertical line downward to the column at the bottom of the chart. Opposite the end of this line we read the work speed of 400 revolutions per minute.

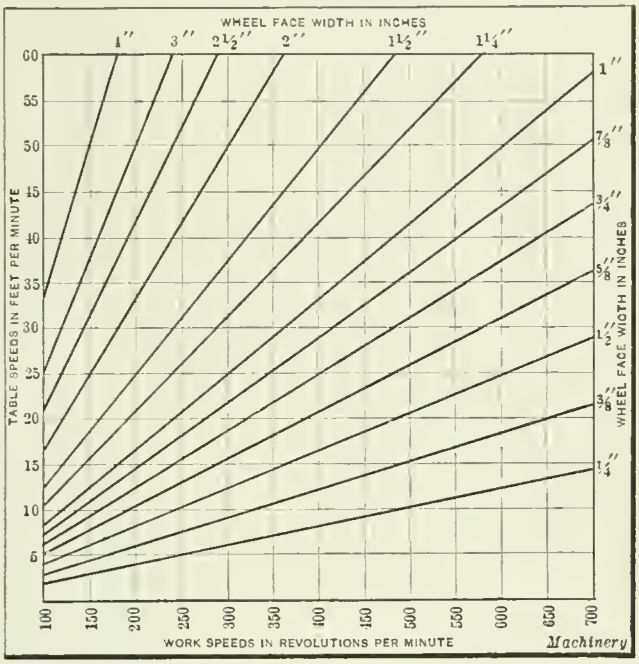

Chart for determining Efficient Combination of Feeds, Speeds and Wheel Widths for Internal Grinding (Values given in Chart do not allow for Overlap)

* * *

OFFICE MANAGERS' CONFERENCE

The fourth annual conference of the National Association of Office Managers will be held in Detroit, June 14 to 16. Among the papers that will be presented before the conference are: "Education the Basis of Office Management," by W. W. Kincaid, president of the Spirella Co., Niagara Falls; "Salary Standardization," by Harry A. Hopf of New York; "Office Machinery in the Reduction of Office Expenses," by H. A. Piper of E. I. du Pont de Nemours & Co., Wilmington, Del.; "Helping Our Schools to Help Industry," by Frank P. Hamon of the Goodrich Rubber Co., Akron, Ohio. There will also be round table discussions on such subjects as "Increasing Office Productivity by Bonuses and Ratings," "Application of Planning Principles to Office Work," "Office Manuals and Written Instructions," "Cutting Red Tape," "Mutual Service Work," and "Training." All interested in office administration are invited to attend the conference. Further information may be obtained from the secretary of the association, G. S. Childs, Alexander Hamilton Institute, 13 Astor Place, New York City.

The Machine-building Industries

THE industries in general show great activity. According to a report of the Federal Reserve Bank, "the industrial machine continues to forge ahead. Several 1920 production records were broken last month, which indicates pretty plainly the rate at which business is traveling. The 1920 records were established by reason of demands which were neglected during the war; the present high peaks have been reached without this urge, and with comparatively little assistance from foreign trade. The present progress of business is not tied down to a few particular lines; it is branching out in all directions. The iron and steel, building, and automotive industries are among the leaders."

On the other hand, we find a general attitude of watchfulness and caution among business and industrial leaders as the industrial machine shows a tendency to increase its speed. This attitude of caution constitutes one of the reassuring elements in the present situation; if adhered to, business will continue in its present state of activity for a longer period. While business conditions today have all the elements that make for stability and continued prosperity, conservative buying and carefully laid plans for the future are necessary if production, distribution, and consumption are to remain at a high level. The Department of Commerce has warned against inflation, and advises a careful study of the severe lessons of 1920.

Briefly stated, production in the basic industries rose during March to a level 8 per cent higher than the 1920 peak. The output of pig iron, steel and automobiles, and the consumption of cotton, exceeded all previous records; building operations showed a further large expansion; contracts made for residence construction during March were the highest on record; and railroad freight shipments are larger than at any corresponding time in the past.

The Machine Tool Industry

In the machine tool industry the rate of activity recorded in this review last month continues practically unchanged. Most manufacturers have sold off the stocks accumulated during the depression. The demand for lathes, planers, radial drills, horizontal boring machines and some lines of automatics is especially good. Special machines for the automobile field are still in demand, the saturation point for equipment in this industry evidently not yet having been reached. The railroads continue to be steady if not large buyers of the type of equipment best suited for repair shops, and the locomotive and railroad car building companies continue to add to their facilities. A fair demand for locomotive cranes is expected this year, although the general crane business is not as yet employed to more than about 50 per cent capacity.

It is difficult to say whether or not the demand for machine tools is in proper ratio to general business activity. Comparing the present production of the entire machine tool industry with that of 1914, it appears that the number of machines built is about twice that of nine years ago. On this basis of comparison one might say that the machine tool industry is rapidly approaching what ought to be termed a "normal" output; but the capacity of the machine tool plants is nearly double the present volume of business, and while some shops are occupied up to a hundred, or nearly a hundred, per cent, others are unable to obtain enough business to take care of as much as half their capacity. Buyers of machine tools are very careful in their purchases and are not taking chances on buying equipment likely to stand idle when the present business boom begins to recede. At the same time, many machine tool users are operating obsolete machinery that it would be true economy to replace by modern equipment.

There is a scarcity of skilled labor in the machine tool industry, and, as the country is producing to the limits of its labor supply, there are no prospects of any improvement in this condition. In some industries where labor has been paid at a lower rate, compared with others, wage increases have taken place.

The Toolmaking and Small Tool Industry

In the special tool and equipment field, business is very good and prices are now at a satisfactory level. Some tool shops could obtain more business than they have, but they too are limited by the available supply of toolmakers. Shops manufacturing small tools continue to handle an increased business, having gained month by month since last November. The increase in the number of orders is even more marked than the increase in the volume of sales, showing that activity in the metal-working field is becoming more and more general. The demand for production tools used in manufacturing in large quantities is becoming greater, indicating that other industries, besides the automobile industry, are producing on an increased manufacturing schedule. The demand for portable electric tools is equal to about two-thirds the capacity of the shops in that field.

The screw products shops are fully occupied and conditions in the gear-cutting field are generally good, although there are some complaints that keen competition has reduced prices to entirely too low a level for continued prosperity in this field.

The Iron and Steel Industry

A new pig iron production record has been set, the output now being at the rate of 44,000,000 tons a year. On May 1 there were 310 blast furnaces in action, an increase of 14 during April. The production of pig iron is now more than 10 per cent in excess of production during the record year 1916. The steel ingot production is also the highest ever recorded. The sales of fabricated structural steel reached a high record in March. Both steel and gray iron castings are in great demand, and most foundries are working to capacity. As a result, molding machines are selling unusually well in spite of the conservative attitude of the managers in the foundry field.

There does not appear to be any real scarcity of iron and steel, because the unprecedented production is ample to take care of actual needs; but prices for quick delivery are rising, because buyers outbid each other for immediate supply.

The Railroad Situation

The outlook for the railroads is very good. The traffic is mostly in excess of facilities, although a great deal of new equipment has been put into use. There is also more new equipment on order than ever before in the history of American railroads. From January 1 to April 1 over 1000 new locomotives and nearly 45,000 freight cars were placed in service, and on April 15, 1950 new locomotives and 117,000 freight cars were still on order. So far the railroads have contracted to spend $1,100,000,000 for equipment and improvements in 1923. In 1922, $440,000,000 was expended. Some railroad men believe that 1923 will be an exceptionally prosperous year in this field, and point to the fact that the freight carried during the first four months was larger in volume than ever before at this time of the year.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Continuous Boring and Turning Machine

A VERTICAL six-spindle boring and turning machine in which both the cutter-spindles and pieces of work rotate in a constant relation around the center of the machine, the spindles being fed downward at such a rate that each piece of work is finished when it reaches the loading position, has been recently built by the Davis & Thompson Co., 251 Reed St., Milwaukee, Wis. External and internal cuts may be taken simultaneously on the same piece. Power is transmitted to the main vertical driving shaft through a gear-box which provides various speeds to suit work of different dimensions. In addition there is a pick-off gear to provide for changing the speed of the rotating head to suit the operation. As the head revolves, the cutters of five spindles are always being fed downward along the piece of work beneath each spindle, but the sixth spindle is raised at the loading position in order to enable the operator to replace the finished part with another piece of work.

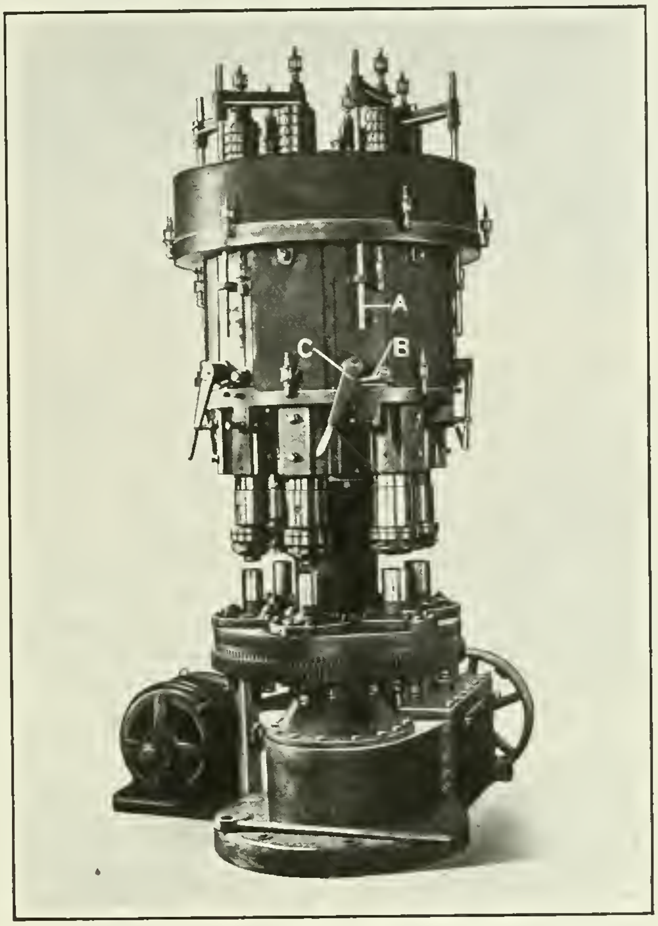

Fig. 1. Davis & Thompson Six-spindle Turning and Boring Machine

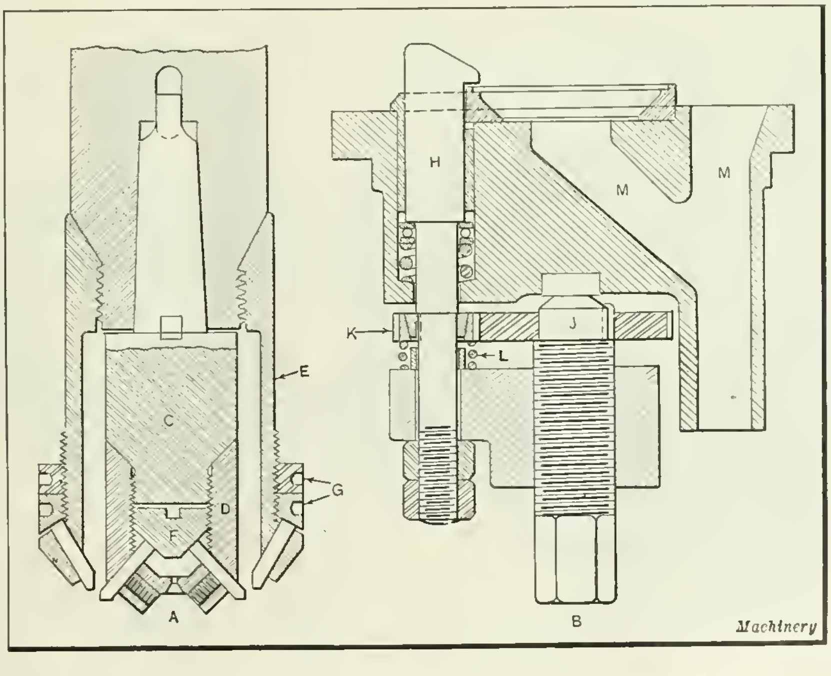

Fig. 2. (A) Sectional View of the Spindle Nose and Cutter-holding Members (B) Chuck-operating Mechanism

From Fig. 3, which shows the top of the machine with the cover removed, it will be seen that the central vertical shaft has a spur pinion at the upper end which meshes with a gear on each spindle. There is a left-hand thread cut on each spindle, and as its gear causes it to rotate, each spindle is fed downward at the desired rate by means of a nut until the work has been finished, and then fed upward rapidly. Differential gearing provides for turning the nut faster than the spindle to give this downward feeding movement.

When a spindle reaches the lowest point of its movement, trip-rod *A* (see Fig. 1), strikes catch *B* of lever *C*, permitting a spring located in the housing to disengage the clutch of the feed gear in the differential gearing of that particular spindle. This clutch then contacts with a surface and produces sufficient friction to keep the nut from turning. The continued rotation of the spindle results in its being raised to the starting position again, at which time the nut once more starts turning and overcomes the friction acting on the clutch, so that it is ready to feed the spindle downward when the operator throws in the feed after placing an unfinished piece of work in the chuck.

The tools that are provided on the machine for simultaneously boring and turning a piece are shown at *A* in Fig. 2. It will be seen that there is an inner holder *C* which is provided with a No. 5 Morse taper shank to fit the spindle socket. Screwed on the lower end of holder *C* there is a member *D* which carries six boring cutters. The turning tools are held in the lower end of holder *E* which screws on the threaded nose of the spindle, there being also six turning cutters. The tools in holder *D* are adjusted to suit the diameter of the work by screwing forward piece *F*, and those in holder *E* are similarly set by means of rings *G*. The spindles are 5 inches in diameter and their bearings are adjustable to insure rigidity in rotation. Large driving gears may be used on the spindles by arranging them as shown in Fig. 3.

Each of the six chucks on the machine illustrated is of the design shown at *B*, Fig. 2. There are three bolts *H* which have an eccentric head, these bolts being tightened or loosened by revolving the central screw *J* with a wrench applied to the lower end. There is a gear on this central screw that meshes with a pinion *K* mounted on a taper collar on each eccentric bolt. In revolving screw *J* to clamp a piece of work in the chuck, gear *K* will revolve and turn each bolt *H* until the bolt is tight against the work, after which gear *K* slips on its tapered seat. Until the head of the bolt contacts with the work, the pressure exerted by coil spring *L* is sufficient to make pinion *K* turn the bolt.

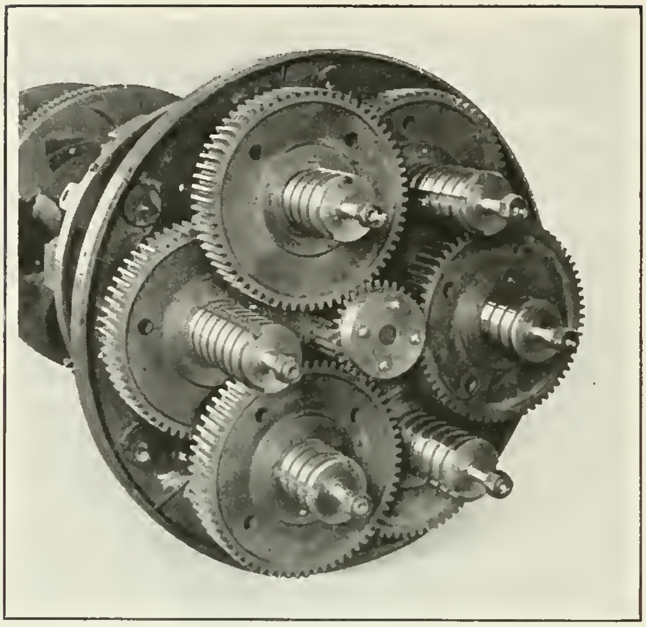

Fig. 3. Arrangement of the Spindle Driving Gears

It is obvious that this ingenious mechanism provides for clamping a piece in the chuck with one movement of central screw *J*. Chips falling from the boring and turning tools are disposed of by having them fall through passages *M*. The central screw is, of course, turned in the opposite direction to quickly release the work after it has been finished. Work up to 12 inches in diameter can be handled on this machine; in an operation consisting of turning and boring 6-inch diameter pots, 9 inches long, the production was three per minute. This machine weighs about 9500 pounds.

CLEVELAND BENDING ROLL, PUNCHING MACHINE AND SPACING TABLE

Three machines of interesting design which have been recently built by the Cleveland Punch & Shear Works Co., Cleveland, Ohio, are presented in the accompanying illustrations. The pyramid type bending roll shown in Fig. 1 measures 10 feet 2 inches between the housings; the multiple punching machine illustrated in Fig. 2 is mounted three on one bed for punching angle-irons up to 26 feet in length; and the hand spacing machine, of which a view of the operating unit is shown in Fig. 3, is intended for handling structural members such as I-beams, channel and angle-irons, and plates up to 40 feet in length.

The bending roll has a direct-connected motor drive, which is entirely self-contained and arranged for raising and lowering the top roll by power. This is accomplished through bevel gears, an elevating screw, a hinged yoke and a roll box at each end of the rolls. It is only a one-man job to disconnect and drop the hinged yoke. Two clutches are provided so that either end of the top roll may be raised or lowered independently of the other. An additional single clutch controls the rotation of the rolls. The lower rolls are 8 inches in diameter, one of which has three splines, while the other has two splines and a flanged groove. The upper roll is 11 inches in diameter. Special attention is called to the fact that none of the gears protrude into the foundation and hence no pit is required beneath the machine to receive them.

The mounting of three Style C punching machines on one bed, as shown in Fig. 2, is particularly desirable when holes are to be punched in a large number of angle-irons, as, for example, in the construction of oil derricks, roof trusses, and radio towers or other towers used for supporting water or storage tanks. Angle-irons used for these purposes, as a rule, have groups of holes punched at each end and at the center. The machine at the right-hand end of the bed is stationary, and the other two are adjustable by hand along the bed, to suit the locations of the holes to be punched. Each machine may be operated individually by depressing its treadle, or all three may be operated simultaneously by a treadle at each end.

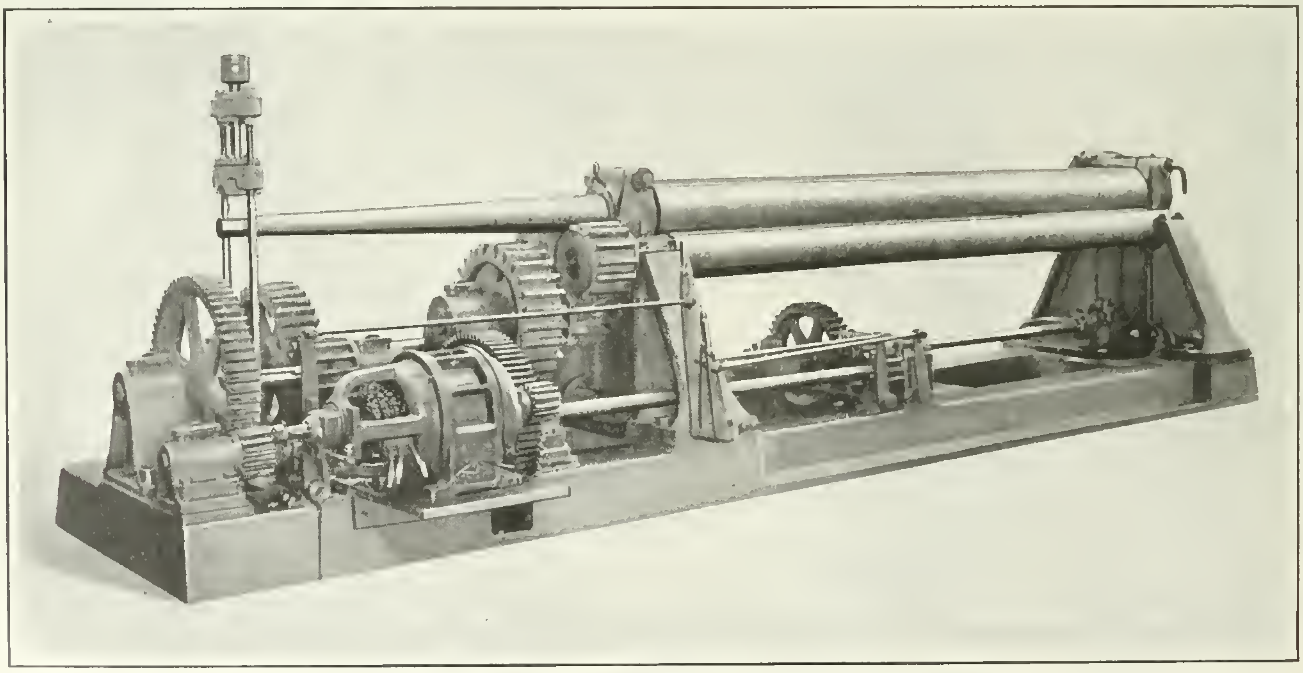

Fig. 1. Bending Roll built by the Cleveland Punch & Shear Works Co., in which the Top Roll is raised and lowered by Power

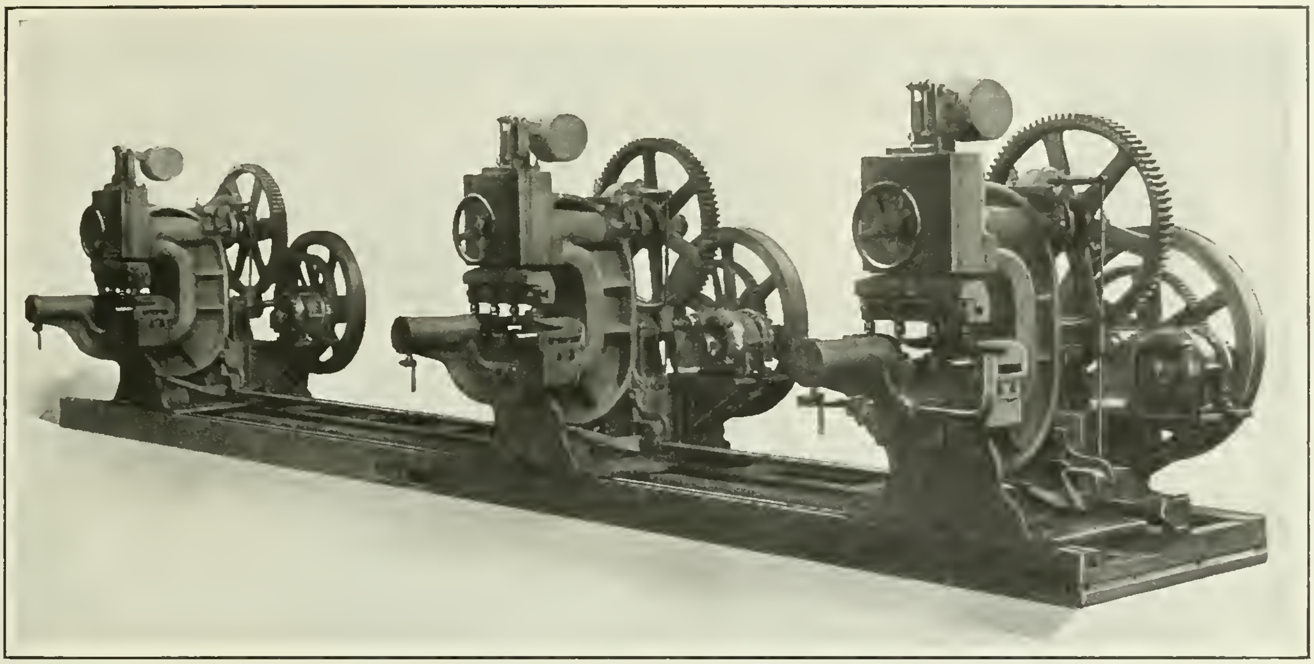

Fig. 2. Three Style C Punching Machines for producing Holes at the Ends and Middle of Angle-irons

Individually adjusted punch attachments are used, a minimum distance of 2 inches being permitted between attachments on each machine, and a maximum distance of 20 inches. Angle-irons may be punched in either leg without turning the angle-iron end for end. Air cylinders are employed to hold the angle-irons firmly in a straight position against adjustable gage-blocks, and supports are provided for the angle-irons. Each air cylinder may also be operated individually, or all of them simultaneously from the stationary machine. The machines illustrated have a capacity for angle-iron up to 6 by 6 by 5/16 inch, but a similar combination can be provided for larger or smaller material.

The hand spacing machine also referred to at the beginning of this article may be used with practically any architectural-jaw, open-gap single punching machine or with the I-beam type of machine. The work is held on the front side of the movable rail *A*, Fig. 3, and rests on rollers. This table will handle 24-inch I-beams with the material-supporting rolls in their lowest position. The table is of the open-side rail type and permits of loading and unloading directly from the front.

The movable rail *A* is guided by rolls *B* located on stationary tie-rails. End castings on the movable rail carry clamps for securing the work to the rail. One end casting may remain constantly in the same position, and the opposite one adjusted to suit the length of the work. The clamps may be released and thrown back so that the clamps and end castings may be returned over the fabricated material for reloading, it being thus unnecessary to unload before returning the rail to the reloading position.

The material-supporting rollers are raised and lowered individually by means of a crank, and the movable rail is propelled through a rack-and-pinion mechanism actuated by means of the 36-inch handwheel seen in Fig. 3. Stopping of the table may be accomplished by the use of adjustable steel stops, hard wood stops with pins, or notched wooden templets attached to the back of the movable rail. Then, by revolving the handwheel in the direction of the material travel, the stops are brought into contact with a stationary dog at the point where a hole is to be punched. The handwheel is next rotated slightly backward to escape the dog, and then rotated forward to move the material, allowing the dog to rise into the path of the succeeding stop. The backward movement of the handwheel does not move the material backward, as was true in former designs of spacing tables. A steel tape facilitates setting the adjustable stops.

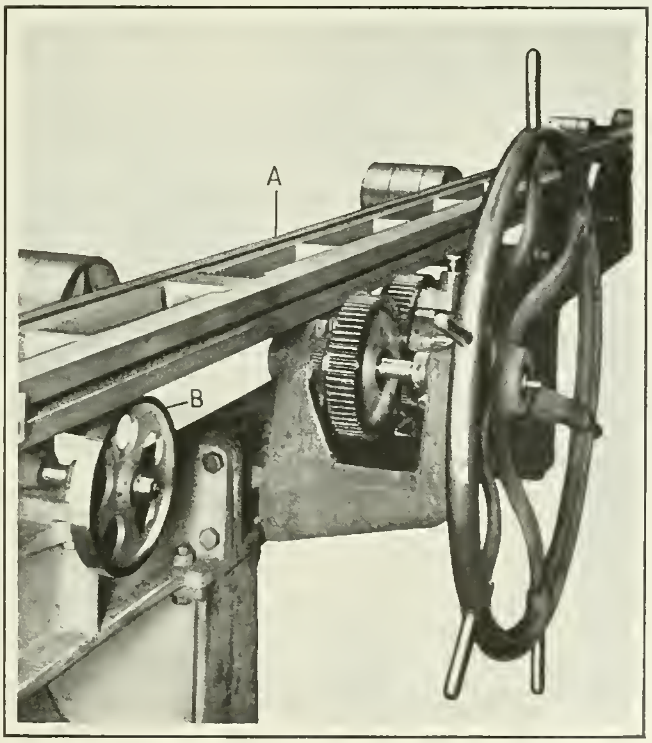

Fig. 3. Operating Unit of the Hand Spacing Table

BOOTH ELECTRIC MELTING FURNACE

Small quantities of metals can be conveniently melted for tool-room and similar purposes by employing a ladle-type electric furnace which is now being placed on the market by the Booth Electric Furnace Co., 411 N. Wells St., Chicago, Ill. This furnace has a capacity for melting 50 pounds of brass or copper, 20 pounds of iron or steel, or 12 pounds of aluminum at one time. In melting brass or aluminum, the metal is placed in the ladle and melted by drawing an arc between two 3/4-inch graphite electrodes which are arranged in approximately horizontal positions. However, in melting iron or steel, the electrodes are placed almost vertical to produce a fan-shaped arc directly on the charge. High-speed steel containing 20 per cent tungsten has also been melted in this furnace.

After a charge has reached the molten state, the electrode holders are withdrawn so that the ladle may be lifted from its supports for pouring. The ladle top is hinged in order that it may be raised for charging. The arc remains steady during a melting, and should it cease, the resulting noise immediately attracts the attention of the attendant; however, little attention is said to be necessary. The lining of the ladle may be either acid or basic. This furnace may be operated on alternating or direct current. Its shipping weight is approximately 450 pounds.

NILES-BEMENT-POND RAILROAD SHOP MACHINES

A locomotive-frame slotting machine which will accommodate six 6-inch frames or four 8-inch frames at one time for simultaneously slotting, and a 48-inch car-wheel borer, have been recently built by the Niles-Bement-Pond Co., 111 Broadway, New York City. In the slotting machine, which is equipped with three heads as shown in Fig. 1, a reversing motor is used on each head to drive the head. The reversing motion in former designs was effected either by means of a crank and connecting-rod or by reversing pulleys and belts which transmitted power to a rack on the cutter-bar. In the new design the reversing motor drives through only one pair of gears, rotating a vertical screw which directly engages the cutter-bar.

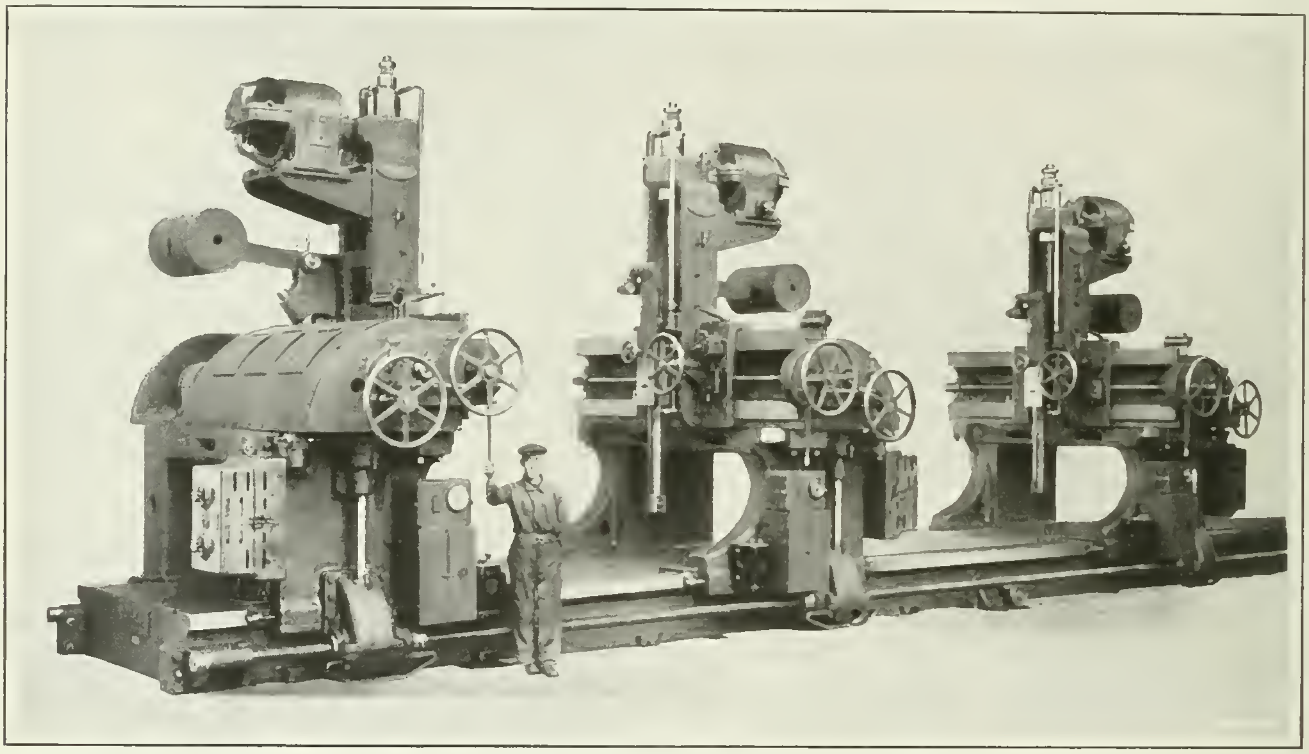

Fig. 1. Niles-Bement-Pond Locomotive-frame Slotting Machine equipped with Reversing Motors for driving Each Head

These reversing motors are of 20-horsepower capacity, and have a 4 to 1 speed range. The cutting and return speeds are controlled independently, and any combination can be obtained within the range of the motor. The return-speed range limits are naturally much higher than those of the cutting speed. Two dials on the contactor panel are connected with the rheostats which govern these speeds, the desired cutting speed being set on one dial and the return speed on the other. The motor is reversed by automatic contactors governed by a pilot switch, which, in turn, is actuated by the tripping of adjustable dogs on the cutter-bar. These dogs are set to give the desired length and location of stroke, the maximum stroke being 38 inches.

Another novel feature of this machine is the feeding arrangements. Each head has its own motor for feeding and traversing the head along the bed and the saddle along the cross-rail. This motor, through gearing, drives nuts on fixed screws extending along each side of the bed, to furnish the longitudinal feed and traverse of the head. The same motor feeds and traverses the saddle along the cross-rail through another train of gears. The control and operation of both the feed and traverse is electrical. A dial is set to cause the motor to make one or more revolutions intermittently and obtain the desired feed; however, the throwing of a switch permits the motor to run continuously to furnish a fast traverse to either the head or saddle.

The machine may be built in one-, two-, and three-head styles, and with any length of bed. The bed of the machine illustrated is 60 feet long. Each head is self-contained and independent in every way, and comprises two principal members—the yoke and cross-rail. The latter can be swiveled in the horizontal plane for cutting angular surfaces. The opening in the yokes is 61 inches wide and 41 inches high.

The extension tool-bar is cylindrical in form, has a relief socket on the tool apron and an upper bearing in the cutter-bar. The tool-bar is revolved by means of worm-gearing. Handwheels are employed for setting the tools and for cutting fillets. Slotting at an angle too steep to be accomplished by swiveling the cross-rails is necessary at the ends of some locomotive frames. This requirement is met in the machine by combining the longitudinal and cross feeds for simultaneous action. Combinations of these feeds may be obtained for slotting at any angle up to 45 degrees.

The car-wheel borer is of an improved design comprising several features which tend toward increased production and safety. The frame itself, as will be seen by referring to Fig. 2, is a one-piece casting of heavy construction which promotes output because of its rigidity and the ability to take heavy cuts. The pattern of the frame has been altered to give greater support to the hub-facing bar so as to make the heavy cuts possible.

An automatic self-centering chuck is an interesting and time-saving feature of the new machine. After the wheel to be bored has been swung into place on the table by means of the motor-driven crane supplied for that purpose, the motor is started at a slow speed. A mechanism in the table then causes the chuck jaws to move inward radially until they engage the wheel tread. When the job is firmly clamped, the table begins to rotate, and the driving force employed after the cutting operation begins, serves to further lock the wheel in the jaws. When the job is finished, the motor is reversed and the relative motion between the driving gear and the table then serves to loosen the jaws and withdraw them toward the periphery of the table. The boring-bar counterweight operates down an incline on the back of the machine frame, and is so arranged that it is prevented from falling in the event of breakage of the supporting chain.

The machine is supplied with reversing motors for either direct or alternating current. The different table speeds are obtained by using a variable-speed motor in the case of direct current and a constant-speed slip-ring motor operating through a speed-change box where alternating current is used. No clutches are used in either case. Dynamic braking can be employed when a shop is equipped with direct current. Although the machine can also be furnished for driving by belt, an electric drive is recommended.

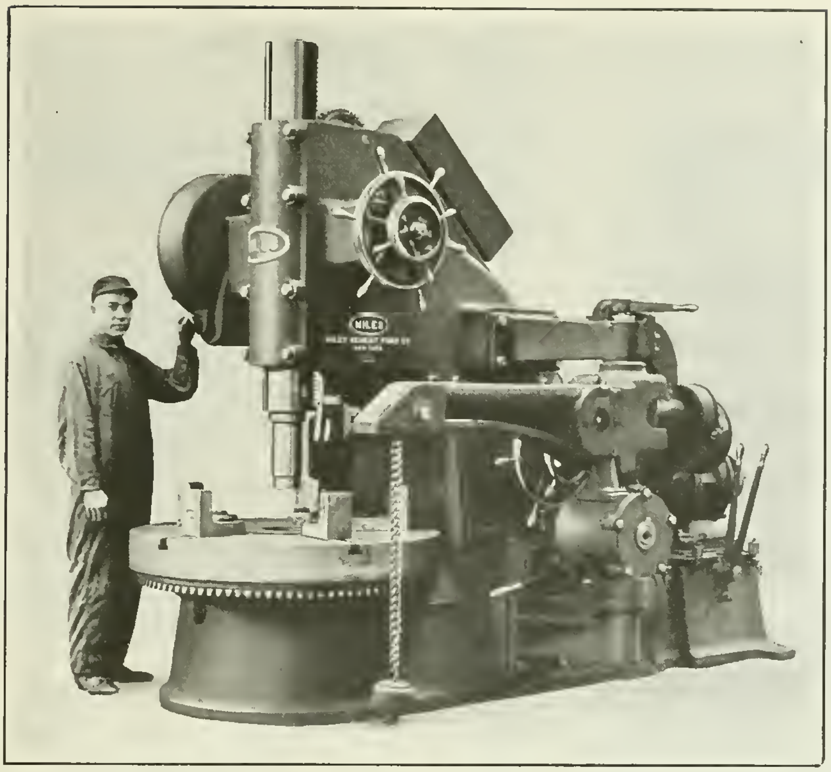
Fig. 2. Forty-eight-inch Car-wheel Borer with Hub-facing Attachment

AMERICAN AUTOMATICALLY OILED GEARED-HEAD LATHE

A recent development in lathe design is an automatically oiled twelve-speed geared-head machine made by the American Tool Works Co., Cincinnati, Ohio. The geared-head mechanism provides twelve mechanical spindle speeds in geometrical progression on all sizes of lathes up to and including the 36-inch "medium-pattern" machine. One of these lathes equipped with the new geared head is shown in Fig. 1. It is said that the 24-inch heavy-pattern lathe can use a 20-horsepower motor up to its full capacity; on the belt-driven machine of the same size the power is delivered to a 16-inch pulley by by a 6-inch double belt. All gears in the head are made of heat-treated manganese steel, and all speed change-gears are hardened. There are only three shafts, and so the gear centers can be located farther apart than in a four-shaft head of about the same dimensions, thus enabling gears of larger diameter to be employed. The entire mechanism runs in a bath of oil.

The head is under instant control through either of two levers, one located at the right-hand side of the apron and the other at the left-hand side of the head. These levers operate a friction clutch incorporated in the driving pulley, or in the driven gear of the motor train when the machine is motor driven. A band brake operates in unison with the friction clutch, being engaged when the friction is released. By means of the band brake, the spindle may be instantly stopped or allowed to drift, and may be securely locked in the stationary position.

In order to relieve the driving shaft from the belt pull, the pulley is bronze-bushed and mounted on a long steel sleeve of large diameter which takes the belt pull. This sleeve is also bronze-bushed and forms the journal for the driving shaft to which the pulley is keyed. An automatic oiling system reduces to a minimum the possibility of the pulley unit running dry. A feature of the head is the use of a gear-tooth clutch on the high-speed drive in place of the jaw clutch commonly used. The clutch consists of an external and an internal gear of the same diameter, pitch, and number of teeth. It is engaged and disengaged as easily as an ordinary transmission gear is slipped in and out of engagement. The clutch teeth are generated on a Fellows gear shaper, and rounded on the ends to facilitate engagement. Both members of the clutch are made of alloy steel, heat-treated and hardened.

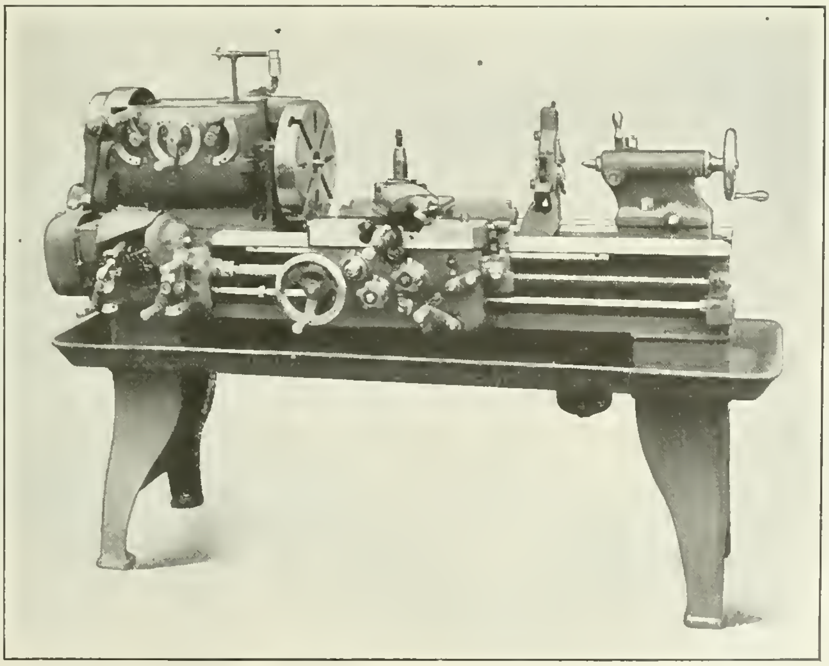
Fig. 1. American Twelve-speed Lathe equipped with an Automatically Oiled Geared Head

An automatic oiling system for lubricating the geared head is one of the most important improvements incorporated in the machine. By means of a geared pump located in an accessible position inside the head, oil is pumped from a reservoir in the bottom of the head to a filtering and distributing tank in the head cover, from which every bearing in the head is lubricated. The construction will be understood by reference to Fig. 2 and the diagrammatic view of the oiling system in Fig. 3. After the fil-

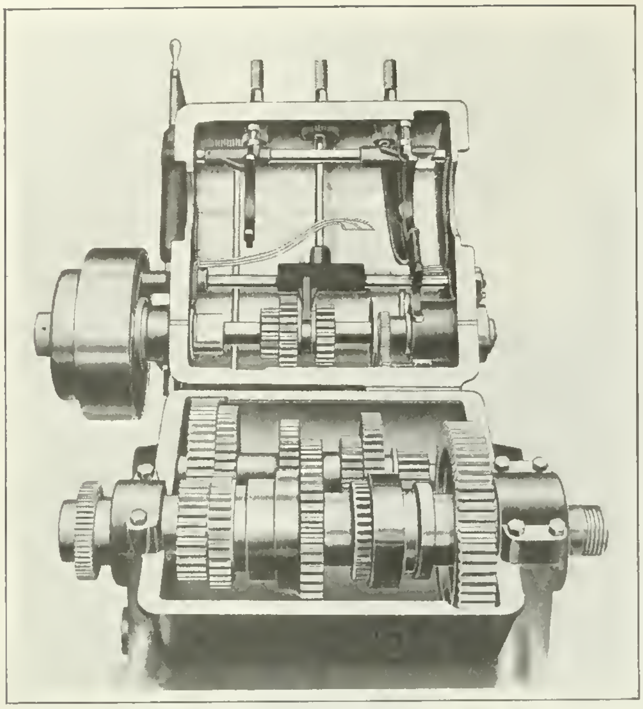

Fig. 2. View of the Geared Head with the Cover raised to show the Gears and Oiling Arrangement

tration of the oil, it gravitates to the various head bearings through pipes leading from the filtering tank. The pump supplies oil to the tank faster than the filter can take care of it and in much larger quantities than the bearings use; consequently, the surplus overflows on the gear teeth and keeps them constantly lubricated. All oil supplied to the bearings is thoroughly cleansed and strained by the filter to insure clean lubrication.

All heavy particles of foreign matter in the oil fall to the bottom of the reservoir in the head casting, and as the oil accumulates in this settling tank it overflows into a straining compartment from which it passes through a fine-mesh metal strainer into the pumping reservoir. From this point it is lifted by the pump into the filtering tank in the head cover, where it is filtered through a felt pad one-half inch thick before it reaches the distributing chamber from which it is led to the various bearings. This distributing chamber is divided into several compartments, each of which holds a supply of oil for one particular bearing. This arrangement insures that each bearing will have a copious supply of oil which cannot be diverted to any other bearing. A removable plug in the bottom of the settling tank provides a means for removing the sediment from the tank, and a signal glass in the supply line from the straining compartment to the filtering tank shows the operator how the oil-pump is working.

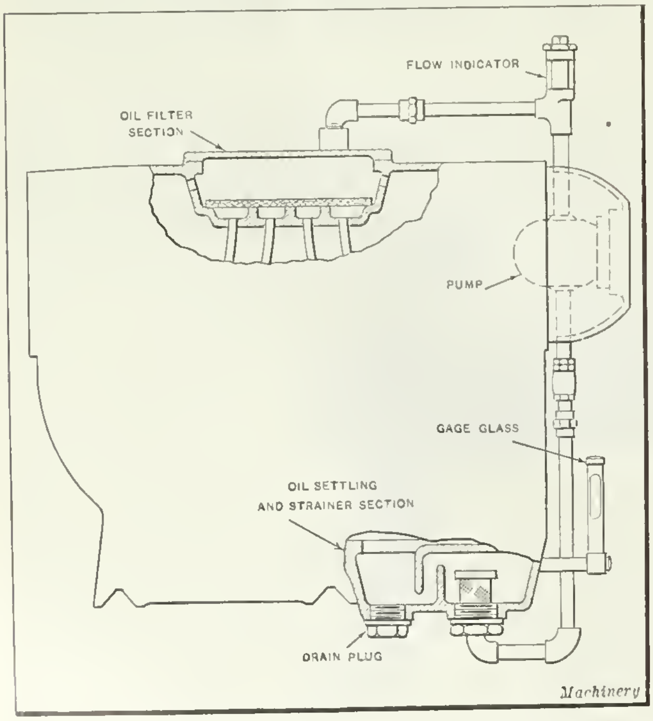

Fig. 3. Diagram of the Automatic System for oiling the Head Unit

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LANDIS IMPROVED PIPE AND NIPPLE THREADING MACHINE

An improved design of pipe and nipple threading machine has been brought out by the Landis Machine Co., Waynesboro, Pa. It is equipped with a Landis internally tripped die-head, which automatically insures a uniform length of thread on nipples and eliminates the necessity of gaging each nipple by hand. Threading, reaming and chamfering operations can be performed on pipe and nipples. The machine is shown in Fig. 1, and the operating principle of the internally tripped die-head is illustrated in Fig. 2. This die-head is equipped with high-speed steel chasers and chamfering reamers.

Referring to Fig. 2, it will be seen that the knurled collar *A* and clamping rod *C* are integral. One end of rod *C* is threaded and screws into a tapped hole in the shank of reamer *K*. Knurled collar *B* is integral with tube *D*, the latter being threaded on one end to screw into spider *E*. Spider *E* has a square hole through it, and is tapped part of the way to fit tube *D*; this gives thread bearings on the four sides of the square hole. The remaining portion of the hole in the spider is left plain to afford a bearing for driver *H*. Driver *H* also has a square hole in the end to receive the shank of reamer *K*.

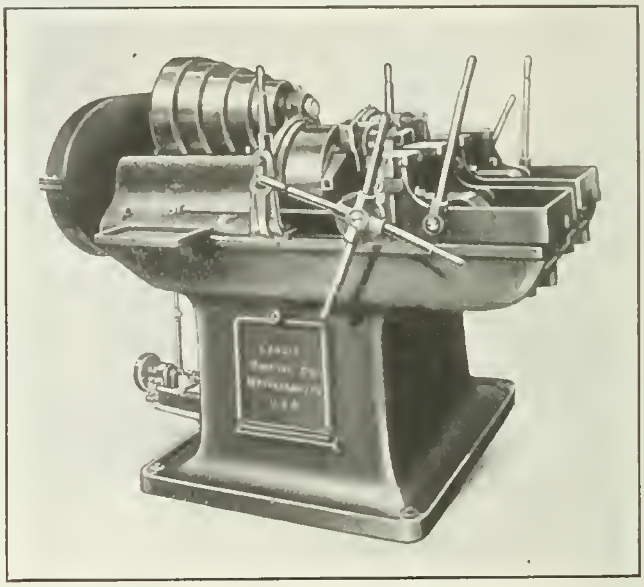


Fig. 1. Landis Pipe and Nipple Threading Machine with Internally Tripped Die-head

To set the reamer to the correct position, the knurled collar *A* is tightened by hand. This clamps together in one unit, tube *D*, driver *H*, and reamer *K*. Surface *Y* on the reamer has no cutting edge; therefore, as a nipple is being threaded and the end begins to bear on the reamer, parts *D* and *H* transmit pressure to spider *E*. Through the medium of pins *F* in the spider, rings *G* and *I* are carried backward for a distance *X*, or until pin *M* is disengaged from bushing *L*. The full opening movement is then completed by a spring in the adjusting ring. To adjust reamer *K* longitudinally, clamping rod *C* is unscrewed by turning knurled collar *A* to the left. Then collar *B* is turned to the right or the left for a forward or a backward adjustment, depending

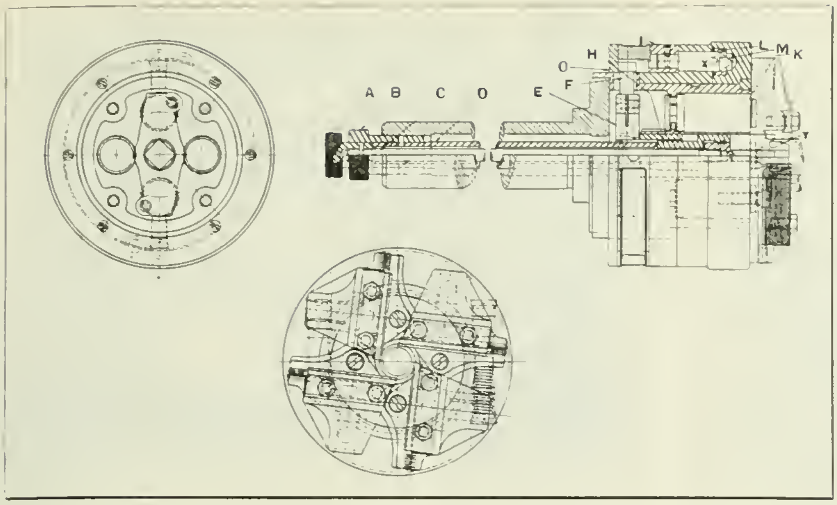


Fig. 2. Construction Details of the Landis Internally Tripped Die-head

on the length of thread to be cut. This machine is made in ½-, 1¼-, 2-, and 4-inch sizes, and in both single- and double-spindle types.

CLEVELAND UNIVERSAL DRILL JIG

A drill jig of novel design is being introduced to the trade by the Cleveland Universal Jig Co., 2005-2009 Oregon Ave., Cleveland, O. The jig is simple in construction, and is made in two types. Type A, which is shown in Fig. 1, arranged for drilling a hole in an automobile part, is designed primarily to take the place of the screw-bushing type of jig. It consists of a base and two columns in which there are two plungers holding a top plate, which is bored in line with a hole in the base, both holes receiving drill bushings. The plungers are operated up and down by means of racks and pinions in order to load and remove work. The pinion-shaft is actuated by the handle shown at the right, which is positively locked in any position on the sector by pressing the latch to pull down a wedge and cause a shoe to clamp the sector. The drill bushings can be made to suit any shape of work, whether round or odd.

Type B jig is shown in Fig. 2 in use for drilling a bell casting. This jig is designed to take the place of the leg-and-box type of jig. As with Type A, no clamps or screws need to be tightened in order to hold the work. It will be seen that this jig consists of a square base with a post fastened to each corner. To these posts a top plate is fastened, which is bored to receive the drill bushings. The same handle and rack-and-pinion movement are used as in the Type A jig, but instead of two plungers being pulled down, one plunger is pushed up to hold the work rigidly against the top plate while being drilled.

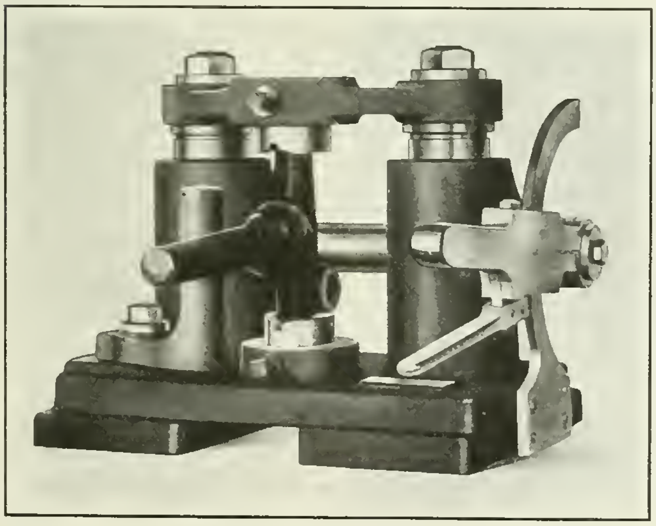


Fig. 1. Cleveland Type A Universal Drill Jig set up for drilling a Hole in an Automobile Part

The loading and unloading of the jig is simple, the work being put in place, and the handle pulled down so that the piece is held rigidly between the bushings, in the Type A jig, or against the top plate in the Type B jig, after which the handle latch is pressed to hold the work in that position. The handle latch is pushed down and the handle raised in order to remove the work.

Any number of different parts can be drilled by changing the bushings in the Type A jig, and the top plate in the Type B jig. This means a great saving in tool storage space and in the cost of making jigs for new parts, as it is only necessary to make new bushings or a new top plate when a different part is to be drilled. The greatest advantage claimed, however, is that a remarkable saving of drilling time can be effected, owing to the fact that both loading and unloading of the jig is done with the minimum number of motions. The loading time on practically all parts in both jigs is two seconds, and the unloading time is the same, making a total of four seconds.

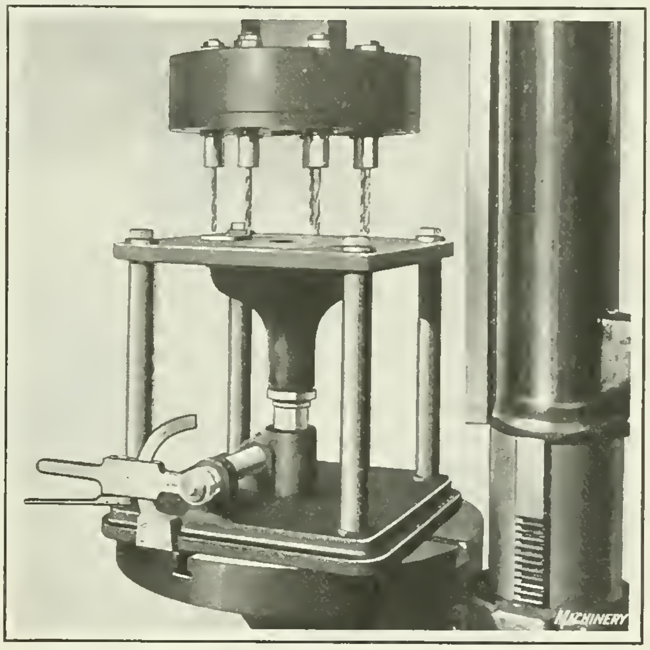


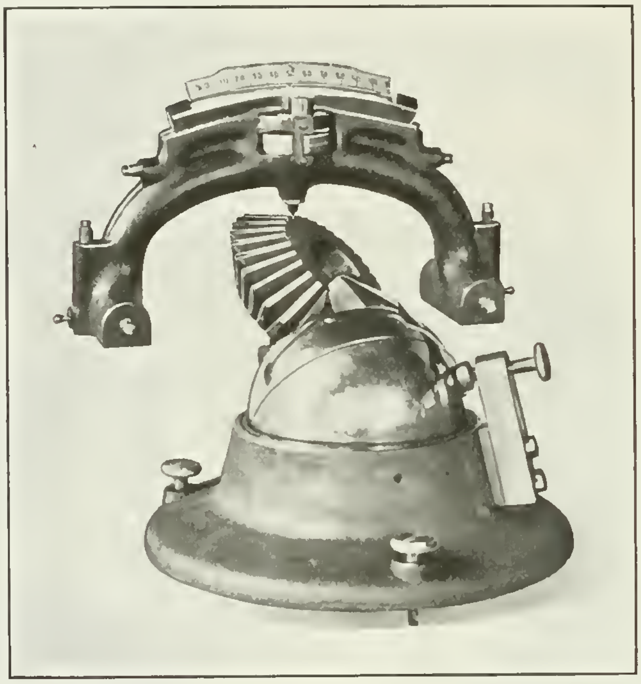
Fig. 2. Type B Universal Drill Jig set up for drilling the Bolt Holes in a Bell Casting

HERBERT PENDULUM HARDNESS TESTER

An instrument of considerable interest has been brought out by Edward G. Herbert, Ltd., Chapel St., Levenshulme, Manchester, England, for testing the hardness of substances from lead to sapphires. The special application of this device in the machine-building field is for testing hardened parts. Briefly, the instrument consists of a frame which is supported on the work by a ruby or steel ball, and may be oscillated like a pendulum. There is a curved spirit level at the top of the frame and a scale that permits of observing accurately the distance traveled by the bubble in the level when the frame oscillates. The hardness of a metal may be determined in two ways; first, by observing the distance that the bubble moves from the zero graduation on the scale with the first oscillation of the pendulum, and second, by ascertaining the length of time elapsed while the pendulum swings ten times. The construction and application of this device will be explained more fully in the following:

The ball on which the instrument rests is one millimeter in diameter and held in a chuck at the center of the device. Six adjustable weights are provided so that the center of gravity of the instrument may be made to coincide with the center of the ball. Directly above this ball there is a weight which is mounted on a screw, and by raising or lowering this weight, the center of gravity of the instrument can be brought to a predetermined distance above or below the center of the ball, graduations on the weight showing the displacement of the center of gravity in hundredths of a millimeter.

When the center of gravity is at the center of the ball and the ball rests on a hard level surface, the instrument will be in neutral equilibrium, and will remain in any position in which it may be placed, whether upright or tilted at an angle. If the center of gravity is above the center of the ball, the equilibrium may be unstable, in which case the instrument tends to "lie down" in some direction, but if the center of gravity is below the center of the ball, the equilibrium is stable. The instrument constitutes a pendulum which will oscillate about its central position, the time of oscillation being greater as the length of the pendulum (that is, the distance between the center of gravity and the center of the ball) is less. For standard tests, the length of the pendulum is one-tenth millimeter (0.0039 inch), and the time of a single swing on a very hard surface is ten seconds.



Herbert Pendulum Hardness Tester which tests the Hardness of Metals by the Length or Time of Oscillations

As previously mentioned, this pendulum hardness tester provides two entirely independent tests of hardness. Both these tests have a scale of hardness numbers from 0 to 100, but the hardness numbers of a given substance are not the same on the two scales. The two tests will generally show the same order of hardness for a given part, but sometimes a specimen will be shown harder or softer by one test than by the other. For most purposes, the time test is recommended, as it is quickly and easily made, gives uniform results, and does not require accurate leveling or extreme smoothness of surface; whereas the scale test requires accurate leveling of the surface to be tested (the instrument itself serves as a spirit level for this purpose) and freedom from scratches or other imperfections. The time test is a general test of hardness, and the scale test, in conjunction with the time test, is a further means of investigating the physical properties of materials.

In making a scale test, the device is tilted to the right until the bubble comes to zero on the scale, and then the instrument is placed in that position on a level surface and released. It will then swing in pendulum fashion with the oscillations gradually decreasing in amplitude owing to the expenditure of energy at the point of contact between the ball and the surface being tested. On plate glass the bubble travels from 0 to 97 on the scale: in the first oscillation, however, when placed on a less hard surface, such as hardened steel, the ball will indent the surface slightly and elongate this indentation as the pendulum swings. The energy consumed in thus displacing the metal is taken from the potential energy of the pendulum, as is shown by shortening its first swing.

The position of the bubble on the scale at the end of the first swing indicates the work done by the ball on the specimen, and is a measure of its hardness, as previously mentioned. In the case of a soft specimen, the indentation is relatively deep, and the pendulum comes to rest after a short swing; on lead it will not swing at all, so the bubble remains at zero. Typical scale-test readings with a steel ball are as follows: Glass, 97; very hard carbon steel, 93; hard carbon steel, 88; tempered high-speed steel, 75; annealed high-speed steel, 54; annealed carbon steel, 41; rolled brass, 14; cast brass, 4; and lead, 0.

In making a time test, the hardness number is the time in seconds consumed in making ten single swings. The pendulum is placed gently on the specimen with the bubble at or near 50 and caused to oscillate through a small arc. As the suspension is extremely delicate, it is preferable to set the pendulum swinging by touching it with a feather. The time is taken with a stop-watch provided with the equipment. In most cases it is sufficient to time a single or double swing, but on the softer metals and also for very accurate readings, the time of ten swings is taken. The time of oscillation is within limits independent of the amplitude. If it is caused to make a long swing on a soft metal, the instrument will merely settle down at the end of the swing in a new position, about which it will oscillate with short, rapid swings characteristic of the particular metal. Typical time-test readings with a steel ball are as follows: Glass, 100; very hard carbon steel, 75; hard carbon steel, 65; tempered high-speed steel, 52; annealed high-speed steel, 26; annealed carbon steel, 22; rolled brass, 15; cast brass, 11; and lead, 3.

If the pendulum is shortened to zero or the center of gravity of the instrument is placed above the center of the ball, the time of the swing will be greater than when the center of gravity is below the center of the ball, and the pendulum will be more sensitive to small differences in hardness; however, it requires more careful manipulation. Flat specimens are supported on a level table while being tested, and irregular or cylindrical objects are held in a universal ball vise provided with locking devices and leveling screws as shown in the accompanying illustration. A screw adjustment is provided for regulating the size of the bubble; the bubble tends to shrink in a warm atmosphere, but the instrument is otherwise unaffected by temperature. The pendulum is 12 inches long and will span flat surfaces up to 6 inches in width or circular objects up to 8 inches in diameter. The instrument is made in two weights, 2 and 4 kilograms, respectively, but the dimensions are identical in both. The lighter pendulum is supplied with either a ruby or a steel ball, and is suitable for testing the whole range of materials from lead to sapphires. The heavier pendulum is supplied with a steel ball only, and is intended for testing soft and hard materials up to and including hardened tool steels. This instrument is less affected by imperfections in the surfaces being tested than the lighter instrument, and is satisfactory for general shop testing.

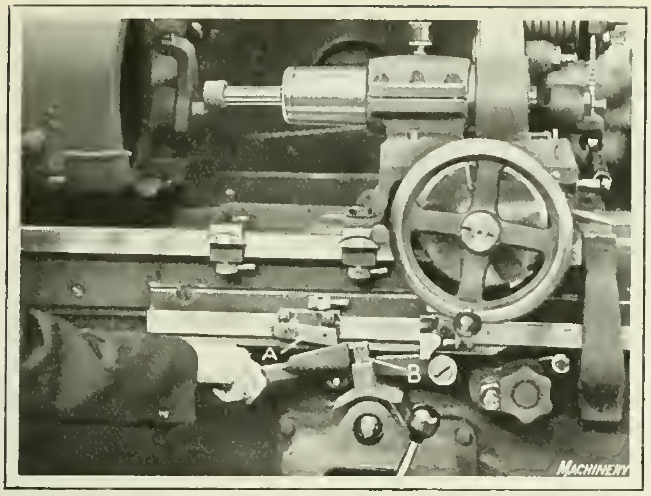


Fig. 1. Quick-return Mechanism for Table of Heald No. 72 Internal Grinding Machine

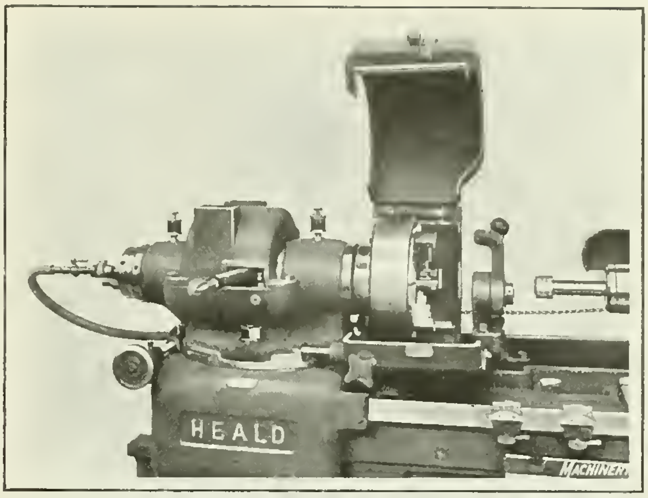


Fig. 2. Swinging Guard with which the Work-head of the Heald Grinder is now equipped

HEALD INTERNAL GRINDING MACHINE

A number of features have been added to the hydraulically driven No. 72 internal grinding machine built by the Heald Machine Co., 16 New Bond St., Worcester, Mass., which was described in March Machinery. The most important of the new features is a rapid return for the table. This rapid return is coupled with the hydraulic mechanism and is obtained as the wheel leaves the work on the out stroke, raising the left-hand dog *A*, Fig. 1, which causes the dog to pass over the reverse trip-lever *B*. A bevel surface on a bar under the dogs engages a roll which, in turn, actuates a plunger to operate a valve. This allows oil to go through a by-pass and furnish full power to move the table at top speed to the end of its stroke. Because of this quick return the operator may gage or remove the work with the loss of very little time. By simply throwing the reverse lever to the left the table again comes to the work at full speed, slows down to the working speed, and is then ready to grind a new part. Obviously, this rapid traverse effects a considerable increase in production.

Another new feature of the machine is the swinging work guard shown in Fig. 2. By simply releasing a spring catch, the guard swings up out of the way of its own accord and allows the operator plenty of room to gage or remove the work without inconveniencing him in any way. All piping on this machine is on the outside, which facilitates any necessary repairs to the line in case of leakage. There is a mechanism for opening and shutting off the water line simultaneously with starting and stopping the work. The lever on the front side of the work-head as seen in Fig. 2, which is used for starting and stopping the work, is connected through links at the back of the head to a valve in the water line.

The machine is also furnished with a swinging wheel-truing device, shown in Fig. 3 in the dressing position. Fig. 2 also shows this truing diamond, but in this illustration it is swung back out of the way. After the diamond has been once set and the wheel trued to grind a hole to the required size, it is only necessary to swing the truing diamond into position for subsequent dressings. The hole ground in the work need only be gaged occasionally to determine whether its size is being accurately maintained. When the wheel is worn slightly, the operator can move a dial one or two notches to bring the wheel into position for truing, and after truing, the wheel will be in the same relation to the work as when it was first trued, thus maintaining the correct size of hole.

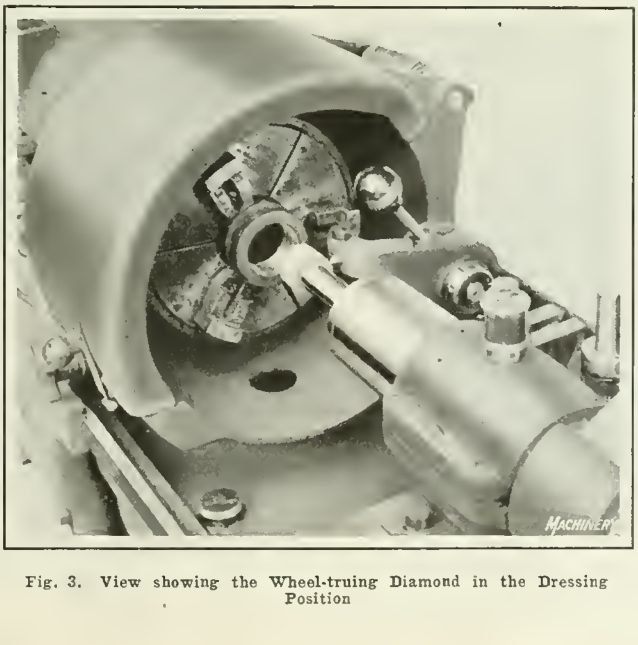


Fig. 3. View showing the Wheel-truing Diamond in the Dressing Position

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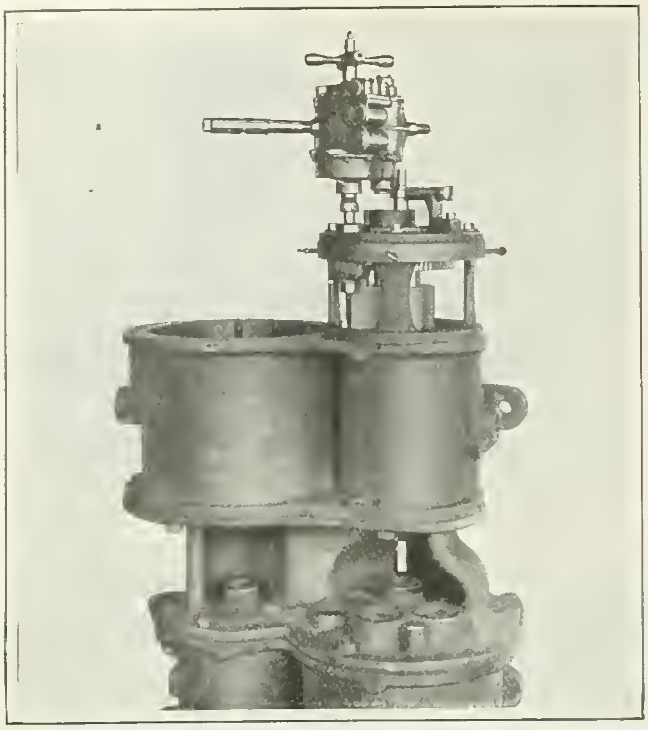
UNDERWOOD PORTABLE CYLINDER BORING EQUIPMENT

The latest development in the line of portable boring-bars made by the H. B. Underwood Corporation, 1015 Hamilton St., Philadelphia, Pa., is an improved equipment designed for reboring the cylinders of locomotive air compressors, either in the repair shop or while the compressor is in position on the locomotive, and for reboring pump cylinders in railroad shops and other industrial plants. This boring-bar is of a simple compact design that permits its use in close quarters. It is made with fewer parts than previous designs. The equipment consists essentially of a bearing plate carrying a boring-bar driving spindle and feed-screw mounted on a clamping ring, and a cutter-head.

Power for driving the equipment is derived from an air motor, the driving spindle being provided with a Morse taper shank to fit the motor. The spindle drives a pinion which meshes with a gear keyed to the boring-bar, affording a simple drive. Keyed to the feed-screw is a feed gear which meshes with a reverse gear journaled on a pin centered in the boring-bar. The reverse gear turns freely on this pin unless prevented by the engagement of a feed pawl, which holds the reverse gear stationary relative to the bar and causes the feed gear to revolve the feed-screw and advance the cutter-head into the work. The cutter-head is rapidly returned to the top of the cylinder by placing the motor on the shank of the reverse gear.

The application of the equipment is as follows: The pilot guide is screwed on the stuffing-box of the cylinder.



Underwood Portable Boring-bar Equipment for reboring the Cylinders of Pumps and Locomotive Air Compressors

the bar placed in the cylinder, and the clamping ring securely fastened to the top flange of the cylinder by studs and nuts, as shown in the illustration. Any inaccuracy in the position of the studs can be quickly corrected by means of four thumb-screws in order to set the bar in alignment. The tool is adjusted and held rigidly in the cutter-head by simply tightening a collar-screw and, if desired, may be as readily released when the cutter-head is at the lower end of the cylinder. In boring cylinders with this equipment, the use of calipers is entirely dispensed with, a gage furnished with each bar providing a simple method of setting the tool to the required position.

The time required for reboring both ends of a 9½-inch air pump with this equipment was as follows: Setting up on steam end, 7 minutes; reboring time, 16 minutes; removing equipment, 7 minutes; setting up on air cylinder, 8 minutes; reboring air cylinder, 15 minutes; removing equipment, 7 minutes; total time, 60 minutes. The tool is regularly made in sizes suitable for reboring cylinders and bushings of standard compressors, and may be adapted to other sizes by changing the cutter-heads. The weight of the equipment having a capacity for boring cylinders from 8½ to 11 inches in diameter and of 12-inch stroke (not including the weight of the motor) is about 140 pounds.

MOTOR DRIVE FOR HARRIS HOB SHARPENING MACHINES

The No. 815 automatic hob sharpening machine built by the Harris Engineering Co., Bridgeport, Conn., which was described in February, 1922, MACHINERY, is now being equipped with a new style of motor drive recently developed for the line of hob sharpening machines built by this company. This drive consists of two General Electric motors, one of which is mounted on the turntable which carries the wheel-head. Provision has been made for raising this motor to take up slack in the driving belt. The motor for driving the reverse table and indexing mechanisms and the spiral generating device is mounted on an integral bracket at the rear of the machine base, the necessary speed reduction being obtained through gears.

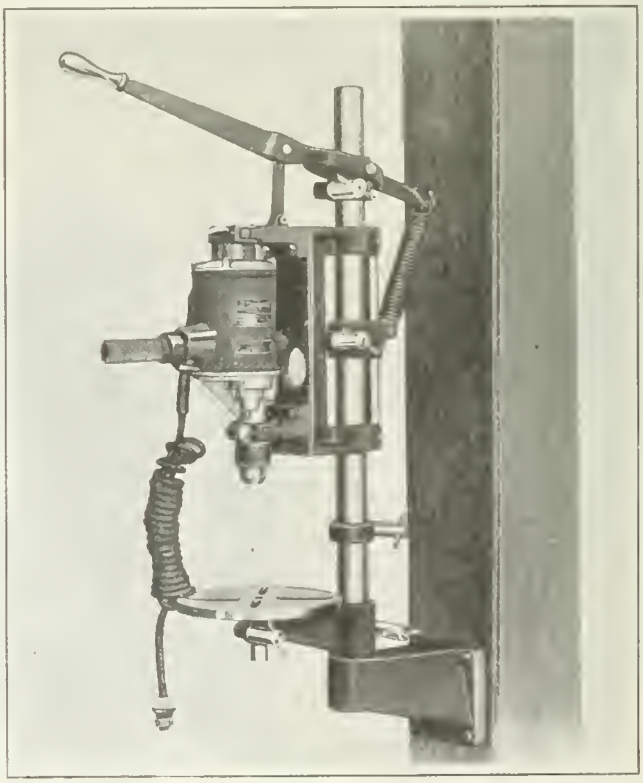
The upper motor is fastened by means of cap-screws extending through its feet to four large square-head adjusting screws. These screws are clamped rigidly in tapped holes in brackets by four lock-nuts. In adjusting the motor to take up belt slack, the four cap-screws and the lock-nuts are loosened slightly, and each of the square-head screws is turned an equal number of quarter turns, as indicated by the square head, until the belt is given sufficient tension. The lock-nuts and cap-screws are then tightened again to hold the motor rigidly. The motors are controlled by separate switch boxes of the safety type.

The vertical and lateral adjustments of the wheel-slide are effected through handwheels, which replace the ball-crank handles previously furnished. These wheels are of ample size to permit adjusting the slide closely. Each handwheel, through worm-gearing, operates a pinion that meshes with a rack on the movable member. The adjustment is very sensitive and easy to operate.

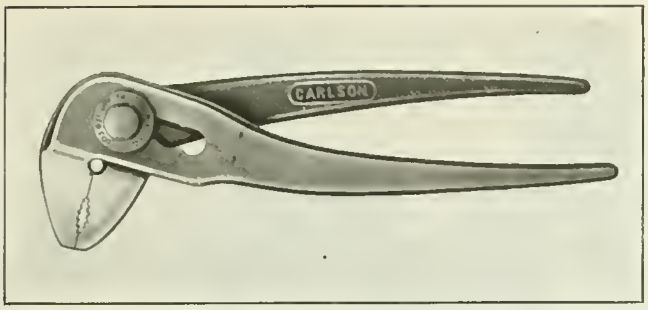
STANDARD PORTABLE ELECTRIC POST DRILL

The drill shown in the accompanying illustration is a recent design of the Standard Electric Tool Co., Cincinnati, Ohio. The principal advantage of this equipment is that it may be used as either a portable or a stationary tool, the drill being readily detached from the bracket for portable use. The company's hand and breast drills are used; this arrangement doubles the range of work of these tools.

The equipment can be mounted in any out of the way place, either on a wall or post. The bracket which holds the drill can be fitted at any point on the column, and raised and lowered by means of a clamping screw. The method of assembling the feed lever and coil spring gives an easy feed and a quick return. The table is slotted so that work can be clamped in place, and it can be swiveled about the column to any position that the post will allow. The drill bracket also swivels about the column, and both the table and the drill are adjustable vertically. The principal specifications are as follows: Over-all height, 36 inches; vertical adjustment of drill, 15½ inches; distance from column to center of table, 6⅛ inches; diameter of table, 9 inches; vertical travel of drill, 3⅛ inches; and net weight, 75 pounds.



Portable Electric Post Drill made by the Standard Electric Tool Co.



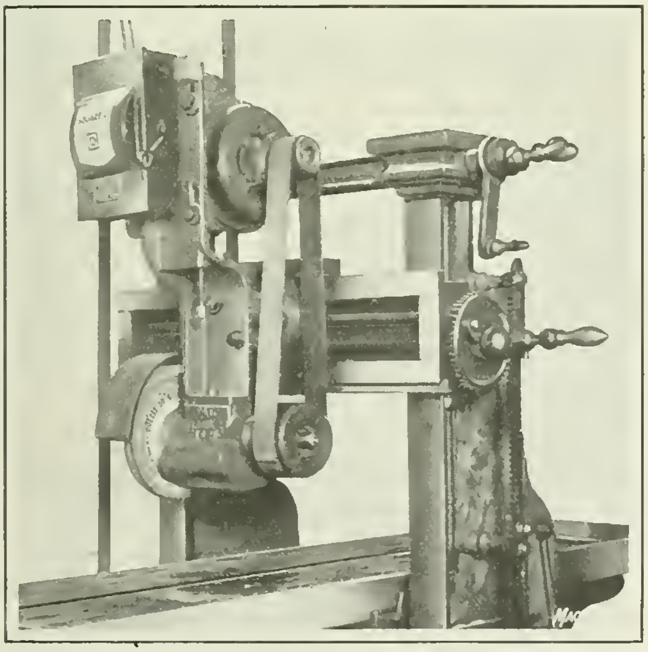
Carlson Plier which can be quickly adjusted to suit Different Sizes of Pipe

CARLSON PLIER

A plier that can be quickly adjusted to fit different sized pipes, bolts, nuts, caps, nipples, and similar parts, is now being manufactured by the Noble & Westbrook Mfg. Co., Hartford, Conn. The details of the construction may be seen in the accompanying illustration. This plier is especially useful for tightening or loosening parts located in corners or in close quarters. It is made from a drop-forging, machined, heat-treated, and given a charcoal and gun finish. The capacity is for parts up to 1 inch square or 1⅛ inches round, the length 7 inches, and the weight about ¾ pound. A patent is pending on the design of this plier.

HAWES PLANER GRINDING ATTACHMENT

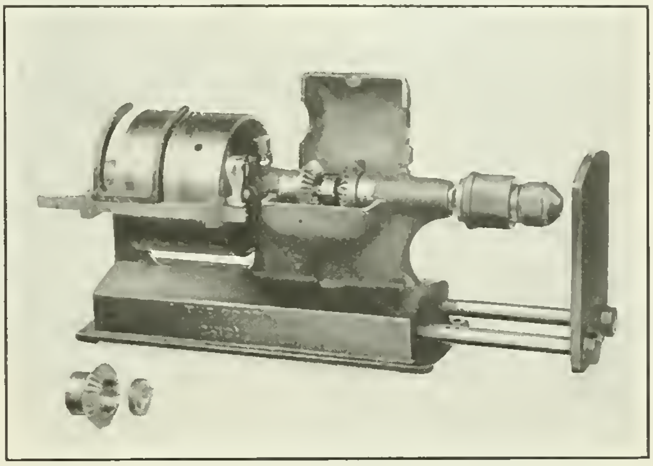
A grinding attachment intended for application on planers is being placed on the market by C. L. Hawes, Ashtabula, Ohio. This grinder will carry an emery wheel 12 inches in diameter and 2 inches thick. It is driven by a 1½-horsepower motor, an induction motor for 60-cycle three-phase current, running at 3600 revolutions per minute, being satisfactory. The wheel-shaft is 1 inch in diameter. The grinding head is equipped with Timken roller bearings mounted in dustproof housings. A patented oiling device insures proper lubrication from an oil reservoir which holds about a pint of oil and thus needs filling only about once a month. The motor has a 2-inch vertical adjustment for taking up stretch of the belt, and is held in position by means of an adjusting screw. The distance from the bottom of the bearing housing of the attachment to the top of the motor base is only 30½ inches.



Hawes Grinding Attachment for Application to Planers

PROCUNIER BENCH TAPPING MACHINE

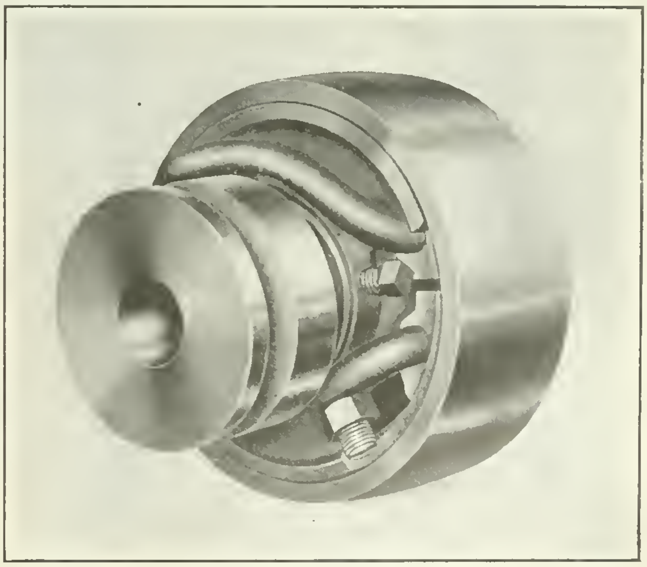
A bench tapping machine made by William L. Procunier, 18 S. Clinton St., Chicago, Ill., is shown in the accompanying illustration. This machine is equipped with a patented double-jaw chuck which grips and drives the tap by the square end, at the same time gripping and holding the tap true by the round shank. This tapping chuck may be furnished with or without a safety friction which slips the instant that a tap strikes the bottom of the hole, considerably facilitating tapping operations. In the lower right-hand corner of the illustration are shown two parts of the improved clutch used in this machine. In case these parts become worn out, it is a simple matter to replace them, disassembly of the machine not being necessary.



Procunier Tapping Machine of the Bench Type

CONWAY EXPANSION CLUTCH

For geared-head lathes and other single-pulley machines in which speed changes are obtained through gears, the Conway Clutch Co., 1962 W. 6th St., Cincinnati, Ohio, has brought out a line of expansion clutches which are said to develop a large amount of power for the space occupied. A feature of this clutch is the complete release obtainable, there being a friction band which springs entirely free from the drum because of its resiliency. This band is held tightly concentric with the shaft by means of a guide machined on the periphery of a carrier. There is a space of 0.010 inch between the friction band and the drum at all points when the band is released. The actuating parts are made from "Hytem" alloy steel and are hardened and toughened.



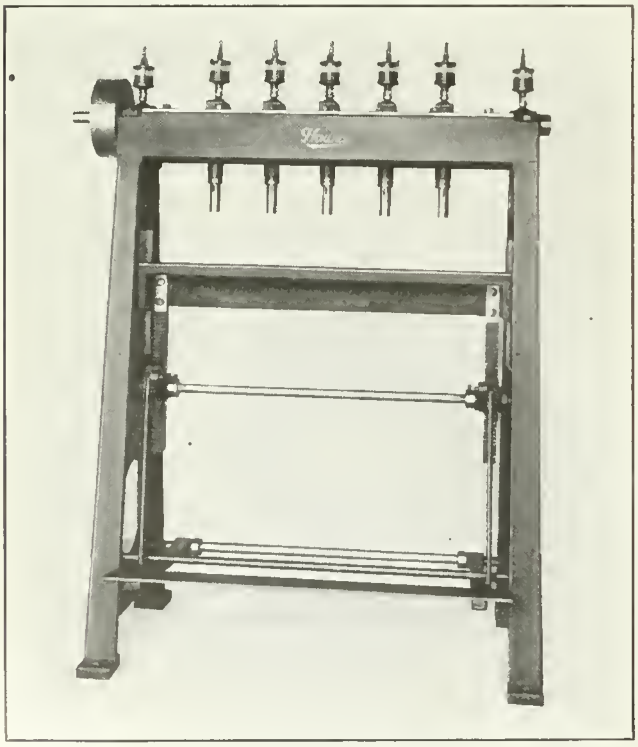
Conway Expansion Clutch for Geared-head Lathes and Other Single-pulley Machines

A large lever ratio is embodied in the clutch to reduce the power required for shifting, thus permitting the use of short levers. One screw is employed to adjust the entire clutch evenly. All parts are made to standard "Go" and "Not Go" gages so as to be interchangeable. In mounting this clutch on a shaft, oil is first applied on the shaft and then the collar is slid to the proper position and set. The loose member, consisting of the pulley, sleeve, and gear, is then slid against the collar, and after seeing that this unit revolves freely on the shaft, the clutch is forced into place over a key and held by a set-screw. End play of 1/64 inch is allowed between the inside face of the carrier and the loose member. The cone is then assembled on the shaft, after which the yoke or shifter fork is inserted. An oil chamber in the loose member should be filled each week with as much mineral oil as it will hold.

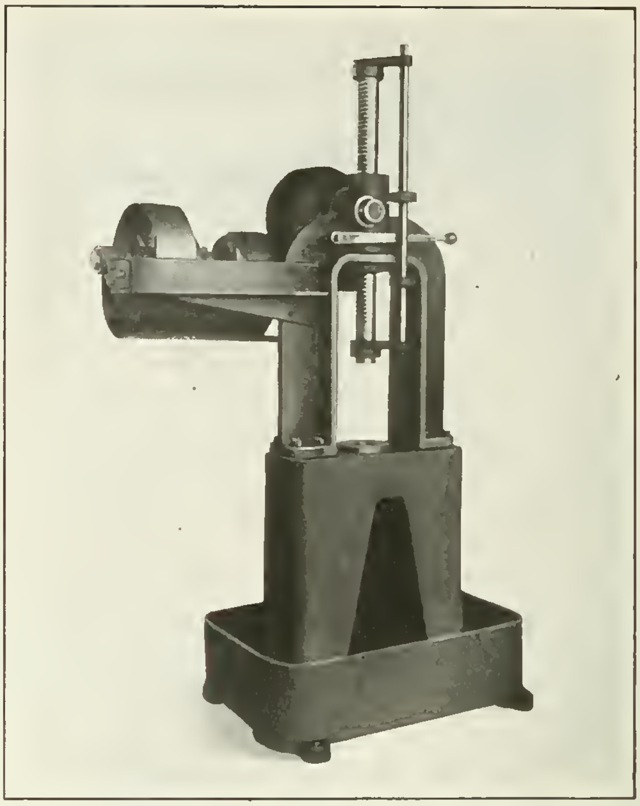
HAWES GANG DRILLING MACHINE

For a special variety of work in which holes are to be drilled in a straight line and the same or various distances apart, C. L. Hawes, Ashtabula, Ohio, has designed the gang drilling machine illustrated. Each drill spindle has an individual gear-case, all the gears in which are hardened and ground. The drill heads can be set any distance apart from 1¾ inches to within the range of the machine. All that is necessary to change the position of a head is to loosen the gib screws on top of the main frame which clamp the head in position, after which the head may be slid to the desired location. After the gibs have been retightened, there is no danger of the heads working endways out of position.

The illustration shows the machine fitted with a table operated by means of a foot-treadle; however, hand-operated and automatically fed tables may also be supplied, the type of table depending on the nature of the work to be handled. The machine may be run at a high speed for wood work. Each spindle has a ball thrust bearing and a No. 1 Morse taper socket. Some of the important dimensions are as follows: Height from floor to center of driving shaft, 52 inches; length of table inside of housings, 35 inches; and maximum height from top of table to nose of spindles, 9 inches. The approximate shipping weight is 1000 pounds.



Hawes Gang Drilling Machine



American Vertical Press for Push-broaching and Assembling Operations

AMERICAN BROACH AND ASSEMBLY PRESS

A vertical press having a pressure capacity of from six to eight tons and a maximum stroke of 18 inches has been built by the American Broach & Machine Co., Ann Arbor, Mich. The machine is intended for push-broaching operations and assembly work. It is equipped with a pair of friction clutches which gives it a flexible control. The drive is transmitted through a hardened steel worm and bronze worm-gear, and then through a hardened pinion to the steel ram. Automatic stops are provided, which are adjustable to suit the desired length of stroke. The table is bored 5 inches in diameter central with the ram to receive standard reducing bushings such as are used on horizontal broaching machines. The ram is 2½ inches in diameter, and has a hole in the lower end which is tapped 2 inches in diameter and 8 threads per inch. The space between the upright legs of the frame is 12 inches.

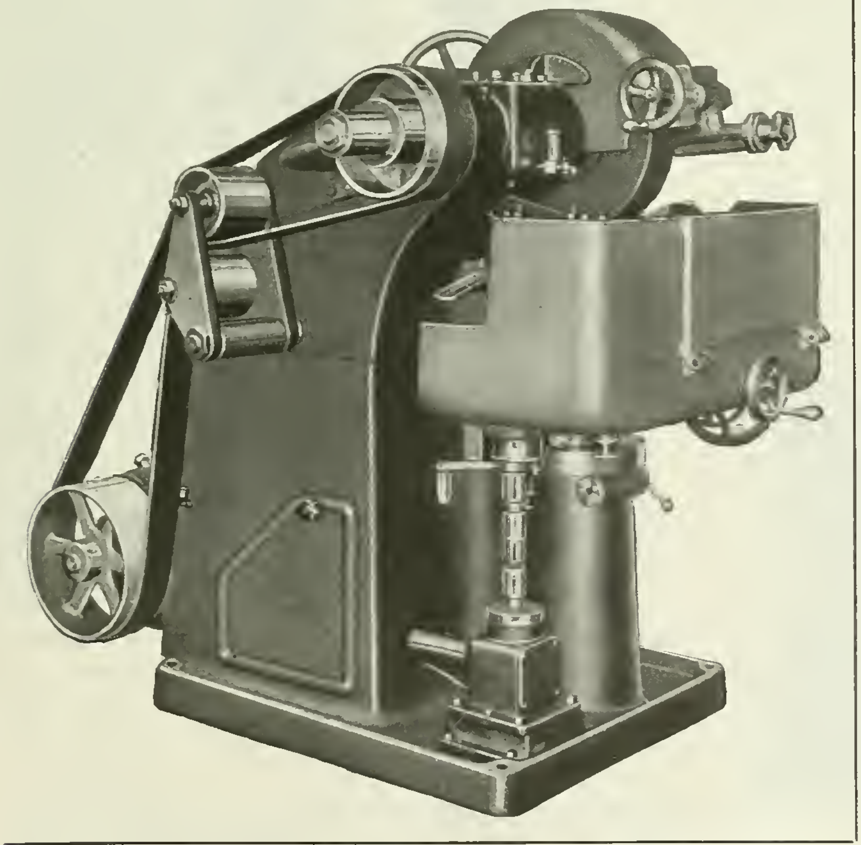
DETROIT CENTERLESS GRINDING MACHINE

An improved centerless grinding machine known as the No. 4-B has been brought out by the Detroit Machine Tool Co., 6525 St. Antoine St., Detroit, Mich., for grinding accurately, on a high-production basis, straight cylindrical parts such as piston-pins, gear and governor shafts, rubber and fiber rods, ball and roller bearing races, etc. The basic principle of the earlier No. 4 grinding machine described in April, 1921, MACHINERY is incorporated in the new machine; that is, the feed wheel is directly beneath the grinding wheel so that the work being ground rests on it and is rotated by it. This feed wheel is double the width of the grinding wheel, so that the work is rotating at the proper speed when it comes in contact with the grinding wheel. The feed wheel is mounted on a vertical column, about which it may be pivoted to vary the angle with the grinding wheel any amount up to 10 degrees, thus changing the speed of the work through the machine.

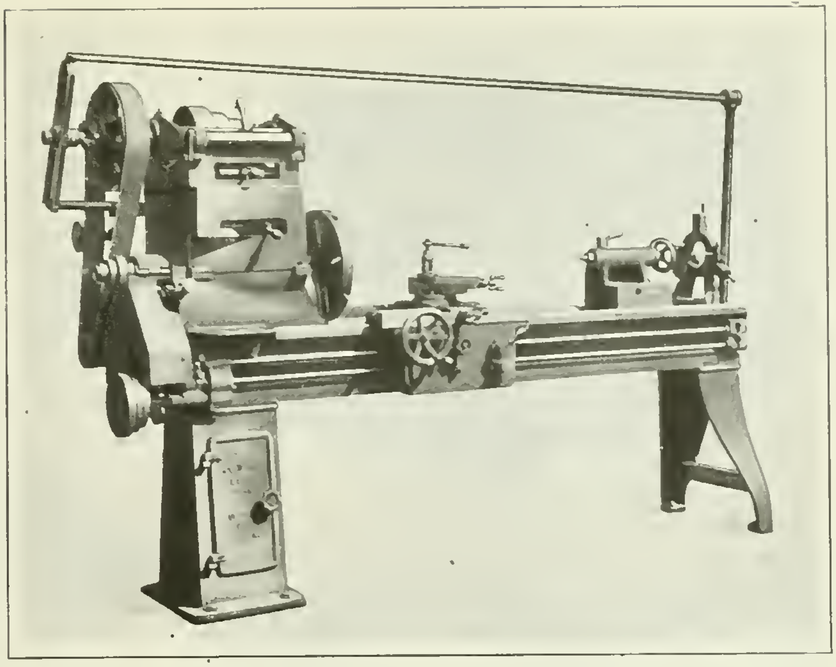
The diameter to which work is ground is controlled by means of a sensitive adjustment in the column of the lower unit. The adjustment is made through a large handwheel and a dial having graduations of ten-thousandths inch, spaced one-quarter inch apart, which, of course, permits minute adjustments. Two speeds for both the grinding and driving wheels are obtained through a change-gear box. The main driving pulley is 12 inches in diameter and runs at 750 revolutions per minute, giving grinding wheel speeds of 1080 and 1176 revolutions per minute and driving wheel speeds of 33 and 44 revolutions per minute. Other grinding wheel speeds may be obtained by the use of a special pulley.

The feed wheel is driven direct from the change-gear box through a pair of bevel gears and a vertical universal drive. This direct drive overcomes any tendency toward unsteady rotation of the lower wheel which might occur from the slipping of a belt. Backlash in the feed wheel is prevented by including a worm drive on the lower spindle, there being an ingenious arrangement to compensate for wear of the worm-gearing. The grinding wheel is driven by belt from the gear-box pulley, the belt running over a ball-bearing idler.

A feature of the grinding wheel drive is the method used for connecting the spindle to the ball-bearing spindle pulley. The pulley is mounted on a stud which is supported at the outer end by a cast-iron bracket. The inner side of the pulley carries a plate provided with a splined bore which engages with the splined end of the spindle so as to form a flexible coupling. This coupling transmits only a rotary motion to the spindle and thus overcomes the possibility of wear in the spindle bearing due to belt pull. The machine grinds work up to and including 4 inches in diameter.



Detroit Centerless Grinding Machine of Improved Design



Steptoe Engine Lathe equipped with Motor Drive

MOTOR DRIVE FOR STEPTOE LATHES

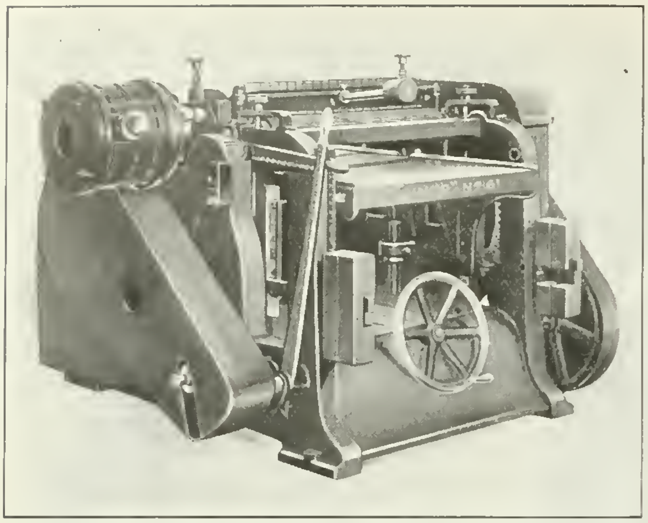
The line of engine lathes recently brought out by the John Steptoe Co., 2961 Colerain Ave., Cincinnati, Ohio, may now be equipped with a compact motor drive, as shown in the accompanying illustration. The arrangement is applicable to the 14-, 16-, 18-, and 20-inch machines. It can be readily attached to lathes in the field, as little machining is necessary, the principal work required being the drilling and tapping of a few bolt holes.

The countershaft unit is bolted directly over the lathe cone pulley, and is provided with a clutch gear so that the motor can be engaged and disengaged instantly. The cone pulley on the countershaft may be moved away from the lathe spindle to tighten the headstock belt while the proper tension of the belt from the motor to the countershaft is maintained by means of an idler pulley. The motor is placed directly behind the lathe in line with the bed. A constant-speed motor running at from 1100 to 1200 revolutions per minute is recommended.

OLIVER "MOTOR-ON-HEAD" SURFACERS

All wood surfacers or planers built by the Oliver Machinery Co., Grand Rapids, Mich., may now be equipped with a motor drive in which the rotor is mounted directly on the shaft of the cutting cylinder, and the stator is fastened to the frame of the machine. This drive eliminates all belting, as will be seen by referring to the accompanying illustration of the No. 61 improved single surfacer, which is intended primarily for pattern-shop use.

The machine is made in two widths, namely, 24 and 30 inches, and the bed may be lowered to plane material up to 8 inches thick. The standard feeds are 14, 18, 24, and 31 feet per minute. The cylinder is a crucible steel forging, and carries thin high-speed steel knives which are



Oliver No. 61 Pattern-shop Single Surfacer with Improved Motor Drive

securely clamped against steel chip breakers having lips shaped to repel shavings and chips. The cylinder is ground to size all over and is provided with ball bearings. A back pressure bar follows the cylinder to supply a hold-down pressure on the lumber as it leaves the cutting member. Adjusting screws provide for regulating the pressure.

The Oliver Machinery Co. has also developed a No. 100 motor-driven knife-grinding attachment which may be operated from a lamp socket and which is designed for use on any of the surface planers or jointers built by the company. It grinds or "joints" the knives while they are held securely in place in their cutting position in the heads. Frequent whetting and joining is a comparatively simply matter, and so it is easy for the operator to keep the knives sharp.

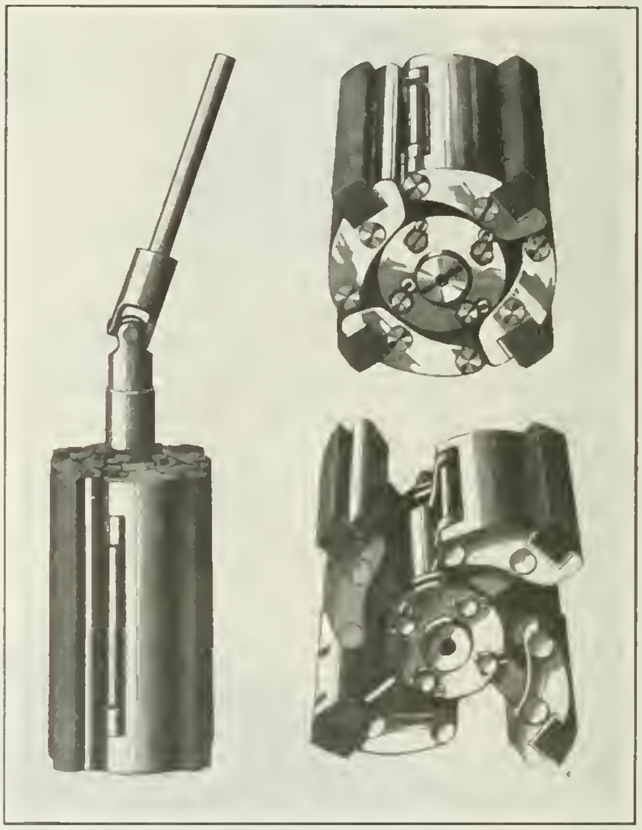
VAN KEUREN "MICROGAGE" SET

A complete set of "microgages" arranged in ten-thousandths of an inch, which is intended for checking micrometers and also for direct use on parts being machined, has been added to the line of measuring instruments manufactured by the Van Keuren Company, 362 Cambridge Street, Boston 34, Mass. Heretofore the "microgages" were only obtainable in small sets and in thousandths of an inch. The set illustrated contains thirty-five gages; the ten-thousandth series of ten gages ranges from 0.1000 to 0.1009 inch; the thousandth series of ten gages, from 0.101 to 0.110 inch; and the hundredth series of nine gages, from 0.120 to 0.200 inch. The remaining gages measure 0.300, 0.500, 1.000, 2.000, 3.000, and 6.000 inch, respectively. Standard gage-block sets are usually limited to 4-inch gage-blocks; with the 6-inch block the range of the set is 14 inches, and over 140,000 combinations are available. The 6-inch block may also be used for increasing the range of existing sets of gage-blocks.

Van Keuren "Microgage" Set for checking to Ten-thousandths of an Inch

"CENTRIMATIC" CYLINDER HONE

An automobile cylinder hone having self-adjusting, self-centering, and self-aligning features which are said to insure round and parallel cylinder bores, is now being placed on the market by the Automotive Maintenance Machinery Co., 549 W. Washington St., Chicago, Ill. As will be seen from the illustration, there are four honing stones held by wings which are hinged at both ends to the rigid arms of a central spider. Because of this construction the stones are always maintained parallel to each other and to the axis of the tool, no matter what their distance from the center of the hone. When the hone is rotated in a cylinder bore, the centrifugal force causes the wings to swing out and bring the stones in contact with the cylinder walls. An end view of a closed hone is shown in the upper right-hand corner of the illustration, while an expanded hone is shown in the lower right-hand corner. Abrasive stones which remove metal at a rapid rate without loading and which polish the walls in the same operation have been selected for the tool. No liquids or lapping compounds are required.



Self-adjusting, Self-centering, and Self-aligning Cylinder Hone made by the Automotive Maintenance Machinery Co.

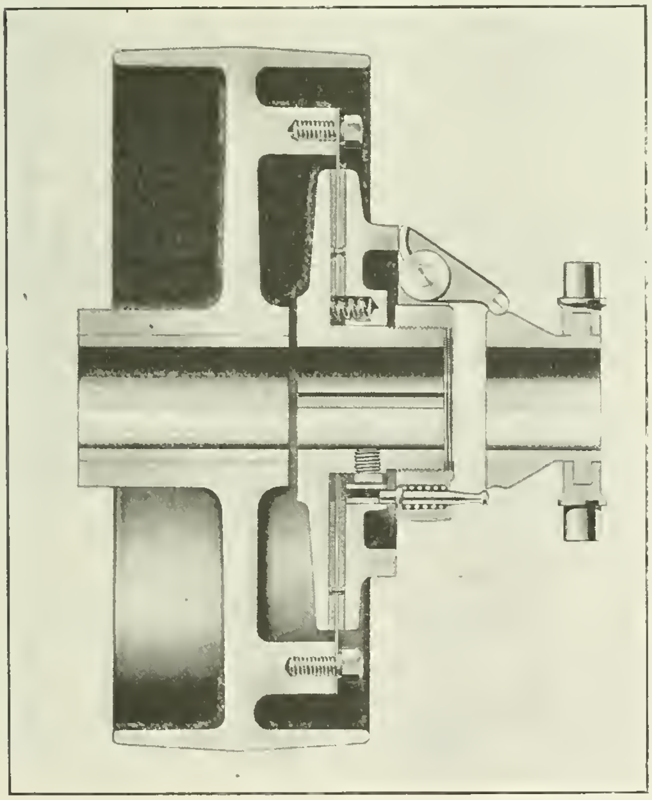
The self-adjusting and self-aligning features are obtained by interconnecting the wings with links to a pair of disks. These connections coordinate the action of the four wings so that the slightest radial travel of one wing produces an equal travel of the other three. This linkage automatically keeps the stones equidistant from the center of the hone and insures that the cutting surfaces of the stones will rotate in a true circular path.

Each stone is held by a steel channel and hollow setscrews in such a way as to distribute the honing pressure along the entire length of the stone. This insures a minimum of stone breakage, and makes the replacing of a stone a quick and simple matter. The centrifugal action resulting from the rotation of the hone within the cylinder, in addition to expanding the hone automatically to the correct diameter, also provides the proper cutting pressure. It is not necessary to caliper the hone diameter before beginning to work on a cylinder; the diameter of the bore needs to be watched only during the operation.

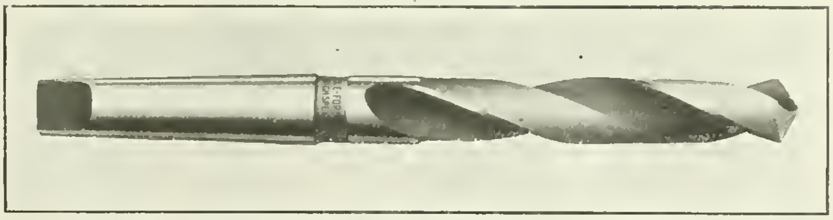
Extension blocks provide for increasing the diameter across the honing surfaces of the stones when cylinder bores from 4 to 5 inches in diameter are to be honed. It is recommended that the hone be driven at a speed of from 800 to 1100 revolutions per minute. The drive may be furnished by a portable electric drill, standard drilling machine, or multiple-spindle honing machine. In grinding a cylinder it is the practice first to enlarge the bore at its smallest diameter, and then slowly move the hone up and down until the bore in enlarged the full length to the desired diameter.

TWIN-DISK CLUTCHES

Two disks are brought into contact with the sides of a steel driving plate bolted directly to the flywheel or the driving pulley of a machine in a line of clutches which is being introduced to the trade by the Twin Disc Clutch Co., Racine, Wis. The construction will be readily understood by referring to the sectional view shown in the illustration. These clutches are intended for driving machines direct from main shafts without the necessity of using countershafts and the extra belting. When used with a pulley, either the pulley or clutch must be a floating fit on the shaft to provide the lateral movement required for the free running clutch when it is disengaged. Twelve holes provide for adjusting the distance between the two disks; this is accomplished by pulling out the locking pin and turning the yoke until the pin drops into the next hole. This gives an adjustment of 0.005 inch between the disks. A grease cup must be fitted to the throw-out collar and filled frequently. As the clutch is of the dry-plate type, the disks should not be oiled. In one installation, a battery of eight lathes is driven from one jack-shaft by equipping each machine with one of these clutches, thus eliminating eight countershafts and cross belts.



Twin-disk Cluch which transmits Power direct from the Flywheel or Driving Pulley



"Cle-Forge" Drill which is hot-worked and milled to give it the Qualities of Both Forged and Milled Drills

"CLE-FORGE" DRILLS

High-speed drills have been made by two methods during the last few years. The first method involves a hot-working process to form the flutes, followed by a machining and a twisting process, or simply by a twisting process. In the second method the drill is milled from round bars. The Cleveland Twist Drill Co., Cleveland, Ohio, has for years manufactured both types of drills and has experimented, with a view to placing on the market one that would have the advantages possessed in part by the forged drill and in part by the milled drill. In spite of the additional toughness imparted to the drill by the first method, the second type of drill is the one manufactured and sold in the largest quantities. This is attributed to the fact that the webs of such drills are centrally located by the milling machine, whereas with the forged drill the web may not be central and it may be necessary to bring it in the correct position by a straightening or a flute grinding process or by resorting to both processes.

As a result of these experiments, the Cleveland Twist Drill Co. is now placing on the market high-speed drills made by the "Cle-Forge" process, these drills being hot-worked where necessary to impart toughness, and machined afterward in the same manner as a milled drill. In fact, the new drills cannot be distinguished from the milled product by mechanical inspection. In cutting quality and strength they are said to surpass the forged drills and their accuracy equals that of milled drills.

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MEETING OF THE TAYLOR SOCIETY

The Taylor Society, the purpose of which is to promote the science of administration and management, will hold a meeting at Hotel Onondaga, Syracuse, N. Y., June 7, 8, and 9, to which everyone interested is cordially invited. The program includes the presentation of the following papers: "Business Cycles and Unemployment," by Wilford I. King, Bureau of Economic Research, New York; "The Sales Machine: 1923 Model," by Harry R. Wellman, consultant on sales problems, professor of marketing at the Amos Tuck School, formerly sales manager of J. Walter Lowney Co.; and "The Planning Department as an Instrument of Executive Control," by Keppele Hall, supervisor of planning, the Joseph & Feiss Co., Cleveland. During the meeting opportunities will also be presented for the inspection of the planning department of the H. H. Franklin Mfg. Co., and of the planning department of the Corona Typewriter Co.

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At the 1923 meeting of the National Foreign Trade Convention it was decided to hold the next annual meeting in Boston in the latter part of May, 1924. It is believed that a meeting held in New England will attract an unusually large number of delegates, and that next spring will see the largest foreign trade meeting ever held in the United States.

SPRING MEETING OF MECHANICAL ENGINEERS

The American Society of Mechanical Engineers held its annual spring meeting in Montreal, May 28 to 31. Among the many papers read on management, power developments, railroad engineering, port development, textile industries, and machine shop practice, the following are of particular interest in the field covered by MACHINERY: "Recent Developments in Balancing Machines," by Carl Richard Söderberg; "The Machine Tool and the Paper Industry," by G. E. Williamson; "Endurance Test Data and their Interpretation," by K. Heindlhofer and H. Sjövall; "Bending Stresses in Curved Tubes of Rectangular Cross-section," by S. Timoshenko; "A Practical Laboratory and Drawing-room Course in Industrial Engineering at Cornell University," by Myron A. Lee; and "Steel-car Construction at the Angus Shops of the Canadian Pacific Railway," by H. R. Naylor.

Recent Developments in Balancing Machines

In this paper the author describes a machine for balancing quickly and at low cost light rotating masses such as the rotors of small electric motors. The problems involved are discussed and the solution presented and illustrated. Four appendices are devoted to the discussion of (a) the correction of a general state of unbalance by two masses; (b) the requirements for constant period of a balancing machine with a movable fulcrum; (c) the analysis of the vibrating motion; and (d) the sensitiveness of the balancing machine.

An Improved Drafting-room Course

The paper by Professor Myron A. Lee shows how the early courses in industrial management have been widened in scope to include the engineering phases of the problems of manufacturing. This has been accomplished by supplementing the lecture courses with a practical laboratory and drafting-room course, in which the student has his own problem to work out in the design and operation of a modern industrial plant.

Methods of Building Steel Cars

In 1909 the Canadian Pacific Railway, to meet the increasing severity of modern traffic requirements, originated a box car having the entire frame built of steel. The production of such equipment in quantity necessitated the erection of an additional shop for the fabrication of the steel work, and the structure built embodied in its arrangement many novel features for the rapid handling of material to and from the machines, and during the various stages of assembly. Mr. Naylor's paper describes this shop completely, giving particulars regarding its lay-out, crane facilities, and machine equipment. The various machining operations and the jig method of car assembly, first put into practice at the Angus shops, are presented in detail, and the methods used in the final erection and finishing of cars are dealt with at some length.

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EXAMINATIONS FOR PATENT EXAMINERS AND SHOP APPRENTICES

The United States Civil Service Commission, Washington, D. C., has announced an open competitive examination for assistant examiners to fill vacancies in the Patent Office. The examinations will be held in various parts of the country on June 20, 21, and 22. Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or from the secretary of the board of U. S. Civil Service Examiners at the post office or custom house in the larger cities. Applications will also be received before July 3 by the commission, for shop apprentices to fill vacancies in the Bureau of Standards, Washington, D. C. Full information and application blanks may be obtained by addressing the commission.

PERSONALS

P. R. HOOPES has opened an office as consulting mechanical engineer at 252 Asylum St., Hartford, Conn. He will specialize in the design of automatic and special machinery and in the development of inventions.

JOSEPH F. SAMPLE, formerly purchasing agent for the Budd Wheel Co., Philadelphia, Pa., is now affiliated with William L. Battersby in the selling organization of Battersby & Sample with office and display space at the Bourse, in the Machinery Exhibition and Sales Department, Philadelphia.

L. B. NOURIE, formerly connected with the Pittsburg office of Manning, Maxwell & Moore, is now associated with the Thomas Spacing Machine Co., and will have charge of sales in the Pittsburg territory of Thomas tools for bridge and structural shops, shipyards, steel car works, boiler shops, tank shops, railroad shops, etc.

HERMAN VOGES, JR., formerly president of the Webster & Perks Tool Co., Springfield, Ohio, with which company he was connected in various capacities for more than twenty-five years, has become affiliated with the Imperial Drop Forge Co., manufacturer of drop-forgings, Indianapolis, Ind., and is now secretary and general manager of this company.

JOHN P. BROWN, for the past three years engaged in rehabilitation work with the Philadelphia Power Plant Engineering School in the capacity of instructor in charge of the departments of machine shop practice and tool making, terminated his connection with that organization on May 31, and is now general manager of the Ace Hardware Mfg. Corporation, 1514 No. Park Ave., Philadelphia, Pa.

OSCAR ERICSSON, who since 1919 has represented several well-known American machine tool builders in the Scandinavian countries and eastern Europe, has terminated his arrangements with these firms on account of the extreme industrial depression in that part of Europe, and is now in the United States, having come here with a view to making connections with some machine building firm in a selling capacity.

HARRY COLLINSON has been appointed district sales manager of the Carborundum Co., in charge of the Milwaukee office and warehouse, succeeding J. H. JACKSON. Mr. Collinson was previously sales representative of the company in the province of Ontario, Canada. He will be succeeded in this position by C. E. BOWMAN, formerly connected with the sales department of Norman MacDonald, who has the agency for Carborundum products in Toronto.

ALLEN B. COFFMAN, formerly sales engineer for the Crouse-Hinds Co., has become manager of the Philadelphia district for the Reliance Electric & Engineering Co., 1056 Ivanhoe Rd., Cleveland, Ohio, manufacturer of electric motors. Previous to his association with the Crouse-Hinds Co., Mr. Coffman was assistant electrical engineer for the Philadelphia and Reading Railroad for approximately four years. He will be located in the Reliance Electric & Engineering Co.'s office in the Perry Bldg., 16th and Chestnut Sts., Philadelphia, Pa.

E. J. BRYANT has been placed in charge of the gage department of the Greenfield Tap & Die Corporation, Greenfield, Mass. Mr. Bryant has had over twenty years experience in the small tool industry—especially in the manufacture and use of gages; he has formerly been connected with the Taft-Peirce Mfg. Co., Woonsocket, R. I., and the Brown & Sharpe Mfg. Co., Providence, R. I. He is a member of the American Society of Mechanical Engineers and also a member of that society's committee on plain limit gages for general engineering work.

F. ARCHER THOMPSON will represent the Bullard Machine Tool Co., of Bridgeport, Conn., in the Detroit territory. He will serve the company in both a sales and engineering capacity. Mr. Thompson is located in the Majestic Bldg., with the Motch & Merryweather Machinery Co., the official representative of the Bullard Machine Tool Co. in Detroit. He has been connected with the Bullard company for several years at the Bridgeport plant, in the manufacturing and service departments, and previous to his present appointment held the position of chief of the equipment department.

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The Bureau of Mines of the Department of the Interior, Washington, D. C., has issued a bulletin (No. 217), relating to powdered or pulverized coal. The advantages of pulverized coal are clearly set forth, and manufacturers who operate large coal-fired furnaces will find much of value in this bulletin, because, through the use of powdered coal, considerable economies are possible in large power plants.

OBITUARIES

CHARLES E. SHELDON

Charles E. Sheldon, chairman of the board of directors of the Whitman & Barnes Mfg. Co., Akron, Ohio, died in his home in Akron on April 30, after a month's illness, aged seventy-three years. Mr. Sheldon was born in Fitchburg, Mass., April 14, 1850. After leaving school, he went to work for the Whitman & Miles Mfg. Co., Fitchburg, in 1867. This company was later consolidated with other plants and the name was changed to Whitman & Barnes Mfg. Co. In 1872, Mr. Sheldon was made superintendent of the Fitchburg works, and in the fall of 1877 he was sent to Akron to take charge of the works there.

He became a director of the company in 1880, and was made treasurer in 1889. In 1891 he was elected general manager, and in 1899 vice-president and general manager. In 1902 he was elected president and served in that capacity until 1915, when he retired, and was elected chairman of the board of directors. He held the record for continuous service with the company of nearly fifty-six years. He is survived by his widow, a daughter, and three grandchildren.

Mr. Sheldon never lost that intimate personal contact with the men in his employ that was at the bottom of the friendly understanding in the industries in the early days, nor was he ever too busy with his life work to give thought to the welfare of his city and his country; and the encouragement he gave to many efforts contributing to the upbuilding of his home city will be long remembered.

FRANK E. WING

Frank E. Wing, treasurer of the L. S. Starrett Co., Athol, Mass., died at his home in that city on May 13, after a long illness, at the age of fifty-seven years. Mr. Wing was born in Conway, Mass., and attended the public schools of Conway and later the Smith Academy at Hatfield, Mass., from which he graduated in 1882. In the fall of that year he entered Yale University, graduating with the degree of B. A. in 1886.

He came to Athol in 1887, and was employed by the late L. S. Starrett. At that time Mr. Wing was the entire office force of the Starrett shop, being both bookkeeper and shipping cerk, and attending to all the correspondence. When the L. S. Starrett Co. was incorporated in 1900 he was made clerk and a director, and in 1912 he was made treasurer, all of which offices he held until his death. He was intimately connected with the Starrett business throughout its development and expansion from a one-room shop in leased quarters to the large Starrett plant of today.

Mr. Wing was a trustee of the Athol Savings Bank, a member and clerk of the Second Unitarian Society in Athol, and for a number of years chairman of the Athol School Committee, and also a library trustee. He belonged to several fraternal orders. In politics he was a republican. He was married in Athol in 1892 to Miss Edith Mary Smith, who survives him, as does also a son, Donald Goddard Wing, now a freshman at Yale.

Peter Weber, president and general manager of the Sloan & Chace Mfg. Co., Ltd., Newark, N. J., died Wednesday, May 9, at the age of sixty-three. Mr. Weber was born in Germany in 1860, and started to learn the machinists' trade when he was fourteen years old. Two years later he came to the United States alone, landing July 4, 1876. During the next eight years he was employed in a number of machine shops, until in 1884 he entered the employ of Mr. Edison, who was then located at Gerk St., New York City. When the Edison General Electric Co. acquired the old Jones car shops at Schenectady in 1887, he was transferred to that plant, where he worked successively as machinist, toolmaker, inspector, assistant tool-room foreman, foreman, and assistant to the general superintendent. In 1896 he became general superintendent, which position he retained until 1899, when he became connected with Mr. Edison at his West Orange, N. J., plant. Here he remained until the end of 1912, when he acquired the Sloan & Chace Mfg. Co., Ltd., of Newark, N. J., remaining president and general manager of that concern until his death. Mr. Weber's relations with Mr. Edison during the entire time that they were associated were always very friendly, and their business association was terminated only because Mr. Weber acquired his own business which required his full attention.

Dr. Hans Goldschmidt, inventor of the thermit process for welding iron and steel, died suddenly in Baden-Baden, Germany, on May 20, following a paralytic stroke. Dr. Goldschmidt was born in Berlin on January 18, 1861. After finishing his elementary education, he specialized in chemistry, physics, and natural sciences in general at several universities in Germany, receiving the degree of Ph.D. from the University of Heidelberg in 1886. In 1887 he entered the firm of T. Goldschmidt, Essen Ruhr, in partnership with his brother, Dr. Karl Goldschmidt. Under their joint guidance the firm grew to international importance with agencies and allied companies throughout the world.

Dr. Goldschmidt's most important invention was the thermit process, which is now used all over the world for welding iron and steel sections and for producing metals and alloys of high purity. He was president of the Goldschmidt Thermit Co., now known as the Metal & Thermit Corporation, during the period from 1904 to 1916.

L. O. Koven, senior partner in the firm of L. O. Koven & Brother, Jersey City, N. J., and vice-president and treasurer of the Hoevel Mfg. Corporation, died May 17, in his sixty-third year.

Arnold Turner, treasurer and manager of the Turner Machine Co., Danbury, Conn., died on May 12.

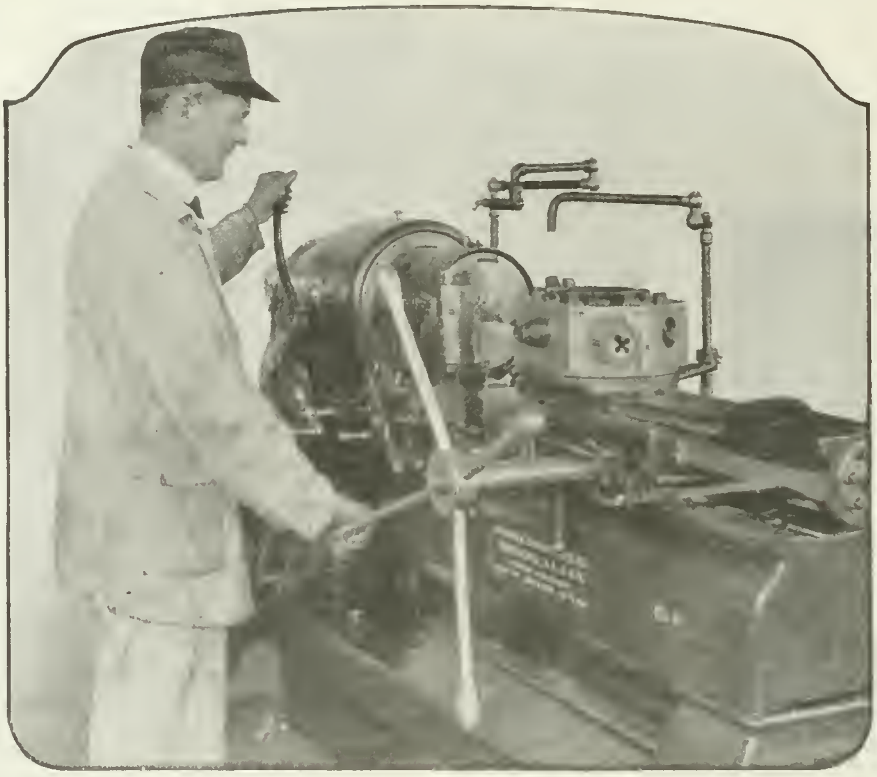
THE AUTOMOTIVE INDUSTRY

The automotive industry, within the space of its short manufacturing career, has advanced until it is today third among the industries of the United States in value of annual output, affording employment each year to about 2,430,000 persons who earn their wage either in the output of the car itself or in producing the materials that go into it. About 600,000 are engaged in the industry itself. Today there are in round numbers, 10,500,000 passenger cars in the United States, or one to every ten persons in the country. The total world registration is but 12,500,000, so that it appears that 83 per cent of the cars now in use are in this country. Of this total approximately 87 per cent are of American manufacture. Each day finds some new place for the motor vehicle.

This development has brought in its wake new questions, or rather old questions demanding new answers. The advance in ten years from 600,000 to 10,500,000 cars brings new requirements in methods, whether they be legislative, industrial or financial in nature. Only trained men can give us the key to their solution. The motor vehicle has become a major unit in transportation, requiring minds of varied training in such fields as civil, chemical, mechanical, metallurgical, and electrical engineering, economics, business administration and finance, research in physical and commercial lines and many other branches, including public service.—*C. C. Hanch in the Journal of the Society of Automotive Engineers.*

* * *

The American Engineering Standards Committee, 29 W. 39th St., New York City, has had eight additional sets of specifications for metals submitted to it by the American Society for Testing Materials. These specifications cover manganese bronze ingots for sand casting; so-called "Government bronze" or gunmetal; brass forging rod; free-cutting brass rod for use in screw machines; naval brass rod for structural purposes; brass ingot metal for sand castings; soft solder; and "high" sheet brass.

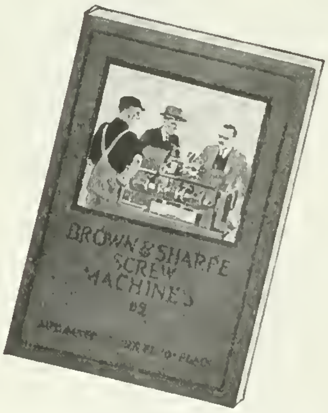


BROWN & SHARPE Handy Control

means faster production on Screw Machine Work

On Wire Feed Screw Machines ease of control is essential for rapid production. The controls on the Brown & Sharpe Nos. 4 and 6 Machines are arranged with one object in view—operating convenience. From his position in front of the machine the operator can handle the turret slide and its automatic feed with his right hand; with his left hand he can easily reach the three levers on the headstock: first, the single lever for opening and closing the chuck and feeding the stock; second, the speed change lever; and third, the back gear lever. In front of him is the cross slide with its controls.

This handy arrangement of the levers and controls reduces operating fatigue and makes possible a high rate of production on long runs. Brown & Sharpe Wire Feed Screw Machines will help speed up your production.



200 pages of Screw Machine Facts with a whole section on Wire Feed Screw Machines—a book worth having. Sent to any address on request. Write today asking for Screw Machine Catalog No. 23-G.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

Use BROWN & SHARPE MACHINES for Production

Rex Micrometer No. 59 is one of a complete line of 24 Brown & Sharpe Micrometers. These Micrometers are regularly furnished with a Clamp Ring which clamps the spindle and preserves the setting. Supply your tool cribs with these reliable tools.

Put BROWN & SHARPE TOOLS in the hands of your machinists

For the Screw Machine Operator working on pieces held to close limits a good micrometer is a necessity. On second operation work where it is important that partly finished pieces be properly completed, frequent measurements with an accurate micrometer are often essential. Brown & Sharpe Rex Micrometers are ideal tools for screw machine work—strong, light, accurate, with clean-cut graduations that are easy to read. An adequate supply of these accurate, dependable Rex Micrometers in your tool cribs will help maintain uniform accuracy on your screw machine work.

The New Tools described in this booklet are helps toward better workmanship. Write for this "New Tools" booklet today. If you want our Small Tool Catalog also, ask for Catalog No. 28.

Brown & Sharpe Mfg. Co.
Providence, R.I., U.S.A.

BROWN & SHARPE TOOLS

for Accurate Work

TRADE NOTES

Ex-Cell-O Tool & Mfg. Co., Detroit, Mich., is located, since May 12, at 1469 E. Grand Boulevard, Detroit.

Cyril J. Bath & Co., machinery dealers of Cleveland, Ohio, have moved their offices from 1603 to 1738 St. Clair Ave., the offices and warerooms now being under one roof.

Gibb Instrument Co., Bay City, Mich., manufacturer of electric welding equipment, has been appointed distributor of the General Electric Co.'s arc welding electrodes in the middle-western states.

Consolidated Machine Tool Corporation of America, 17 E. 42nd St., New York City, has opened a Detroit district sales office in the General Motors Building, 3044 Grand Blvd., under the management of Roland A. Holmes.

J. N. Lapointe Co., New London, Conn., manufacturer of broaching machines and broaches has appointed Charles A. Strelinger Co., Detroit, Mich., exclusive agent in the state of Michigan for the company's line of broaching machines.

Moltrup Steel Products Co., Beaver Falls, Pa., manufacturer of cold-drawn, milled, and ground specialties, has opened a district sales office at 303 White Bldg., Buffalo, N. Y., in charge of Charles T. Neale, district sales manager.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., has recently removed its Pittsburg branch office from 1501 Park Bldg. to more commodious quarters at 335 Fifth Ave. The change was made necessary by the growing volume of business.

Triplex Machine Tool Corporation, 50 Church St., New York City, has appointed the Herberts Machinery & Supply Co., with showrooms in Los Angeles and San Francisco, exclusive sales agent in the state of California for the Triplex combination bench lathe, milling and drilling machine.

Oilgear Co., 64 Twenty-seventh St., Milwaukee, Wis., manufacturer of variable-speed hydraulic power transmissions, has appointed the Buffalo Machinery Sales Corporation, 881 Ellicott Square, Buffalo, N. Y., as sales representative ıor Oilgear products in the western New York territory.

United States Electrical Tool Co., Cincinnati, Ohio, has recently opened two new district offices, one at 430 N. High St., Columbus, Ohio, and the other at 412 First St., National Soo Line Bldg., Minneapolis, Minn. E. W. Beeler will be manager of the Columbus office, and Thomas H. Caley, manager of the Minneapolis office.

Whitman & Barnes Mfg. Co., Akron, Ohio, manufacturer of twist drills and reamers, announces that the company's New York office and store has been removed to 99 Chambers St., corner of Church St., one and one-half blocks from its former location. The new quarters will afford increased facilities for carrying larger stocks of drills and reamers.

Bridgeport Brass Co., Bridgeport, Conn., has removed its New York offices from the Woolworth Building to the Pershing Square Building on Park Ave. between 41st and 42nd Sts. F. Morton Clark has been made district sales manager, and Arthur J. Nelson has been made sales manager of the Fabricating Division at the main office in Bridgeport.

Triumph Electric Co., Cincinnati, Ohio, has removed its New York office to 25 Church St., where a representative stock of Triumph type TR motors, as well as squirrel cage, slip ring and direct-current motors, in sizes from 1 to 200 horsepower, will be carried. A similar stock is also carried in the Philadelphia office. G. F. Adams is in charge of the New York office.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., manufacturer of multi-graduated precision grinders, precision thread lead variators, lathe spacing attachments and "cold-set" diamond tools, announces that the price of the 1923 model precision grinder has been reduced 20 per cent. This reduction is made possible by increased production, better manufacturing facilities, and simplified design.

Rollway Bearing Co., Inc., Syracuse, N. Y., is the new name under which the Railway Roller Bearing Co. of the same city is now known. The new name has been adopted because a continually increasing volume of the company's products is being used in the industrial field, and because the bearings made by the company have been advertised and marketed for the last fourteen years under the trade name "Rollway."

McCauley Metal Products Co., Inc., Buffalo, N. Y., has recently taken over a factory at 41-45 Letchworth St., in that city, for the manufacture of the company's line of bicycle accessories, and light and medium sheet metal parts on a contract basis. A complete plating and enameling department makes it possible to furnish any finish desired. H. J. McCauley is president, and Frank E. Denley of Wheeling, W. Va., will soon join the corporation as factory manager.

Rockford Milling Machine Co., Rockford, Ill., has taken over the manufacture of the Cadillac line of single- and double-end centering and drilling machines, as well as the Cadillac bench centers, formerly manufactured and sold by the Cadillac Machinery Co., Detroit, Mich. In addition to building a complete line of standard machines, the design of which it is planned to improve, the company will be in a position to build special machines and attachments for drilling and centering work.

Skinner Chuck Co., New Britain, Conn., has bought from the Production Tool Equipment Co. of Bridgeport, all the dies, patterns, fixtures, machinery, etc., for the production of the Ketchum vise, which is adapted for use on milling and drilling machines. The Skinner Chuck Co. plans to develop a complete line of milling machine vises with and without swivel bases. The vises will be adapted for a wide range of work—from large milling machine operations to small tool-room operations or special production work.

Stovel & Brinkerhoff, engineers and constructors, 136 Liberty St., New York City, announce the addition of H. M. Van Gelder as a partner in their firm, and a change of name from Stovel & Brinkerhoff to Stovell, Brinkerhoff & Van Gelder. Mr. Van Gelder, a member of the American Institute of Electrical Engineers, has had over twenty years' experience in electrical engineering and construction. He was formerly electrical engineer and managing engineer of Westinghouse, Church, Kerr & Co., and recently project engineer on railroad electrification work with Gibbs & Hill.

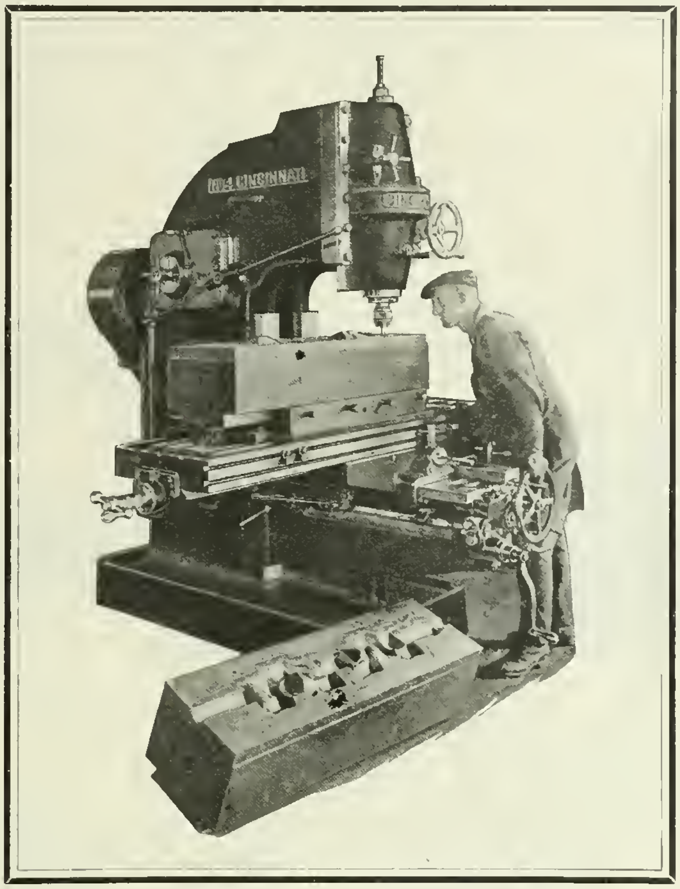
Battersby & Sample, dealers in high-production tools and machinery, Philadelphia, Pa., have recently taken display and office space at the Machinery Exhibition and Sales Department of the Bourse. They are exclusive representatives of Goddard & Goddard Co., Detroit, Mich., manufacturer of milling cutters; Chapin-Skelton Corporation, Syracuse, N. Y., manufacturer of taper reamers; Cogsdill Mfg. Co., Detroit, manufacturer of center drills; Logansport Machine Co., Logansport, Ind., manufacturer of air chucks; Porter-Cable Machine Co., manufacturer of production and engine lathes. A complete line of the tools and machinery that they represent will be displayed.

Rivett Lathe & Grinder Co., Brighton, Boston, Mass., which has been in receivership since March, 1922, was sold by the receiver on April 14, 1923, the purchase including the entire plant, equipment, and business of the company. The purchaser is the Creditor's Protective Committee, by whom the company has been reorganized under the name of Rivett Lathe & Grinder Corporation. Sufficient new capital has been subscribed to put the company on a suitable financial basis. The present management, under the direction of T. S. Ross as president and general manager, will operate the plant and continue the business, producing the same lines of machinery as in the past.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., announces the following changes in personnel: Graeme Ross has been appointed manager of the Kansas City office to succeed F. S. Rossman; E. L. Doty, district service manager of the Buffalo branch office, has been made engineering assistant, service department, with headquarters in East Pittsburg, and J. A. Atkinson has been appointed Buffalo service manager; C. W. Jones, has become general foreman of the controller department, and C. A. Fike general foreman of the coils and insulation department at the East Pittsburg Works; J. H. Hartman has been appointed general foreman of the storekeeping department, and W. S. Oswald general foreman of the railway motor department at the East Pittsburg works.

E. W. Bliss Co., Brooklyn, N. Y., manufacturer of pressed-metal machinery, automatic can machinery, dies, and special machinery, has recently moved its sales and executive offices to the South Brooklyn plant of the company, which is located at the foot of 53rd St. This plant comprises a group of seventeen buildings, covering a ground area of eighteen acres, and has a total floor area of twenty-one acres. It is about a half mile long. During the war, many large additions were made to the plant to meet war requirements until it reached its present proportions. At the termination of hostilities, there was available a considerable amount of space and equipment, so the company determined to consolidate its two Brooklyn plants, and accordingly has moved practically all the machine equipment from the Adams St. plant to the South Brooklyn plant.

CINCINNATI MILLERS



CINCINNATI No. 4 VERTICAL

DIE SINKING

Complete control from one position enables the operator to handle heavy dies with ease.

The convenient location of the power feed control levers (cross, vertical and longitudinal) encourages the operator to use the *power* feeds for roughing out the die. The right feed for any given cut is obtained through the movement of a single lever, without changing position.

An auxiliary handwheel at the front of the saddle for the longitudinal table feed, is convenient when hand profiling.

And the spindle head can be instantly adjusted vertically.

For the long table adjustments the power quick traverse is used.

Have our Specialist make a study of your work

THE CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio

COMING EVENTS

June 7-9—Meeting of the Taylor Society at Hotel Onondaga, Syracuse, N. Y.

June 11-14—Annual meeting of the Electric Power Club in Hot Springs, Va.; headquarters, Hotel Homestead. Executive secretary, S. N. Clarkson, Kirby Bldg., Cleveland, Ohio.

June 14-15—Eastern sectional meeting of the American Society for Steel Treating in Bethlehem, Pa. National secretary, W. H. Eisenman. Hotel reservations made through George C. Lilly, superintendent of heat-treatment, Bethlehem Steel Co., Bethlehem, Pa.

June 14-16—Fourth annual conference of the National Association of Office Managers at Detroit. G. S. Childs, Alexander Hamilton Institute, 13 Astor Place, New York City, secretary.

June 19-23—Summer meeting of the Society of Automotive Engineers at Spring Lake, N. J. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

June 25-29—Annual convention of the American Institute of Electrical Engineers at Swampscott, Mass. For further information, address the secretary's office, 29 W. 39th St., New York City.

June 25-30—Twenty-sixth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa., secretary.

August 20-30—Meeting of the American Institute of Mining and Metallurgical Engineers at Quebec, Canada. Secretary, F. F. Sharpless, 29 W. 39th St., New York City.

September 17-22—Ninth national exposition of chemical industries, in the Grand Central Palace, New York City. For further information address National Exposition of Chemical Industries, Grand Central Palace, New York.

September 24-28—Meeting of the Association of Iron and Steel Electrical Engineers at Buffalo, N. Y., in conjunction with the Iron and Steel Exposition held in the Buffalo Auditorium. Further information may be obtained from the Association of Iron and Steel Electrical Engineers, Empire Building, Pittsburg, Pa.

October 8-12—Annual convention of the American Society for Steel Treating to be held in Pittsburg, Pa., in connection with an international steel exposition. W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio, national secretary.

October 25-26—Production meeting of the Society of Automotive Engineers at Cleveland, Ohio. Further information may be obtained from the society's headquarters, 29 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

University of Missouri, Rolla, Mo. Catalogue 1922-1923 of the School of Mines and Metallurgy containing the calendar, curricula, and other information.

Hebrew Technical Institute, Stuyvesant and E. 9th Sts., New York City. Catalogue for 1923, containing calendar, outlines of courses, requirements for admission, etc.

NEW BOOKS AND PAMPHLETS

Construction and Operation of a Two-circuit Radio Receiving Equipment with Crystal Detector. 14 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 121 of the Bureau of Standards. Price 5 cents.

Auxiliary Condensers and Loading Coil Used with Simple Homemade Radio Receiving Outfits. 19 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 137 of the Bureau of Standards. Price, 10 cents.

An Investigation of the Properties of Chilled Iron Car Wheels—Part III. By J. M. Snodgrass and F. H. Guldner. 100 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 135 of the Engineering Experiment Station. Price, 50 cents.

Lathe Breakdown Tests of Some Modern High-speed Tool Steels. By H. J. French and Jerome Strauss. 43 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 228 of the Bureau of Standards. Price, 15 cents.

Tables for the Calculation of the Inductance of Circular Coils of Rectangular Cross-section. By Frederick W. Grover. 35 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 455 of the Bureau of Standards. Price, 10 cents.

Properties of Electrical Insulating Materials of the Laminated Phenol-Methylene Type. By J. H. Dellinger and J. L. Preston. 125 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 216 of the Bureau of Standards. Price, 30 cents.

Pulling Together. By John T. Broderick. 167 pages, 5 by $7\frac{1}{2}$ inches. Published by Robson & Adee, Schenectady, N. Y. Price, $2

This is the sixth edition of a book dealing with human relations in industry, discussing, in particular, the plan of employe representation. The book is written in the form of a conversation between a salesman and a manufacturer of broad vision, who describes the success of the plan in his own plant. It should be of interest to managers who seek light on industrial democracy as a means of reducing friction between employers and employes. The new feature of this edition is a short sequel entitled "Untouched Wealth," which contains further thoughts on the matter of obtaining cooperation between capital and labor through understanding and mutuality of interest.

The Mechanisms of Machine Tools. By Thomas R. Shaw. 351 pages, 9 by 11 inches; 433 illustrations. Published by the Oxford University Press, American Branch, New York City. Price, $14.

The author of this book has endeavored to place on record the essential principles embodied in machine tool design. He has collected this information from many sources including the transactions of engineering societies and the technical journals in the machine tool field. The illustrations are mainly line engravings, showing quite clearly the details of the design being described. A list of the chapter heads will furnish a comprehensive idea of the contents of the book: Evolution, Types, and Functions of Machine Tools; Materials of Construction; Gearing; Design of Framework; Sliding Bearings; Bearings for Shafts and Spindles; Transmission of Power; Reverse Motions; Hand and Automatic Control; Chucking Devices; Trip, Indexing, and Locking Devices.

Synthetic Resins and Their Plastics. By Carleton Ellis. 514 pages, 6 by 9 inches. Published by the Chemical Catalog Co., Inc., 19 E. 24th St., New York City. Price, $6.

This book has been written for the purpose of placing before the chemist extensive data on a great variety of synthetic products of a resinous character, which may lead themselves to substitution in various places where natural resins are now used. The industrial application of synthetic resins has been considered in detail. The section of the book which is of particular interest to the machine-building field is that dealing with equipment for molding plastic compositions, and methods of molding. The chapter on molds and molding equipment describes various types of molds in detail, methods of heating molds, materials used, correct and incorrect designs of molds, shrinkage allowance, fabrication of molds, and repairs and maintenance. Considerable space is given to a description of different types of presses employed for plastic molding, all of which are illustrated.

Accurate Tool Work. C. L. Goodrich and F. A. Stanley, 300 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $3

This is the second edition of a book dealing with the principles of toolmaking and applications of the important processes and methods of precision work. It takes up the construction of jigs, fixtures, and other special tools for insuring interchangeability of product, explaining how the holes in a jig can be accurately located and bored, and describing examples of jig work. The use of master plates, buttons, disks, size-blocks, sine bars, etc., has been treated at length, together with the processes of making master plates for various purposes, the use of test indicators, accurate gages, the microscope, and other appliances Considerable space has been devoted to ways and means of dealing with angular and taper work. Eight chapters deal with the subject of gage design and construction, covering methods of making plugs and rings, ring thread gages, flat gages, snap gages, gages for automobile parts, and essential devices used by the toolmaker on this class of work.

The Study of Electricity by the Deductive Method. By George Ira Alden. 110 pages, $4\frac{3}{4}$ by $7\frac{1}{2}$ inches Published by the Commonwealth Press, Worcester, Mass.

This book presents the subject of electricity to the student by the deductive method. The method is based on the analogy of an endless flexible shaft revolving about its geometric axis, and an attempt has been made to extend the analogy to the solution of all problems of electric transmission of energy by both direct and alternating current. The first chapter contains a discussion of the essential facts concerning magnetism. This is followed by chapters on mechanics: statement and application of analogy and working hypothesis; application of analogy to the generator; induction; combination of out-of-phase torques; the condenser; and measuring instruments. As a help to the student a brief paragraph is placed at the beginning of each chapter which indicates the trend of thought that will be followed The last chapter contains a group of problems illustrating some types of circuits. A discussion of certain points which for the sake of clearness have been inserted in the text without comment, is given in the form of an appendix.

The Engineering Index—1922. 675 pages, $6\frac{1}{4}$ by $9\frac{1}{2}$ inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, $6.

This is the twenty-first volume of the Engineering Index and the fourth one to be issued by the American Society of Mechanical Engineers. In its compilation a review has been made of about 1300 periodicals, reports and other publications regularly received during the year by the Engineering Society's Library, and from over 600 of these the articles to be indexed have been selected. These represent not only publications printed in the United States but also periodicals printed in foreign countries; thus, it is safe to say that the Index completely covers all the important technical articles appearing during the year 1922. In this edition the items have been made unusually concise, because it is believed that the value of the Index increases with the number of references it contains. The volume includes not only the 1922 periodicals, but also 1921 publications which came in too late to be included in the 1921 Index. The classification and the system of cross-indexing have been perfected. The Index is classified by subjects arranged alphabetically.

Tool Engineering—Turning, Boring, and Grinding. By Albert A. Dowd and Frank W. Curtis. 340 pages 6 by 9 inches; 216 illustrations. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York. Price, $3.50.

This is the second volume of a series of three books covering the science of tool engineering. The present book deals with important factors affecting the design of tools and fixtures for turning, boring, and grinding operations. It gives the reasons why certain methods are better than others, as well as many graphic examples illustrating the use of the principles outlined. The first volume covered the subject of tool engineering as applied to the design of jigs and fixtures, and the third volume will deal with the design of punches, dies, and gages used in production work. The material is divided into sixteen chapters, headed as follows. Consideration of Turret and Engine Lathe Tooling; Design of Chuck Jaws; Second Operation Work; Design of Special Fixtures; Inside Holding Methods, Turning Tools for Turret Lathes; Boring Tools; Facing Tools; Recessing Tools; Reamers and Floating Holders; Cross-slide Tools; Attachments for Turret Lathes, Lay-out Work; Vertical Lathes, Vertical Machines, and Boring Mills; Tapered and Curved Surfaces; and Fixtures for Grinding.

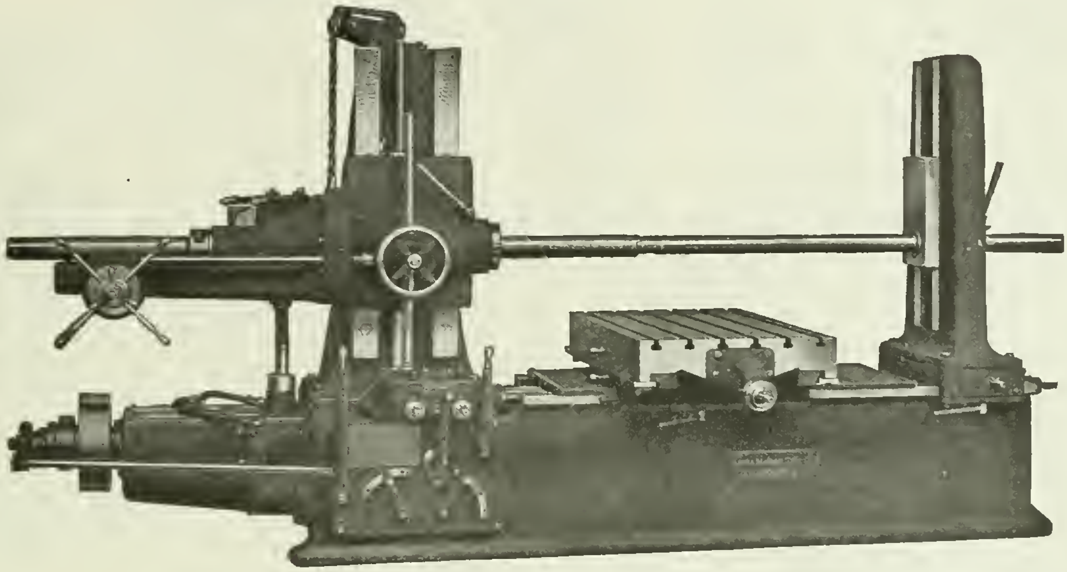
Problems in Machine Design. By O. A. Leutwiler. 140 pages, 6 by 9 inches; illustrated. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $1.50.

The purpose of the author, in preparing this book, has been to present a series of isolated problems covering the various parts of the subject of machine design. Practically all of the problems have been taken directly from existing machines. The majority of the problems in Sections I to XV deal with simple isolated machine parts. Section XV includes problems, in the solution of which the student makes a complete force and stress analysis of all the elements used in the machine. Problems taking up the design of simple machines are given in Section XVI. Section XVII contains a number of tables of use in connection with design work. An idea of the problems covered will be obtained from the following list of contents: Stresses and Strains in Machine Parts; Riveted Connections; Bolts and Screws; Cotter and Pin Connections; Cylinders, Plates and Springs; Belting; Rope Transmission; Chain Transmission; Friction Transmission; Spur Gearing; Bevel and Screw Gearing; Couplings and Clutches; Brakes; Shafting and Bearings; General Problems; Design Problems; and Tables.

Financial Incentives for Employes and Executives. Compiled and edited by Daniel Bloomfield Published in two volumes, containing 325 pages and 407 pages, 5 by 8 inches, respectively. Published by the H. W. Wilson Co., 958 University Ave., New York City. Price for two volumes, $4.80.

The widespread interest in all forms of financial incentives for employes and executives has led to the compilation of a reference book describing such incentives in detail. Better systems of reward for the effort of employes are constantly being devised, and the present work, which is published in two volumes, brings together in convenient form the best of such systems, offering suggestions for adaptation to organizations of different kinds. The executive will find in this compilation ideas gathered from a large number of publications and reports, and from original investigations covering over 1000 concerns and plants. The first volume, containing Parts I and II, covers types of wage systems; piece work; day work and week work; and bonus plans of various kinds. The second volume, containing Parts III and IV, discusses thrift plans; profit-sharing; stock participation plans; mutual benefit associations; pension plans, incentives in retail stores; compensation of salesmen; compensation of office workers; and incentives for foremen and executives. The work is thoroughly indexed, and in addition, contains a bibliography of books relating to this subject.

"IDEALS ARE BORN OF VISION"
The vision was of a machine on which two or more holes could be bored parallel an exact distance apart.

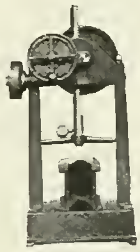


THE IDEAL is the

"PRECISION"

Boring, Drilling and MILLING MACHINE

which realizes the vision and many more desirable things.



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NEW CATALOGUES AND CIRCULARS

Roller-Smith Co., 233 Broadway, New York City. Bulletin 30, illustrating and describing Roller-Smith "Triplex" ammeter for three-phase alternating-current circuits.

P. F. McDonald & Co., 17 King Terminal, Boston 27, Mass. Stock list and catalogue of a comprehensive line of tool steels of well-known American and Swedish brands.

New Departure Mfg. Co., Bristol, Conn. Circulars Nos. 152 FE and 153 FE, illustrating and describing electric riveting hammer and drill with ball bearings, and bearing mountings for large electric motors.

Koen Pump Works, 1387 Niagara St., Buffalo, N. Y. Circular illustrating and describing the principle of construction of the Niagara rotary pump, which is made in two types, with and without a base, and in five sizes.

Clemson Bros., Inc., Middletown, N. Y. Circular of Star hacksaws, which are made with hard tempered and flexible blades. The pamphlet features the Star counter-display rack, which is distributed among jobbers to facilitate the sale of Star hacksaws.

Manufacturers' Brush Co., Cleveland, Ohio. Circular illustrating the "Advance" snips, a combination snip that cuts straight, angles, curves, or circles, and that has a leverage that enables it to cut twice the thickness of metal ordinarily being cut in this way.

New Jersey Foundry & Machine Co., 90 West St., New York City. Catalogue 103, illustrating and describing the portable elevator made by this concern. These elevators are made in both hand power and electric types. Illustrated directions for setting up and operating are included.

Oxweld Acetylene Co., 30 E. 42nd St., New York City. Pamphlet entitled "How Welded Joints Solved Pipe Line Troubles," containing a reprint of a paper read before the International Acetylene Association's convention, which describes some experiences in the use of oxy-acetylene welded joints in pipe lines.

New Departure Mfg. Co., Bristol, Conn. Sheets for loose-leaf catalogue, descriptive of New Departure ball bearings, which are made in single-row, double-row, Radax, front wheel, and magneto types. The catalogue explains the construction of the different types, and the class of work for which each is best adapted.

S K F Industries, Inc., 165 Broadway, New York City. Catalogue of S K F ball bearing hangers and transmission appliances, describing the characteristic features of Skayef self-aligning ball bearing lineshaft equipment, and containing tables of dimensions and list prices for ball bearing hangers, post hangers, pillow blocks, and pulleys and clutches.

Lobbett & Ewing Co., Middleport, N. Y. Booklet illustrating and describing the Culma lathe milling attachment—a universal work-holder for use on all metal-cutting machines, whether lathes, drilling machines, shapers, milling machines, vertical or horizontal boring machines, or surface grinders. It can be used in connection with any of these machines by simply fastening it with two bolts.

Wagner Electric Corporation, St. Louis, Mo. Bulletin 132, on the "Pow-R-full" motor, containing a description of the features of construction and operation of this new Wagner motor. The basic idea in the design of this motor was to produce a motor that would develop greater relative capacity and longer life because of the provision of efficient means for moving an adequate volume of air through the motor.

Simonds Saw & Steel Co., Fitchburg, Mass. Catalogue covering the line of files made by this company. The different types of files and their uses are described, and terms used in connection with them are defined. Full size illustrations of the various kinds are included. The dimensions and list prices for the different types are arranged in convenient tabular form. A copy of this catalogue will be sent upon request to large file users.

Abrasive Co., Philadelphia, Pa. Catalogue descriptive of the grinding wheels manufactured by this company, which are made in two general classes for grinding materials of high and low tensile strength, respectively. The different processes of manufacture are described, and tables for selecting grain and grade are given, as well as list prices for all the different types of wheels. Other information relating to speeds and testing is included.

Chicago Pulley & Shafting Co., Chicago, Ill. Catalogue F, containing 292 pages, 6 by 9 inches, covering the complete line of power transmitting appliances made by this company. The products shown include pulleys, clutches, couplings, sheaves, cold-finished steel and shafting, keyseaters, safety set-screws, ball and roller bearing hangers, pillow blocks, countershafts, chain, sprocket wheels, gears, conveyors, buckets, belting, lacing, tackle blocks, ball bearings, etc.

Hammacher, Schlemmer & Co., 133 Fourth Ave., New York City. Booklet entitled "Seventy-five Years of Constant Growth," containing a history of the growth of the concern from its beginning in 1848 to the present year. The book is attractively illustrated with drawings showing scenes in New York in the early days, and also contains photographs of the men who have helped to build up the business and are responsible for its success.

Reeves Pulley Co., Columbus, Ind. Catalogue T-44, covering the Reeves variable speed transmission. This catalogue of 52 pages describes in considerable detail the design and construction of the various types of automatic variable speed control, the compact individual drives, and several other very interesting new applications of the transmission built by the company. In addition, the catalogue gives complete horsepower ratings and dimensions of all sizes of the company's transmissions.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Catalogue 480, on electric hoists and overhead cranes. The book is profusely illustrated with photographs of actual installations, showing some of the most recent Link-Belt electric applications. Line and wash drawings illustrate proper methods of installation and efficient operation. The practice and methods employed by users in widely divergent fields are described. Copies of the book may be obtained from the headquarters in Chicago or Philadelphia, or from any of the branch offices of the company.

Watts Bros. Tool Works, Turtle Creek, Pa. Catalogue No. 6 illustrating and describing Watts patented full floating chucks and drills for drilling triangular, square, pentagon, hexagon and octagon holes in steel, iron, brass, aluminum, micarta, bakelite, wood, marble, etc. This floating chuck, drill and guide plate may be operated in an ordinary drilling machine, lathe, hand screw machine, or milling machine, the angular holes being produced by a rotary motion. The catalogue describes the uses of these tools, and gives suggestions as to their care and proper application.

Brown Instrument Co., Philadelphia, Pa. Pamphlet entitled "The Malleablizing of Iron Castings," dealing with the annealing problem in the modern malleable foundry. The information presented in this treatise is based on data obtained from about forty representative malleable plants. A brief history of the making of malleable castings is given, and this is followed by a description of the malleable process and a discussion of different types of annealing ovens. Different factors of importance in annealing are also discussed. The book concludes with 17 pages containing reproductions of letters of recommendation of Brown pyrometers as well as illustrations showing a few of the applications of this equipment in malleable plants, and a list of the users.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for April 1, 1923.

State of New York }
County of New York } ss.

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Matthew J. O'Neill, who, having been duly sworn according to law, deposes and says that he is the treasurer and general manager of the Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, and Matthew J. O'Neill, Treasurer and General Manager, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Alexander Luchars, Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars; Matthew J. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

MATTHEW J. O'NEILL, General Manager

Sworn to and subscribed before me this 16th day of March, 1923

WILLIAM E. BACON,
(SEAL) Notary Public, Kings County No. 444
Kings Register No. 3109
New York County No. 79 New York Register No. 3047
(My commission expires March 30, 1923.)

AMERICAN FOUNDRYMEN'S MEETING

The American Foundrymen's Association and the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers held a joint meeting in Cleveland, April 28 to May 3, in connection with which an exhibition of foundry appliances was held. The number of exhibitors was larger than at any previous exhibit in connection with the Foundrymen's meetings, except that held in 1920. In that year, however, there was a machine tool exhibit which could not be included this year on account of the limited space.

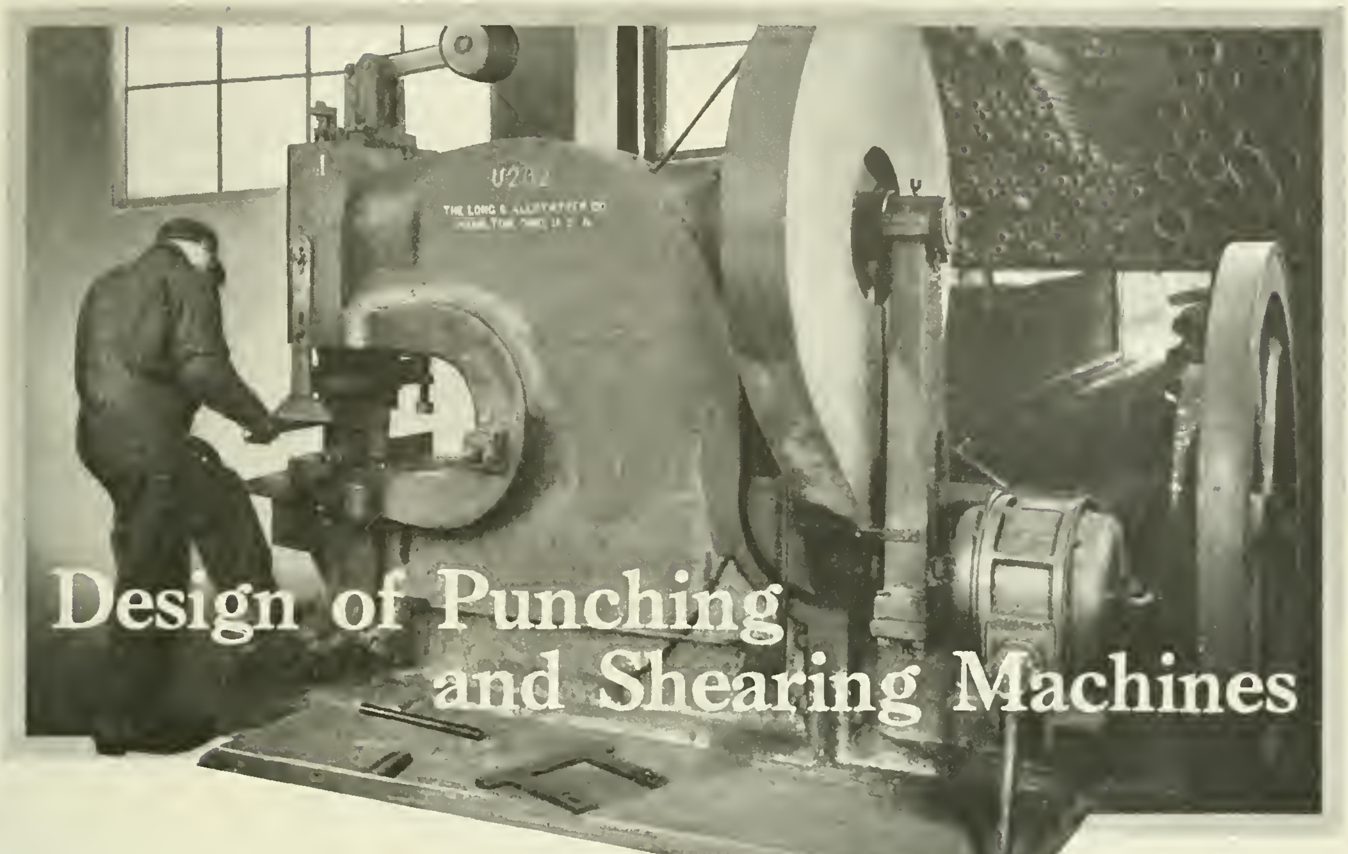
The meetings covered sessions on aluminum and aluminum alloys; steel foundry practice; industrial education in relation to the training of foundry workers; non-ferrous foundry practice; electric furnaces and their use in gray iron foundries; testing methods in sand research; reclamation, conservation, and geological survey work in sand research; malleable casting practice; gray iron foundry practice; and new developments in the foundry industry.

The attendance at the meeting was larger than at any previous gathering of the association, the registration being approximately 3400. It is stated that a large number of orders were placed on the exposition floor, and that both the real and prospective business that developed was far greater in volume than that which has resulted from any previous exhibition in connection with the meeting of the Foundrymen's Association. Among the exhibits, molding machines, sandblast equipment, welding equipment, core ovens, and material handling equipment occupied an important part.

For the coming year G. H. Clamer, Ajax Metal Co., Philadelphia, Pa., was elected president; and H. B. Swan, Cadillac Motor Co., Detroit, Mich., was elected vice-president.

JULY MACHINERY 1923

Design of Punching and Shearing Machines



First of a Series of Articles Giving Formulas for Determining the Dimensions of the Various Parts

Long & Allstatter Punching and Shearing Machine used for Cutting off Piping

By A. LEWIS JENKINS, Professor of Mechanical Engineering, University oi Cincinnati

THAT the punching and shearing machine offers exceptionally good problems for students in machine design has been recognized by the instructors in this subject of many leading universities. It offers practical exercises in the design of bolts, keys, screws, gibs, bearings, gears, shafts, flywheels, pulleys, belts, clutches, springs, counterweights, and link work, and in the analysis of stresses in curved cast frames. Furthermore, unlike the lathe or most other machine tools the problems met with in designing the various elements are not duplicated. Hence, the design of a punching and shearing machine may be said to consist essentially of a series of problems on the design of the most commonly used machine elements, all of which are combined in the end to form a complete machine

The action of a punch or shear produces complicated stresses in the material operated upon. The pressure of the punch and the reaction of the die against the plate produce a shear stress, a compressive stress, and, if there is clearance between the punch and die, tensile and compressive stresses which result from the tendency of the plate to bend. The presence of the compressive and bending stresses renders it practically impossible to determine accurately the shearing strength of any material by means of the ordinary apparatus used in making shear tests. Perhaps a better name for the action of a punch or shear would be "cutting"; this would be indefinite in terms of the concurring stresses.

The subject matter of this series of articles is based on the proportions of punching and shearing machines actually built. Much of the material consists of empirical formulas derived from data taken from practically every make of machine built in this country. The necessary information was obtained from experimental data, by actually measuring machines in operation, and directly from manufacturers. Many proportions previously obtained empirically have been put on a rational basis by introducing proper constants in equations, while empirical formulas have been derived for many proportions that do not permit of rational analyses.

When the punch comes in contact with the material, the point enters for some distance, and there is a flow of metal into the surrounding portion, increasing the thickness of the metal around the hole. This flowing action continues until the material is stressed, principally by shear, sufficiently to produce rupture. A load-depression curve drawn by an autographic recorder will be similar to the load-strain curve for a specimen under tension in a testing machine. It will be an approximately straight line until the material begins to fail and will then curve downward.

The distance that the punch enters the material before failure begins is called the "depth of penetration," and varies with the thickness of the plate, the cutting angles of the die and punch (angle of the knife in a shear) and the material. The depth of penetration for soft steel, according to Kent, may be found by the following formulas:

For a flat knife,

$$p = 0.3t$$

For a 4-degree beveled knife,

$$p = 0.25t$$

For an 8-degree beveled knife,

$$p = 0.16\sqrt{t^3},$$

in which p = depth of penetration, and t = thickness of plate, in inches. Experiments on mild steel have shown that the depth of penetration may be determined by the following formula:

$$p = \frac{0.35t}{t + 0.4}$$

The depth of penetration is less with hard than with soft materials. However, ordinary structural steel breaks when this point is reached, and is easily forced through, whereas soft steel or iron offers considerable resistance after the depth of penetration has been reached.

Force Required to Punch Holes and Cut Plates

The cutting resistance of various grades of structural steel, soft iron, boiler and steel plate varies from 40,000 to 60,000 pounds per square inch. In designing punching and shearing machines, a value of from 55,000 to 60,000 pounds per square inch is generally used. It is safer to use the maximum value, and all formulas in this series of articles are based on that value. The area of metal cut in punching a hole equals the circumference of the hole times the thickness of the plate. Since the force W, in pounds, required to punch a hole equals the area cut multiplied by the cutting resistance,

$$W = 3.1416 \times d \times t \times 60{,}000 = 188{,}500dt$$

in which d = diameter of hole and t = thickness of plate, as before.

From this equation it will be seen that the force required to punch different sized holes in a given material varies as the product of the hole diameter and the thickness of the plate. Assuming that it is desired to find the diameter of the largest hole that can be punched in ¼-inch plate with a machine designed to punch up to ¾-inch holes in ¾-inch plate, we have

$$dt = \frac{3}{4} \times \frac{3}{4} = \frac{9}{16}$$

$$9/16 \div 1/4 = 9/4 = 2.25 \text{ inches}$$

Thus, the same machine could be employed for punching a hole 2¼ inches in diameter through ¼-inch plate.

The force required to shear plates with straight knives inclined at an angle A with each other may be found by the equation

$$W = 0.5t^2 \times \cot A \times 60{,}000$$

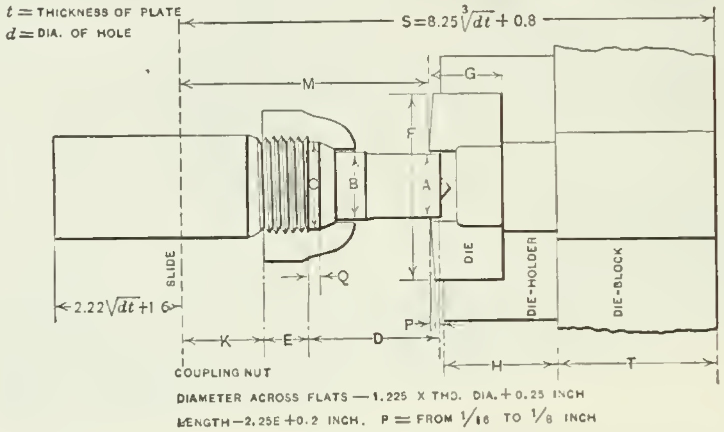
An approximate rule for finding the force required to cut metal by punching or shearing is: Force = 80 per cent of the tensile strength of a bar having a cross-sectional area equal to the area of the metal cut. The side thrust on a shearing blade when it is dull and the plate is tipped may be taken as equal to $1.5W$, when W equals the force acting normal to the plate.

Punch Standards

Many different punching and shearing tools are used, the type depending on the class of work and the machine. The variations are the results of attempts to obtain rigidity and convenience in changing tools, and any one may have an advantage over the others that might be considered a real merit. The first punches used in machines were made with the stems integral. They were expensive to make and were uneconomical in the use of material. When a punch broke, the steel in the stem was worthless, unless it could be drawn and used in another machine. The system of interchangeable punches led to more economical production methods and decreased the cost of maintenance.

The punch and stem are now made separately and connected by means of a coupling nut, as shown in the illustration of the accompanying table. The point on the end of the punch is used in adjusting to the proper position the centers of the holes to be punched, which have previously been laid out and marked by means of a prick-punch. The operator places the work in the machine, and by bringing the point of the punch sufficiently close to the plate, is able to get the prick-mark directly under it.

TABLE OF PUNCH PROPORTIONS*


t = THICKNESS OF PLATE
d = DIA. OF HOLE
$S = 8.25\sqrt[3]{dt} + 0.8$
M
G
F
C
B
A
DIE
DIE-HOLDER
DIE-BLOCK
SLIDE
Q
$2.22\sqrt{dt} + 1.6$
P
K
E
D
H
T
COUPLING NUT
DIAMETER ACROSS FLATS — 1.225 X THD. DIA. + 0.25 INCH
LENGTH — 2.25E + 0.2 INCH. P = FROM 1/16 TO 1/8 INCH

No.	A	B	C	D	E	F	G	H	Thread Diam.	Thds. per In.	K	H+D+E	Q
0	5/32 – 13/32	13/32	9/16	1¼	½	1¼	¾	1⅛	11/16	14	5/32	2⅞	5/32
1	9/32 – 9/16	9/16	¾	1½	⅝	1¼	¾	1⅛	⅞	12	3/16	3¼	5/32
2	9/16 – 13/16	13/16	1	1½	11/16	1⅝	⅞	1¼	1⅛	10	3/16	3 7/16	5/32
3	11/16 – 1 1/16	1 1/16	1¼	1⅞	¾	2	1	1¾	1 13/32	10	¼	4⅜	3/16
3S	9/32 – 9/16	13/16	1	1⅞	¾	2	1	1¾	1 13/32	10	¼	4⅜	5/32
4	15/16 – 1 5/16	1 5/16	1½	2¼	¾	2⅞	1⅛	2⅛	1 11/16	10	¼	5⅛	3/16
4S	9/16 – 15/16	1 1/16	1¼	2¼	¾	2⅞	1⅛	2⅛	1 11/16	10	¼	5⅛	3/16
5	1 1/16 – 1 9/16	1 9/16	1⅞	2⅝	⅞	2⅞	1⅛	2⅛	2	10	5/16	5⅝	7/32
5S	15/16 – 1 3/16	1 5/16	1½	2⅝	⅞	2⅞	1⅛	2⅛	2	10	5/16	5⅝	7/32
6	1 3/16 – 1 13/16	1 13/16	2⅛	2⅞	⅞	3⅞	1¼	2¼	2 5/16	10	7/16	6	7/32
7	1 5/16 – 2 1/16	2 1/16	2 7/16	2⅞	15/16	3⅞	1¼	2¼	2⅝	10	½	6 1/16	7/32
8	1 9/16 – 2 9/16	2 9/16	2 13/16	3	15/16	5⅛	1⅜	2⅜	3	10	9/16	6 5/16	¼
9	2 1/16 – 3 1/16	3 1/16	3 5/16	3	1	5⅛	1⅜	2⅜	3½	10	⅝	6⅜	¼
10	2 9/16 – 3 9/16	3 9/16	3⅞	3½	1⅛	6⅜	1½	2½	4	10	¾	7⅛	¼
11	3 1/16 – 4 1/16	4 1/16	4 9/16	3½	1⅛	6⅜	1½	2½	4¾	10	1	7⅛	¼

Machinery

*Dimension K as given in the table is only for plain punching machines; for combined punching and shearing machines, K should be approximately equal to the thread diameter.

There are three types of punches; the flat end, the spiral end, and the wedge end, the last two being commonly called "shearing" punches. Flat punches should always be used when the thickness of the plate is greater than two-thirds the diameter of the hole. If the thickness is less than one-half the hole diameter, much less force is required when a shearing punch is used, because the area of metal being cut at any time is less than the thickness of the plate times the circumference of the hole. Shearing punches are also recommended for cases where a large number of holes are to be punched close together, because they do not distort the plate as much as flat-end punches. When the wedge-end punch is used in making nuts and washers, it is provided with a removable center which may be changed to suit the size of the hole or removed for regrinding.

There are several standards for punches and dies, and these differ greatly. The ones most commonly used are the "Standard" and the U. S. standard; however, a number of manufacturers have their own standards. The diameter of a punched hole is equal to the diameter of the punch, but if there is an appreciable clearance between the punch and the die, the hole will be conical. The "size" of the punch usually means the actual diameter of the punch or the size of hole it will produce, but sometimes it corresponds to the size of rivet that is to be used in the holes punched.

There is no rational method of determining the proportions of punches. The proportions for U. S. standard punches which will be considered throughout this series of articles are given in the accompanying table. The sizes run from 0 to 11. The die, punch, and coupling nut of a given number fit together. It will be seen that each number is intended for a range of holes, the only difference in the proportions being dimension *A*; for instance, a No. 3 punch is intended for holes from 11/16 to 1 1/16 inches in diameter. Diameter *B* is made equal to the largest value of diameter *A*; hence, dimension *A* for a No. 3 punch varies from 11/16 inch to dimension *B*.

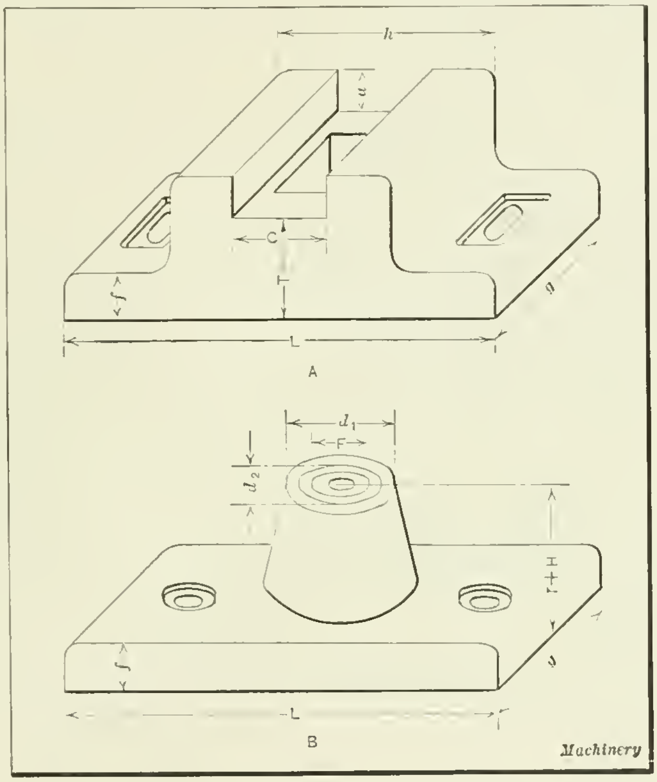


Fig. 1. Punching Machine Die-blocks for Rectangular and Circular Holders, respectively

The punches marked "S" have length *D* the same as for the corresponding number; for example, length *D* for a No. 3S punch is the same as for a No. 3 punch. But dimensions *B* and *C* are the same as for the preceding number (or No. 2 in this case). The coupling nut for a No. 3S punch fits a No. 2 punch and a No. 3 stem. This makes it possible to attach a No. 2 punch having a length equal to a No. 3 punch to a No. 3 stem. Two stems, Nos. 3 and 5, and four coupling nuts, Nos. 3, 3S, 5, and 5S, will accommodate punches ranging from 9/32 to 1 9/16 inches in diameter. The seat of the punch in the coupling nut is at an angle of 30 degrees with the axis of the punch.

In the standards of the Cleveland Punch & Shear Works Co. punches between 1/8 and 1 5/16 inches diameter are 2 1/8 inches long, and the same coupling nut can be employed for more than one size by using a bushing or reducer that fits over the punch and has the effect of increasing diameters *B* and *C*. The "Standard" punches may cover a wide range by using different couplings, similar to those of the U. S. standard; however, instead of making a punch of a given size equal in length to another size, a bushing called a "distance block" is used in connection with the punch to produce the desired length.

Punch Stems and Coupling Nuts

The punch stem or stock may be made square or round. The round type is very satisfactory for punching round holes and costs less to make; however, it is not so desirable for punching holes that are not round, because it is likely to turn in the holder and not permit the punch to clear the die. Machines should be fitted with stems suitable for the largest punches the machines are designed to use, but as a rule the stem is made only slightly larger (to the nearest 1/8 inch) than the diameter of the thread in the coupling nut for the size of punch specified. For example, a machine for punching 1-inch holes through 1-inch plate would use either a No. 3 or a No. 4S punch. The diameter of thread for a No. 3 punch is given in the table as 1 13/32 inches, and so the diameter of stem for this punch would probably be 1 1/2 inches.

The diameter of the stem is a matter of serious consideration. If the slide were designed to take a 1 1/2-inch stem and it should be desired to punch a 1 1/4-inch hole through plate 1/4 inch thick, it would be necessary to construct a special stem. This would suggest that the slide in this machine be fitted with a 1 3/4-inch stem; however, the reason for using the 1 1/2-inch stem is that it would not permit the use of a punch greater than 1 1/16 inches in diameter, and the press would be less likely to be overloaded by an operator attempting to punch, say, a 1 1/4-inch hole through 1-inch plate. Many machines have been broken by excessive overloads produced in this way. If this machine were fitted with a No. 4 stem and a No. 4S coupling, it would be equally well protected against overload, unless the operator had access to a No. 4 coupling. It is undoubtedly better to use a No. 4 stem and a No. 3 die if the machine is to be in the hands of careful operators, and this is often done.

Dimension *K* varies with the size of the punch and the class of work done on the machine. If the machine is used only for punching, the values of *K* given in the table are sufficiently large; but if a given machine is also to be used for shearing, the value *S* must be sufficient to accommodate the shearing tools, and in order to span this distance, after the die-block and holder have been made sufficiently thick, the length of the stem must be increased too. Value *S* may be determined by the empirical formula $S=8.25\sqrt[3]{dt}+0.8$; and by making *K* approximately equal to the diameter of the thread on the stem, the die-block will usually be of sufficient thickness.

The thread on the stem should be about two threads longer than the dimension *E* given in the table. The length of the stem in the holder may be about twice the travel of the slide plus 1 inch; or as expressed by the formula, $2.22\sqrt{dt}+1.6$. The total length of the stem should be about $2.22\sqrt{dt}+1.6+E+K$, the value of *K* depending on whether or not the machine is used for shearing, as previously explained.

The couplings are generally spanner or hexagonal nuts. The diameter of the thread and the distance that the stem enters the nut are given in the table. The plain hole through which the punch protrudes is 1/32 inch larger in diameter than diameter B of the largest punch for which the coupling is to be used. The outside diameter of the spanner nut or distance across flats of the hexagonal nut may be $1.225O + 0.25$, where O is the diameter of the thread. The length of the coupling nut may be made equal to $2.25E + 0.2$.

Dies, Die-holders and Die-blocks

There are two common designs of dies, the flat top and the bevel top. The flat-top die is made slightly higher at the cutting edge than at the periphery to insure contact at the cutting edge. This taper may be 1/16 inch for all sizes up to and including No. 8. There may be a taper of ⅛ inch on dies Nos. 9, 10, and 11. The bevel-top die has beveled serrations running parallel across the top. Dies are marked according to the punch size; those ½ inch and under have a clearance of 1/32 inch around the punch, while those larger than 1/2 inch have 1/16 inch clearance. The dimensions of U. S. standard dies are also given in the table.

Die-holders are made either circular or rectangular, depending upon the design of the block. The outside diameter of round holders should be about $1.5F$, where F is the value given in the table for the outside diameter of the largest die to be used in the machine. The length of the holder should equal $2.5F$, and the width $1.5F$. Thickness H of a round or rectangular holder is given in the table. The top of the die should extend ⅛ inch above the top of the holder, making the distance from the bottom of the holder to the top of the die equal to $H + ⅛$. The die is fastened to the holder by means of a set-screw. Some designers place the die directly in the block, as shown at B, Fig. 1, and do not use a holder.

The die-blocks shown at A and B in Fig. 1 are for rectangular and circular holders, respectively. These die-blocks are shown assembled at A and B, Fig. 2. Length L, Fig. 1, of the die-block is usually made equal to the width of the lower jaw of the machine, and is found as follows:

$$L = 12.25 \sqrt{dt} + 4$$

The distance from the bottom of the slide, when it is in the extreme downward position, to the bottom of the die-holder, on a combined punching and shearing machine is approximately equal to $M + H + P$, where $M = D + E + K - P$; these dimensions are taken from the table. The thickness of the die-block T is determined by the formula

$$T = S - (M + H + P)$$

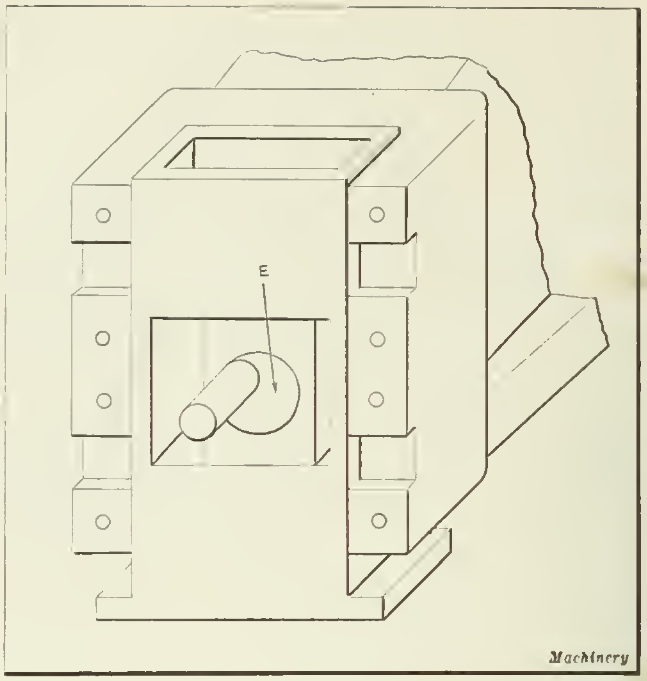


Fig. 3. One Method of designing the Head End of the Frame and the Slide

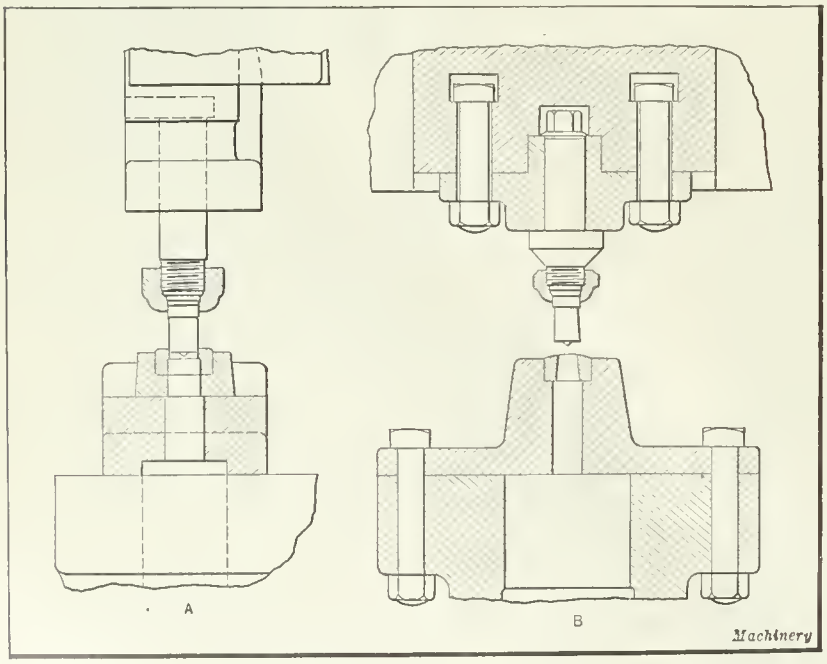


Fig. 2. Sectional Views of Punches and Dies, having Die-blocks like those shown in Fig. 1

The distance P which the punch enters the die should vary with the size of punch and thickness of plate. It is generally conceded that for ordinary steel plate and structural steel it is not necessary for the punch to go below the top of the die, but it usually enters from 1/64 to ⅛ inch. This is to allow for spring of the frame and wear of the punch and die. The conclusion to be drawn from statements by various authorities is that an allowance of 1/16 inch should be made for grinding the punch and die, and from 1/32 to 1/16 inch for the deflection of the frame. Therefore $P = 1/16$ to ⅛ inch.

Other proportions for the blocks shown in Fig. 1 are found by the following formulas, in which H and F correspond to the dimensions given in the table:

$a = 0.75H$

$C = 1.6F$

$f = H$

$g = 3.125F$

$h = C + 2f = 1.6F + 2H$

$L = 12.25 \sqrt{dt} + 4$

$d_1 = 2.25F + 0.25$

$d_2 = 1.5F$

The die-block at A is provided with screws for securing the holder to it, and both blocks have slots in them which allow adjustment when they are being secured to the lower jaw of the frame.

Travel of the Slide

The stroke of the punch or travel of the slide depends upon the greatest thickness of plate and the largest diameter of hole punched. It is desirable to have the punch raised above the plate sufficiently to allow the operator to move the work readily between the punch and die; but it is also desirable to have the stroke as short as possible so as to reduce the twisting moment on the shaft and the force transmitted at the pitch line of the gear teeth. A long stroke permits of a long cut being taken with a bevel shear. The punch is usually passed from 1/16 to ⅛ inch beyond the under side of the plate, and the clearance between the plate and the punch when the latter is at the end of its upward stroke should be about ⅜ inch for a ⅜-inch hole and a ¼-inch plate, and 1½ inches for a 4-inch hole and a 2-inch plate. In punching 1-inch holes through 1-inch plate, the travel is usually about 1½ inches, and for a 1½-inch hole through the same plate, the travel is usually 1¾ inches.

By plotting the values taken from machines made by several different companies, it was found that the travel could be expressed roughly by the empirical formula

$$h = 1.11\sqrt{dt} + 0.3$$

in which

h = travel of slide;
d = diameter of largest hole; and
t = greatest plate thickness;

When the largest diameter of hole is equal to the greatest thickness of plate, this formula is written

$$h = 1.11d + 0.3$$

The slide travel is usually made to the nearest ⅛ inch of the value given by the formulas. The radius e of the path followed by the center of the eccentric on shaft E, Fig. 3, which is employed to reciprocate the slide, is called the "eccentricity," and is equal to one-half the slide travel. It is expressed by the formula

$$e = 0.55\sqrt{dt} + 0.15$$

Designing the Pendulum

The pendulum (also called "pintle" and "pitman") is a special form of connecting-rod which is fitted to the slide in such a way that it is not subjected to tension on either stroke. This eliminates the use of a large wrist-pin which would be subjected to double shear. The pendulums differ slightly in shape, as they may be made of cast iron or steel. The type of pendulum that will be proportioned in this article is shown at U in Fig. 4. It will be assumed that this is to be an iron casting. Diameter D of the eye is determined by the diameter of the eccentric or cam on the main shaft, the eccentric being subjected to a force approximately equal to the maximum force required to punch the hole.

The length of the cam bearing or width C of the slide, as shown at X, is sometimes made equal to diameter D. This bearing is subjected to pressure during only a part of the downward stroke. The allowable bearing pressure per square inch varies from 5000 to 16,000 pounds, depending on the size of the machine and the designer. Equating the total bearing pressure with the total load,

$$DCp = 3.1416Pdt$$

in which

d = diameter of largest hole punched;
t = greatest thickness of plate; and
P = resistance of plate to punching, per square inch.

Assuming $D = C$, $P = 60{,}000$ pounds, and $p = 11{,}750$ pounds,

$$D^2 = C^2 = \frac{3.1416 \times 60{,}000\ dt}{11{,}750} = 16dt$$

Therefore,

$$D = C = 4\sqrt{dt}$$

This value of 11,750 pounds per square inch for the unit pressure gives the same result as an empirical rule which states that the diameter of the eccentric or cam should equal twice the diameter of a round rod having a cross-sectional area equal to the area sheared in punching the hole. This rule may be expressed by the equation,

$$\frac{3.1416}{4}\left(\frac{D}{2}\right)^2 = 3.1416dt$$

Simplifying,

$$D = 4\sqrt{dt}$$

This formula is satisfactory only for machines ranging from those for punching ¾-inch holes through ¾-inch plate to those for punching 3½-inch holes through 2-inch plate, and should not be used for smaller or larger machines. Small machines operate faster and are more likely to be overloaded and neglected than the larger sizes. For this reason a greater factor of safety is used in their design, this being equivalent to using a variable bearing pressure. It is also more economical to make dimension C greater than dimension D on large machines. These considerations are embodied in the formulas

$$C = 3.5\sqrt{dt} + 0.5$$
$$D = 3\sqrt{dt} + 1$$

The latter value of D is equal to 1 inch plus 1.5 times the diameter of a round rod having a cross-sectional area equal to the area of the metal sheared in punching the hole, and gives much larger values for small machines and smaller values for large machines than is given by $4\sqrt{dt}$. It should be used in designing a punching machine of any size, and will be used in proportioning parts in this article.

The load on the pendulum lower bearing of diameter d_1 (Fig. 4) is approximately equal to the total force required to punch the hole. The bearing surfaces have only a small

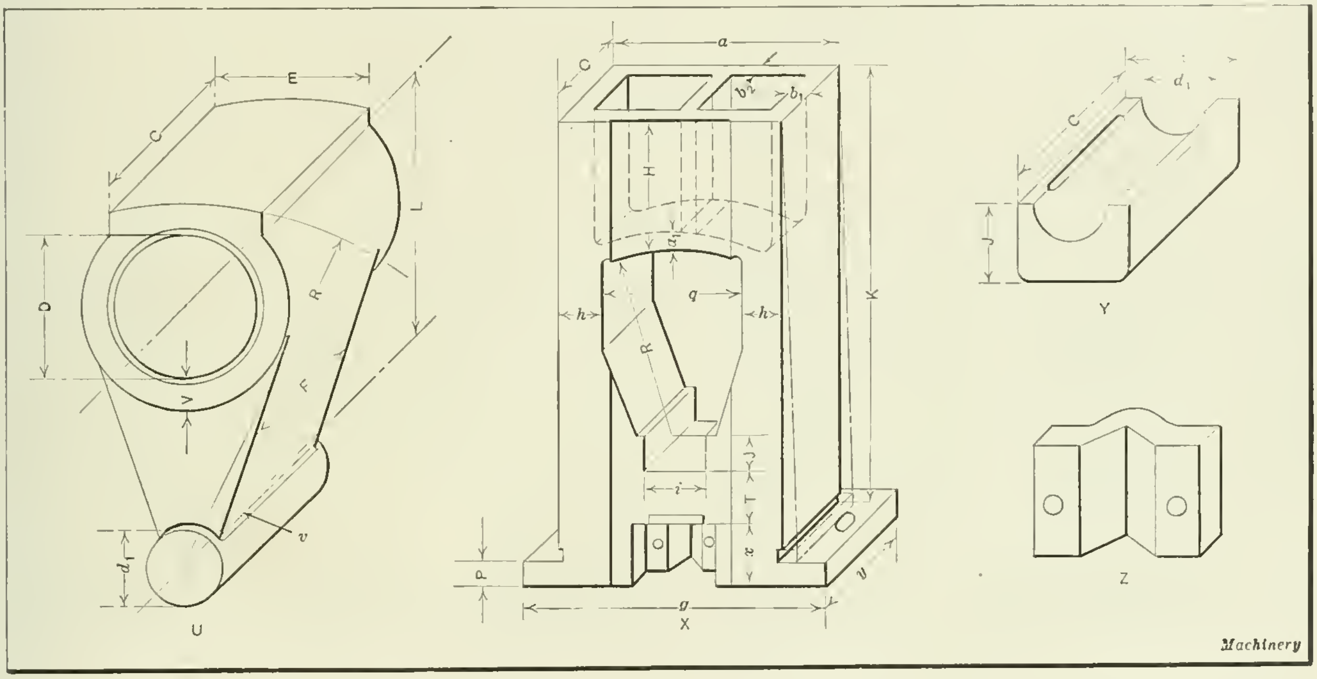


Fig. 4. Details of the Pendulum, Slide, Pendulum Box, and Punch-stem Clamp

relative motion, are subjected to pressure during a part of the downward stroke only, and are free from pressure on the upward stroke, so that the surfaces become well lubricated before each load is applied. Under these conditions it is permissible to use a bearing pressure as great as 20,000 pounds per square inch; however, a pressure of about 18,000 pounds per square inch gives satisfactory results for medium-sized machines. Assuming that the length of the lower bearing equals length C or $4\sqrt{dt}$, and equating the area of the lower bearing times the unit pressure, with the load,

$$Cd_1 \times 18{,}000 = 3.1416dt \times 60{,}000 = 188{,}500dt$$

and

$$d_1 = \frac{188{,}500dt}{18{,}000C} = \frac{10.48dt}{4\sqrt{dt}} = 2.62\sqrt{dt}$$

This formula is satisfactory for machines of medium capacity, but it is better to use $d_1 = 0.5D$, where $D = 3\sqrt{dt} + 1$, which gives

$$d_1 = 1.5\sqrt{dt} + 0.5$$

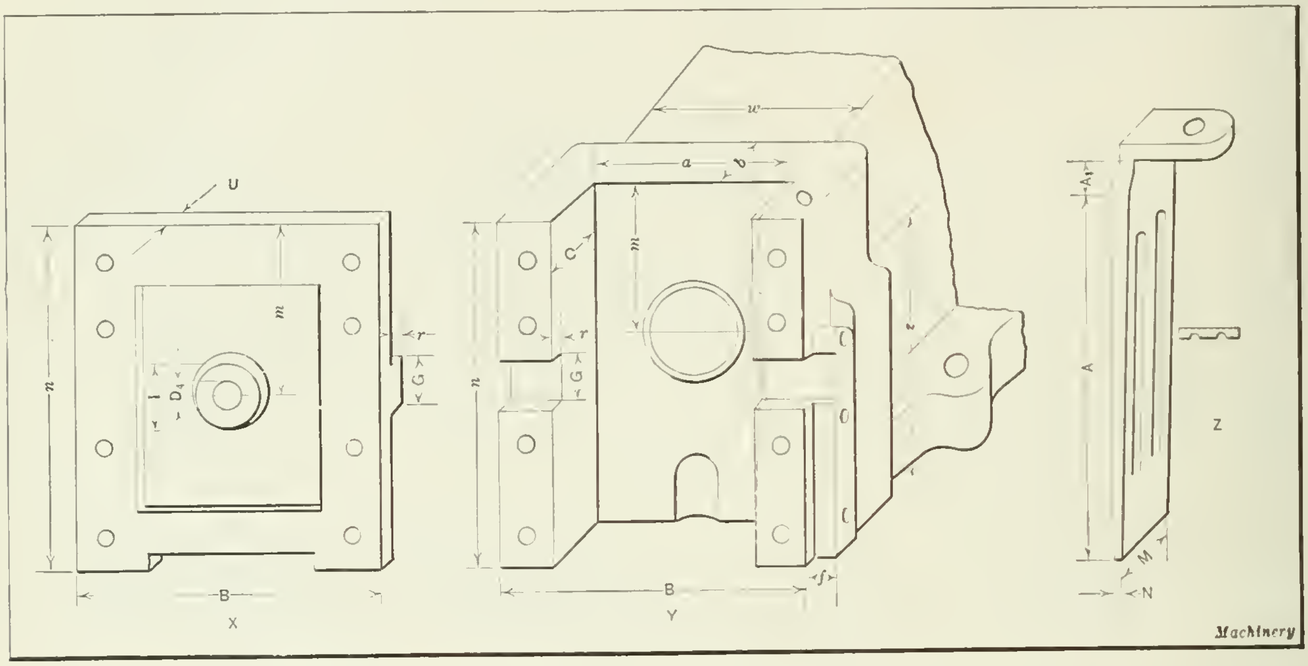


Fig. 5. Details of the Slide Plate, Head End of Machine Frame, and Slide Gib

Distance L between the centers of the pendulum bearings is sometimes made equal to $D + d_1$, but it is better to make it twice the cam diameter minus 1 inch or

$$L = 2D - 1 = 2\,(3\sqrt{dt} + 1) - 1 = 6\sqrt{dt} + 1$$

Thickness V of the metal around the eye, including the bushing, may be determined as follows:

$$V = 0.75\sqrt{dt} + 0.2$$

Some designers consider it essential to use a bronze bushing in the cam bearing of the pendulum, having a thickness of from 3/16 to 3/8 inch. If there is a fillet on the main shaft between the cam and the main journal, the pendulum must be bored to clear it. Radius R of the bearing surface on the top of the pendulum, which coincides with a mating surface on the slide, is found by the formula

$$R = L + 0.5D + V = 8.25\sqrt{dt} + 1.7$$

Width E of this surface is found by the formula

$$E = D = 3\sqrt{dt} + 1$$

The formula for determining breadth F of the web is

$$F = C - 0.5\sqrt{dt}$$

The web may be tangent to the outside of the metal surrounding the eye and the lower bearing, but in order to have free movement of the lower bearing in its box, a small amount of metal should be removed, as shown at v. It is better, however, to bring the web sides nearer together at the bottom, so as to make cut v unnecessary.

Formulas for Determining the Slide Dimensions

The details of slides or plungers differ but slightly except in the method of attaching the punch stem. Sometimes the stem is held to the slide by means of a clamp, such as shown at Z, the V-shaped groove in the clamp and that in the slide forming a square opening which gives four contact lines with the punch stem, and thus secures it rigidly. In other designs the stem is attached to a block that is dovetailed into the end of the slide and allows the center of the punch to be located near the edge of the slide, when it is desired to punch small holes. A third method that is extensively used is to secure the stem to a bolster which is bolted to the slide. The sliding block mechanism shown in Fig. 3 is simple to construct, but it is not so satisfactory on account of wear, and is seldom used. There is a greater area to sustain the pressure, but there is also a greater relative motion between adjacent surfaces when the load is applied. No provision is made for taking up wear, and since wear is not uniform, it becomes necessary to refinish the bearing in the slide when a worn block is replaced with a new one.

The length of the slide in Fig. 3 may be a little less than that shown at X, Fig. 4, but other proportions may be the same with the exception of the opening in the block, which should be great enough to allow a clearance equal to about $0.25\sqrt{dt}$ between it and the pendulum on each side, and should fit the pendulum and bearing box Y, respectively, top and bottom. The greatest stress produced in the slide is a compressive one, which acts between the pendulum box and the top of the punch stem. The pressure is sometimes taken at the end of the stem by a steel plate from 1/4 to 3/4 inch thick, which is fitted or cast to the slide to distribute the pressure over a greater area. Slides are usually made of cast iron, although many are steel castings. There are instances where it has proved cheaper to replace cast-iron slides that have been weak and failed frequently, with steel slides, rather than to change the patterns for the frame and other parts, which would have been necessary if the dimensions of the cast-iron slide had been changed.

Many of the proportions for the slide shown at X are determined by empirical rules; however, those that admit of any rational derivation have been developed. Some of the dimensions correspond to dimensions of the pendulum and other parts, and are found by the same formulas. However, for the sake of convenience, they will be repeated.

$$C = 3.5\sqrt{dt} + 0.5$$

$$q = 2\,(e + 0.5D + V + 0.2\sqrt{dt} + 0.1) = 6\sqrt{dt} + 1.9$$

$$h = 2.5\sqrt{dt} - 0.25 \qquad a = 2h + q = 11\sqrt{dt} + 1.4$$

$$K = 8.25\sqrt{dt} + 1.7 \qquad i = 1.5d_1 = 2.25\sqrt{dt} + 0.75$$

$$J = d_1 = 1.5\sqrt{dt} + 0.5 \qquad P = \sqrt{dt} + 0.5$$

$$g = a + 1.75\sqrt{dt} + 2.25 = 12.75\sqrt{dt} + 3.65$$

$$n \text{ (see view } Y\text{, Fig. 5)} = 14.4\sqrt{dt} + 6.43$$

$$K = n + 2c + \sqrt{dt} = 16.51\sqrt{dt} + 6.73$$

$$K + P = 17.51\sqrt{dt} + 7.23 \qquad x = 2.2\sqrt{dt} + 1.6$$

$$m \text{ (see view } Y\text{, Fig. 5)} = 0.5n - 2e = 6.09\sqrt{dt} + 2.91$$

$$H = m + c - 0.5D - V = 4.4\sqrt{dt} + 2.36$$

$$T = 1.16\sqrt{dt} + 1.07 \qquad y = 4.25\sqrt{dt} + 1$$

$$a_1 = \sqrt{dt} + 0.25 \qquad b_1 = 0.875\sqrt{dt} + 0.2$$

$$b_2 = 0.75\sqrt{dt} + 0.125$$

The section at the middle of the slide where it is cored to receive the pendulum is subjected to bending when punching or shearing, and the stress is appreciable when the machine is being used as a slitting shear. The analysis of the stresses in this section involves several assumptions, and the results are not so reliable as those obtained by using the formula given for finding value h. The top of the slide when in its lowest position, should be flush with the top of the head at Y, Fig. 5, and the clearance between the flange of the slide and the bottom of the head, when the slide is in its highest position, should equal $\sqrt{dt}$. The clearance between the outside of the pendulum eye and the inside of the slide should be $0.2\sqrt{dt} + 0.1$. At the front and rear of the slide a strip of surface at each edge about $1.25h$ wide and running the full height of the slide is finished to serve as a bearing surface against the plate which holds the slide in place or against the frame, as the case may be. The surfaces between these finished strips are a few thousandths of an inch lower and are not highly finished.

Proper lubrication is essential to satisfactory operation of the slide, and so oil-grooves should be cut in all bearing surfaces. Oil-cups and oil-holes should also be arranged to insure a supply of oil at each bearing and should be so placed that they may be easily reached by the operator. Slides are provided with gibs which may be fastened to either the slide or the head of the frame. In the latter case, the surface in the head which the gib contacts with must be tapered as shown by the dotted lines at Y, Fig. 5. If carried by the slide, it is necessary to taper the slide as indicated by the dot-and-dash lines at X, Fig. 4. The taper is usually from 1/8 to 1/2 inch per foot. The gib is always placed on the side of the slide that is not subjected to pressure due to the angularity of the pendulum or to side thrust on a slitting shear. Not all slides are provided with the partition or web near the top, which furnishes a convenient means of attaching the counterweight. The latter may also be attached to a lug cast on an inside wall of the slide or to a pin passed through holes drilled in the front and rear walls.

Pendulum Box, Punch Stem Clamp, and Gib

The pendulum box is usually made of cast iron, although some designers prefer a steel casting. The depth of the bearing is made slightly less than one-half diameter d_1 of the pendulum to prevent pinching. The box is accurately machined to fit the slide, and is held in position without the use of dowels or screws. The following formulas may be used for determining the dimensions given at Y, Fig. 4:

$$i = 2.25\sqrt{dt} + 0.75 \qquad d_1 = 1.5\sqrt{dt} + 0.5$$

$$C = 3.5\sqrt{dt} + 0.5 \qquad J = 1.5\sqrt{dt} + 0.5$$

The clamp shown at Z is used to secure the punch stem to the slide, as previously mentioned. The center line of the stem does not always coincide with the center line of the slide, as the distance between the stem center line and the front of the slide varies from $0.35C$ to $0.5C$. It will be seen, in detailing the slide and clamp, that the V-shaped channel for receiving the punch stem will come close to the back of the slide, and it is advisable in most cases to reinforce the slide by casting a boss or projection on the back. This lug will be almost flush with the bottom flange of the slide and has a height somewhat greater than x.

The clamp comes flush with the bottom of the slide, and is secured to the slide with cap-screws. These press the clamp against the stem and tend to break it through the middle like a beam. Therefore, in order to determine the thickness of the clamp at the center, assume that the load exerted by each screw is about 5000 pounds per square inch at the root of the thread, consider the cap as a beam, loaded in the middle and supported at the centers of the screws, and assume an allowable bending stress of 4000 pounds per square inch. The clamp is usually provided with a set-screw for holding the stem to it.

The gib is made of bronze or brass, and is machined flat on the bearing side. The opposite side is often grooved as shown at Z, Fig. 5, to facilitate finishing and to reduce the weight. Length A of the finished portion equals length n of the guide surfaces of the head plus the travel of the slide, or, expressed as a formula,

$$A = 15.5\sqrt{dt} + 6.7$$

Width M is made from 1/16 to 1/8 inch less than width C of the slide, while thickness N at the thin end, is made from 1/8 to 5/8 inch, and the taper from 1/8 to 3/8 inch per foot. Distance A_1 should be a little larger than twice the thickness of the nuts used on the adjusting screws. Large machines are provided with two screws for holding the gib in place.

Attaching the Counterweight

All machines having a capacity for punching 1-inch holes through 1-inch plate or greater, and some as small as for punching 5/8-inch holes through 5/8-inch plate, have a counterweight attached to the top of the slide to facilitate placing the punch by hand. There are two methods of mounting the weight; one of these is to carry the weight by a bar or lever having a depth equal to about four times the thickness, and connecting the bar by means of a link to the slide, the fulcrum being fastened to the head of the frame with cap-screws and the lever being located longitudinally with respect to the frame. A somewhat similar arrangement is to connect the lever to the slide by means of a coil spring, which relieves the lever from shocks produced by the inertia of the weight. The second general method is to locate the lever at right angles to the frame and use the spring connection. On quick-acting machines the effects of inertia are so great that it is advisable to use long coil springs instead of weights.

The leverage of the supporting bar varies from 3 to 1 to 5 to 1, and the counterweight should about balance the weight of the slide and pendulum. The weights are usually made cylindrical with a length ranging from 0.75 to 2 times the diameter. The bending stress in the lever due to the counterweight should be about 1500 pounds per square inch when the lever is made of cast iron. If the distance between the fulcrum and the end of the lever that is attached to the slide is too small, the travel and inertia of the weight will be excessive. It is therefore advisable to lay out this linkage to scale, and be sure that the weight clears the frame and does not travel too much.

The Faceplate

Thickness U of the faceplate shown at X, Fig. 5, does not permit of rational solution, but may be found by the formula

$$U = \sqrt{dt} + 0.5$$

Diameter D_4 of the bearing is equal to the diameter of the cam minus the travel of the slide, and may be found by the formulas

$$D_4 = 1.89\sqrt{dt} + 0.7 \text{ (without fillet on cam)}$$

and

$$D_4 = 1.75\sqrt{dt} + 0.7 \text{ (with fillet on cam)}$$

The length of the bearing should equal from D_4 to $1.25\ D_4$, and the following formulas may be used to find the other dimensions:

$I = 1.75\ D_4$ $\qquad r = 0.5\ \sqrt{dt} + 0.125$

$G = 2\ \sqrt{dt} + 1$ $\qquad m = 6.09\ \sqrt{dt} + 2.91$

$n = 14.4\ \sqrt{dt} + 6.43$ $\qquad B = 15.5\ \sqrt{dt} + 3.4$

The faceplate on machines larger than for punching 1-inch holes through 1-inch plate is sometimes provided with two lugs, as indicated in Fig. 5, while in other instances two steel studs fastened to the frame are inserted in holes in the faceplate to align it, instead of using lugs on the plate. Each stud may have a diameter equal to $1.4\ \sqrt{dt} + 0.75$. There is no rational method of determining the load carried by the studs or cap-screws, used in securing the faceplate to the head. The number of studs or screws varies from six to ten, and their diameter from 3/8 to 1 inch. A rule that has proved very satisfactory is as follows: The total area of the screws or studs should equal the area of metal sheared in punching the hole.

* * *

FIXTURE FOR MILLING AND UNDER-CUTTING CLUTCH TEETH

By J. T. LONGDON

The milling fixture here illustrated was designed by the writer for milling and under-cutting the teeth in three-jaw clutches of the design shown by the two views in the lower left-hand corner of the illustration. The fixture consists essentially of a collet spindle on which the work is mounted, a worm and worm-wheel for rotating the spindle so as to feed the work to the milling cutter, and a pair of cams which give the endwise movement to the spindle that is necessary to produce clutch teeth of the required shape.

The work is placed over the collet which is expanded by the action of spindle *D*. This spindle is drawn inward by means of the capstan wheel *N* and draw-rod *M*. The disk or collar *P* is screwed on the end of rod *M* and tightened in place so that it forms a stop for the latter part, by bearing against the end of part *C*. Key *V* prevents spindle *D* from rotating independently of part *C*. On the end of part *C* is a cam *H*, which is held in place by key *J* and set-screws *O*. The stem of cam *K* is made a push fit in body *A*, and is bored out to receive row *M*. Cam *K* is also recessed to receive collar *P*. Set-screw *L* prevents cam *K* from rotating.

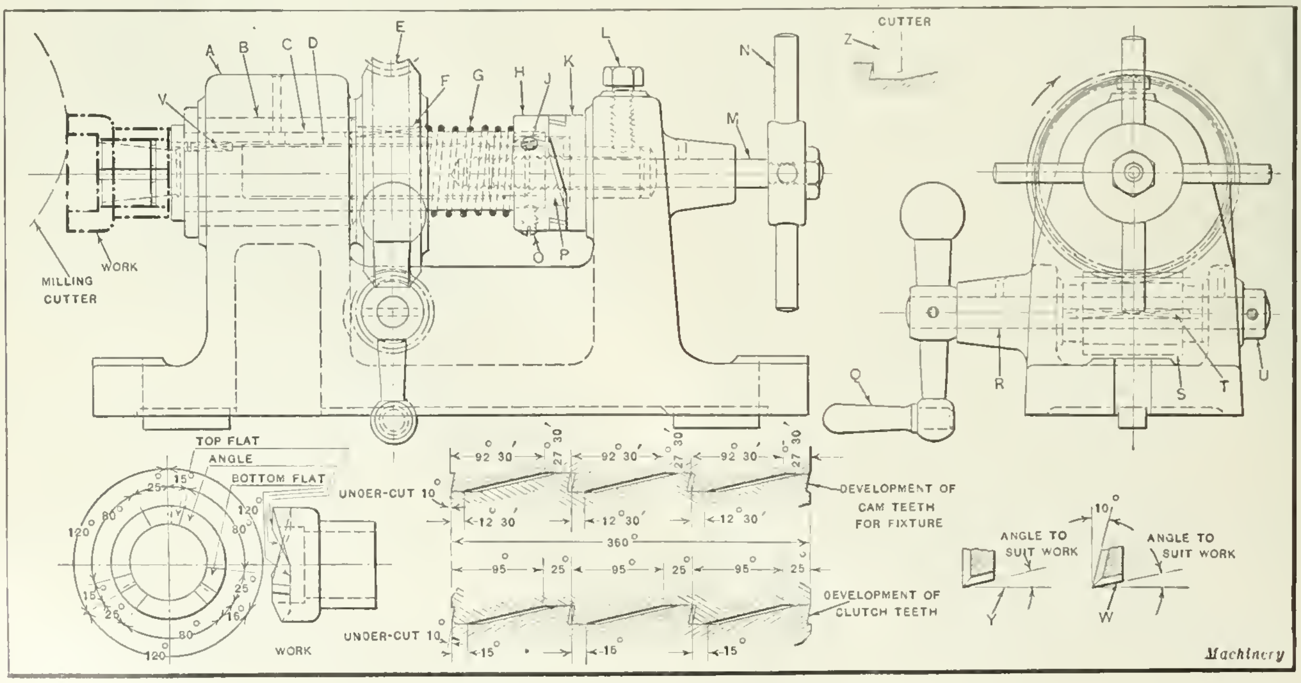
Reference to the illustration will show that after the work is in position and the collet has been expanded, parts *C* and *D* form an integral part, which, in operation, has an inward and outward, as well as a revolving movement in and through bushing *B*, which is a press fit in *A*. The in and out movements are controlled by cams *H* and *K*. A keyway is cut in part *C* to accommodate key *F*, located in worm-wheel *E*. Worm-wheel *E* is, of course, a sliding fit on part *C*. The ratio of the worm and worm-wheel is 40 to 1. Spring *G* serves to keep the cam faces in contact. Spindle *R* carries the ball-crank handle *Q* and the worm *S*. The worm is prevented from rotating independently of spindle *R* by key *T*. Spindle *R* is held in place by collar *U*.

In operation, the ball-crank handle is rotated clockwise, thus causing the worm-wheel to revolve in the direction indicated by the arrow in the view in the upper right-hand corner of the illustration. One revolution of the work or forty revolutions of handle *Q* are required to complete the tooth-cutting operation. To under-cut the teeth, the ball-crank handle is rotated in a clockwise direction until the cam faces are in the position shown. The ball-crank is then rotated in a counter-clockwise direction as far as possible, thereby under-cutting one of the teeth. This operation is repeated for each tooth. In the illustration, *Z* represents the face of the cutter used to under-cut the clutch tooth faces. At *Y* is shown the profile of the clutch tooth milling cutter, and at *W* is shown the tooth profile of the under-cutting milling cutter. These cutters should be as large in diameter as the work will allow, because the surfaces cut will be slightly concave, but the amount of concavity is so small that it is not detrimental to the work.

* * *

THE ENGINEERING PROFESSION

Engineering work has become an increasingly important factor in the progress of civilization and in the welfare of the community. The engineering profession is held responsible for the planning, construction, and operation of such work, and is entitled to the position and authority that will enable it to discharge this responsibility and to render effective service to humanity. That the dignity of their chosen profession may be maintained, it is the duty of all engineers to cooperate in upholding the engineering profession by exchanging general information and experience with fellow engineers and students of engineering and also by contributing to work of engineering societies, schools of applied science, and the technical press.—*From the Code of Ethics of the American Society of Mechanical Engineers*



Fixture employed in milling and under-cutting Clutch Teeth

Cutting Worm Threads

By FRANKLIN D. JONES

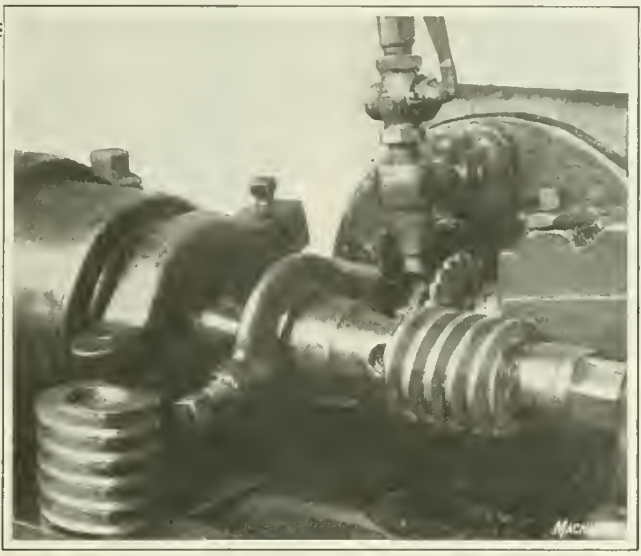


Fig. 1. Milling a Worm Thread

WORM threads are cut either by using some form of thread-cutting lathe and a single-point tool, by using a thread milling machine and a disk type of cutter, or by using a gear-hobbing machine. Worm threads should preferably be cut so that the sectional shape of the thread in an axial plane conforms to the shape of a standard involute rack, the included angle of the thread being 29 degrees, and the total depth of the thread groove being equal to 0.6866 × pitch of worm. This rack shape may be obtained by using a properly ground lathe tool set so that the plane of the cutting edges coincides with the axis of the worm; but if the tool is set normal or at right angles to the sides of the worm thread, the sectional shape of the thread in an axial plane will be modified.

If the worm threads incline considerably from a plane perpendicular to the axis of the work, as in the case of multiple-threaded worms, the use of an ordinary double-sided cutting tool is objectionable, because the tool has an acute angle and considerable positive rake on one side, with an obtuse angle and excessive negative rake on the other side. To avoid an extreme condition of this kind, a single-sided tool may be used for finishing one side of the worm thread at a time. To obtain a good contact between the worm and worm-gear, it is essential to use a hob having cutting edges that correspond to the sides of the worm thread.

In using a thread milling machine, if the cutter has straight cutting edges, the worm thread will not be given the correct shape, the variation depending upon the diameter and helix angle of the worm thread and the cutter diameter. Instead of milling a thread in this manner and then using a hob that is modified to suit the shape of the worm thread, it is better to change the shape of the disk cutter, assuming that the error resulting from the use of a straight-sided cutter is considered of sufficient importance to warrant using a modified milling cutter. The magnitude of this error, as previously intimated, varies according to the relation between the cutter diameter, the worm diameter, and the helix angle of the thread. A cutter is modified to mill a worm thread having a true rack section in an axial plane, by making the cutting edges convex an amount depending upon the related factors just referred to.

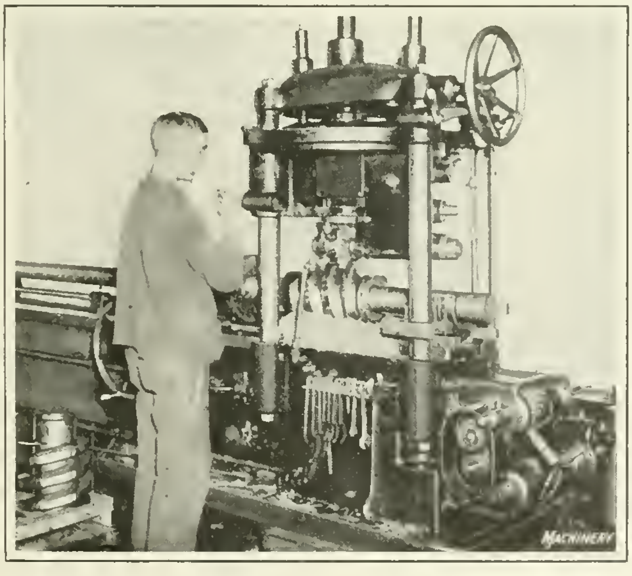


Fig. 2. Milling Double-threaded Worm having a Lead of 7 Inches

Ordinary engine lathes are used quite extensively for cutting worm threads. Whether or not lathes can be used to advantage depends on such factors as output required and size and nature of the work. Automatic lathes of the type made by the Automatic Machine Co., Bridgeport, Conn., are efficient for cutting worms on a quantity basis. After the work is placed in position, the movements of the lathe are controlled automatically. Front and rear tools are used, and when the lathe is in operation these tools first move in to the cutting position, the carriage is then traversed, the tools withdrawn at the end of the cut, and the carriage returned to the starting point; this cycle of movements is repeated until the work is finished. For cutting a worm thread, a square-ended roughing tool may be used at the rear, and a finishing tool at the front of the work.

Milling Worm Threads

Thread milling machines are more efficient than ordinary engine lathes for cutting worm threads, as well as for other threading operations within their range. This is because the cutting action is continuous, and a thread may be finished in one cut unless the pitch is quite large, in which case it may be necessary to take two or possibly three cuts. An example of worm thread milling is shown in Fig. 1; this is a detailed view of a Lees-Bradner machine cutting worms for automobile steering gears. The cutter at the rear is inclined to align it with the helix angle of the thread, and it is traversed as the worm blank revolves slowly. The tangent of the angle to which the cutter is inclined may be determined by dividing the lead of the worm thread by the pitch circumference of the worm. An indexing mechanism on the headstock of the machine provides means of rotating or re-locating the work spindle relative to the cutter when multiple threads are being milled.

In using thread milling machines, it is essential to rotate the cutter as fast as possible without dulling it excessively in too short a time, because the higher speed not only increases production but also enables the cutter to form smooth threads. While information on cutting speeds and feeds must necessarily be subject to considerable variation,

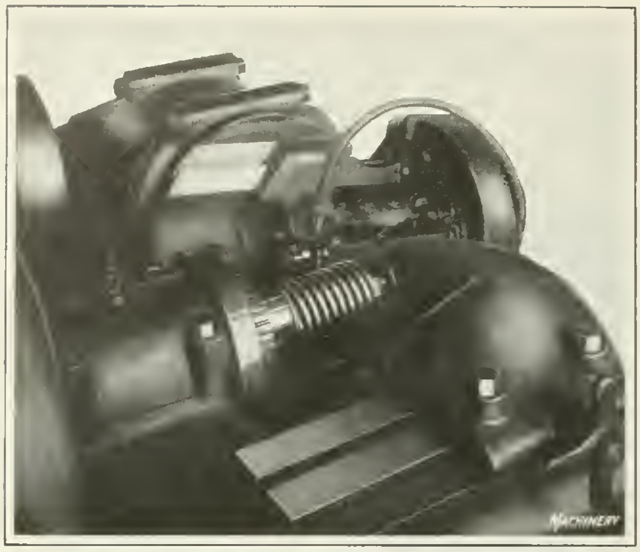


Fig. 3. Gear Generator equipped with Auxiliary Cutter-spindle for milling Worms

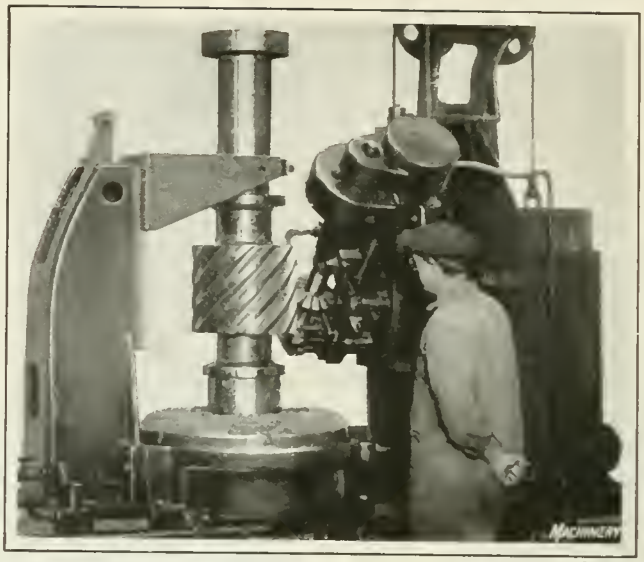


Fig. 4. Milling Twelve-threaded Worm on Hobbing Machine using a Disk Cutter and Hand-indexing

a cutting speed of 100 to 125 feet per minute is a fair average range for milling steel worms. The rotation of the work, which represents the feeding movement, usually varies from about 4 to 7 inches per minute. The speed of the worm shown in Fig. 1 is at the rate of 6 inches per minute.

Another type of thread milling machine is shown in Fig. 2 milling a large worm at the plant of Edwin Harrington Son & Co., Philadelphia, Pa. This is a double-threaded worm having a lead of 7 inches, and three cuts were required for roughing and finishing the thread. As the illustration shows, the cutter is located above the work, and it is set according to the helix angle of the worm thread by adjustment about a vertical axis. A chuck holding the left-hand end of the worm is carried directly by the lead-screw, which is traversed at the required rate through change-gears. This gearing is on the carriage, and serves to control the relative speeds of two worm-gears, one revolving the lead-screw and chuck and the other a nut through which the lead-screw passes. The indexing mechanism for multiple threading is located just back of the chuck.

Milling Worm Threads on a Gear Generator

The application of a Lees-Bradner gear generator to the milling of worms is shown in Fig. 3. The auxiliary cutter-spindle intended for cutting small gears and threading worms is used for this operation. This worm is 3½ inches in diameter, ½ inch pitch, and is cut with a feed at the circumference of 6 inches per minute. The machine is provided with an indexing fixture for use in cutting multiple threads. A fixture of the same general type, but differing somewhat in design, is illustrated in Fig. 5. The center has a notched flange *A*, the number of notches corresponding to the number of threads on the worm to be milled. The driver has a pivoted arm or latch *B*, which is moved from one notch to another for indexing after each thread groove is finished. This particular arbor is used for holding two worms.

A Newark hobbing machine is shown in Fig. 4 milling a twelve-threaded steel worm. The helix angle is 45 degrees, and the normal circular pitch 2.467 inches. An ordinary disk cutter is used, one thread being milled at a time, the same as in a thread milling machine. After each passage of the cutter, the cutter-head is returned by a rapid traverse, and the gear is indexed by hand for milling the next tooth space. The crank for indexing is located at the end of the machine to the right of the operator, and the required indexing movement for the work-table is controlled through suitable change-gears. As the illustration shows, the lower end of the gear shaft is inserted in a cast-iron sleeve which is bolted to the work-table.

Cutting Worm Threads by Hobbing Process

Gear-hobbing machines have been used to advantage for cutting single- and multiple-threaded worms by the hobbing process. This method is particularly efficient for multiple-threaded worms, because all of the threads are finished simultaneously instead of taking separate cuts and indexing, as is necessary in a lathe or thread milling machine. The hobbing machine is geared with reference to the number of threads, as in cutting a helical gear.

In connection with this efficient method of cutting worms, a special form of hob has been developed by Gould & Eberhardt, which is shown at work in Fig. 6 cutting a seven-threaded worm. This hob has fourteen roughing teeth and

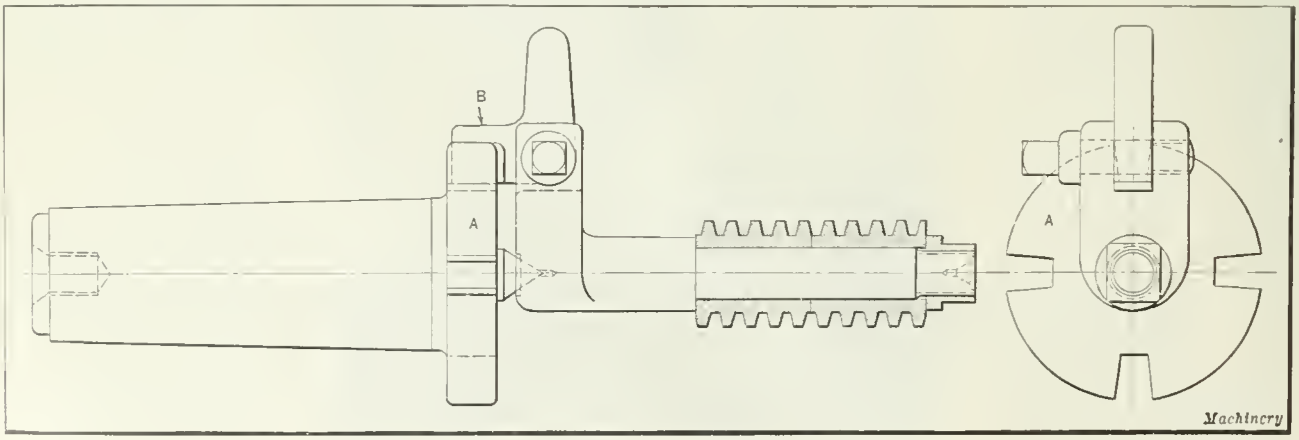


Fig. 5. Indexing Type of Arbor used in milling Multiple-threaded Worms

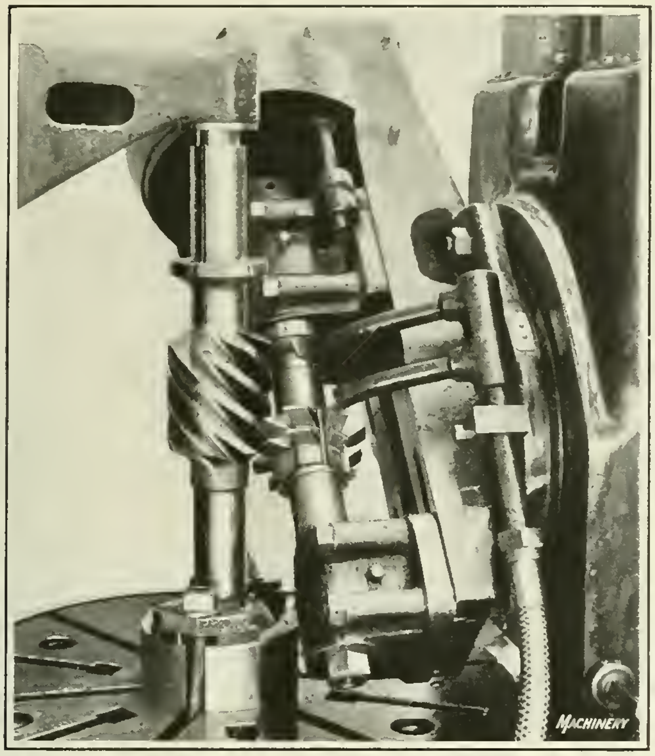


Fig. 6. Cutting Worm Threads by Hobbing Process

three finishing teeth arranged along a helical path, the same as on a regular hob. These teeth progressively increase in width and height to distribute the work of cutting. To prevent interference with the outer half of the worm thread and the cutting of a distorted thread form, the lead of the hob teeth on the following side (as determined by its movement relative to the work) is modified. The worm shown in Fig. 6 has an outside diameter of 4.1 inches, a linear pitch of 1.37 inches, and a face width of 4½ inches. The thread is finished by grinding after hardening.

* * *

FLASH AND FIRE TESTS FOR FUEL AND LUBRICATING OILS

When oil is heated it will give off vapor, the amount of heat necessary to bring this about being governed largely by the nature of the oil. Not all substances, when heated to the vaporizing point, yield an inflammable gas, but this characteristic is found in oils and allied substances. The temperature at which an oil, upon heating in the presence of air, develops vapors, which when a spark is applied will ignite or flash, is called the "flash point." When the heating is continued above the flash point, a temperature is reached at which the vapors are thrown off the surface of the oil in such quantity as to ignite and burn continuously. The temperature at which this occurs is called the "fire point."

Factors that Determine Fire Hazard

The purpose of the flash test, no doubt, has always been to determine the fire or explosion hazards of oils, but the flash point, although probably the most important factor, will not by itself determine the fire hazard of any substance. The fire hazard of a substance is also influenced by the volatility, the boiling point, the vapor pressure, the vapor density, the diffusibility and tendency of the vapors to travel, and their explosive limits in air, the tendency of the oil to chemical change, the quantity of heat liberated per unit of time and volume, the temperature of the flame, the corrosive action and toxic properties of the substance and all its products of combustion, its behavior toward water, both before and after ignition, and the tendency of the substance to leak.

In the case of burning or fuel oils the principles underlying the determination of the flash and fire points are quite important, and much work has been done on the design of flash and fire testing apparatus that will give definite results and will eliminate the personal equation of the operator. These all, however, fall short of giving a physical constant that definitely determines any property of the oil that cannot be determined more accurately in some other manner, as by evaporation or distillation tests.

In the case of lubricating oils, however, flash and fire points have practically no value in indicating lubricating qualities. The flash and fire points of lubricating oils are all sufficiently high to show that there is practically no fire hazard, and even in special cases where these determinations might give indications of constituents of too low boiling points, these can be determined much more accurately and satisfactorily by evaporation and distillation tests. Where specifications still demand that flash and fire points of lubricating oils be taken, the open cup type of tester will give satisfactory results. In making the tests, the points given in the following which were set forth in a U. S. Bureau of Mines publication, should be carefully considered.

Factors that Influence Tests

1. First of all, the conditions under which flash testing is done should always be comparable. Tests should always be repeated, using fresh samples of oil.

2. On account of the influence of barometric pressure on the flash point, final observations should be corrected for barometric pressure, using a proper correction table. A rise of 1 millimeter in the barometer effects a rise in flash point of about 0.038 degree C.

3. The shape and size of the cup in which the oil is heated is of importance. The dimensions of the oil-cup in the Cleveland tester are practically standard.

4. The size of the thermometer bulb has to be taken into consideration in testing for flash point. It is customary to prescribe the kind of thermometer to be used.

5. The rate of heating should be confined to relatively narrow limitations, for it has been definitely proved that a particular oil, when heated at a given rate, will show a different reading if the rate of heating is more or less rapid. An oil that has been heated more rapidly than the specified rate will, as a rule, show a lower flash point reading. When a longer time than specified is allowed to bring the temperature of the oil up to the flash point, the reading of flash point is, in general, higher.

6. The size of the test flame should be constant. A large test flame generally brings about a lowering of the flash point.

7. The test flame should never be applied to an oil more frequently than the directions for operating the instrument demand. Repeated application of the test flame will bring about a destruction of the vapors without producing the actual flash.

8. Samples of oil containing water in the form of an emulsion or otherwise should be previously heated to a point below the expected flash point and the water allowed to settle out. Only an oil practically free from water should ever be placed in the flash test-cup on account of the danger of foaming and frothing, which will frequently cause the cup to overflow. The presence of water vapor makes the determination of the flash point very uncertain, and the presence of 1 per cent of water will prevent flashing entirely. Even smaller quantities will bring about increases in temperature at which the flash point is observed.

9. The efficiency and accuracy of a flash-cup apparatus is, to a large degree, commensurate with the extent to which the personal equation is eliminated. The most satisfactory instrument for the purpose of flash-point testing is one whose manipulation is entirely mechanical and automatic.

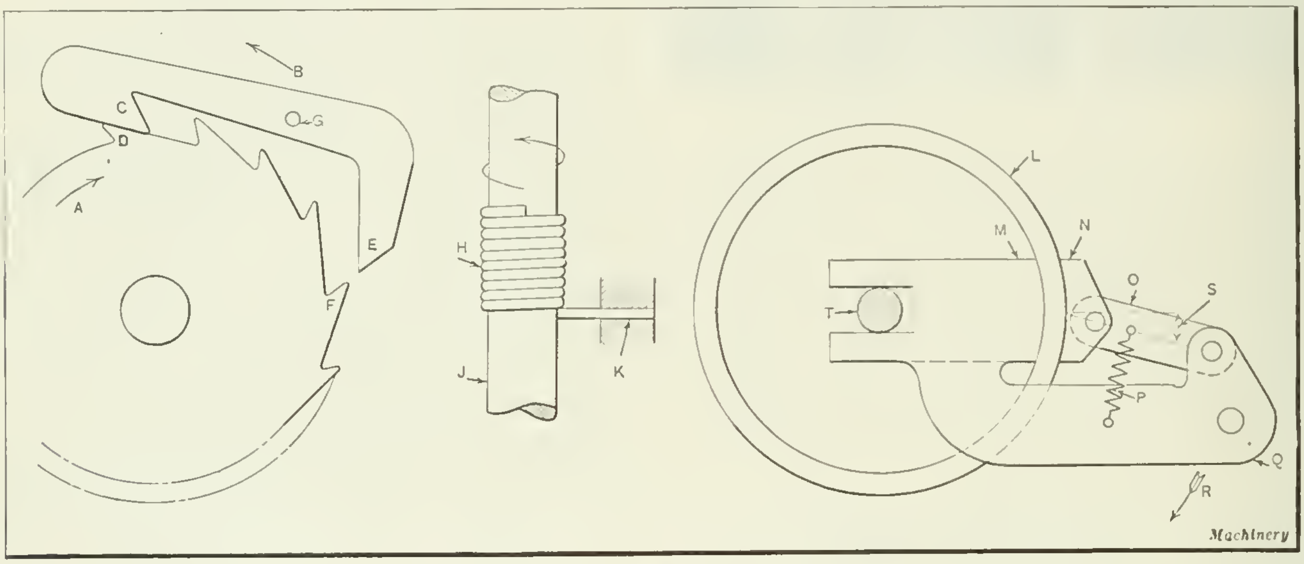
SILENT AND FRICTION RATCHETS

By FREDERICK FRANZ

The writer read with interest the article "Ratchet Mechanisms" which appeared in March MACHINERY on page 536, and was prompted to present the following supplementary description. The three types of ratchets here described have proved highly satisfactory in actual service, and will doubtless be of interest to many readers.

The ratchet mechanism shown at the extreme left in the accompanying illustration has a double-ended pawl which operates silently. When the ratchet wheel turns in the direction indicated by arrow *A*, or when the pawl rotates in the direction indicated by arrow *B*, the end C of the pawl is raised by tooth *D*, thus bringing the end *E* into position to be engaged by tooth *F*. The engaging faces of the teeth are sloped so that the pawl will slide to the root and obtain a full contact. No spring is attached to the pawl.

When used as a feeding device, a frictional resistance, such as a friction washer placed on the fulcrum pin *G*, must be provided to eliminate rattle and insure the proper functioning of the pawl. When used simply to prevent the reversal of either member, no frictional resistance is necessary.



Three Types of Ratchet Mechanisms of Unique Design

This type of ratchet gives good service on the spring motor of a certain make of talking machine. In laying out a ratchet of this type it should be borne in mind that one of the pawls is just on the point of passing the tip of one of the teeth when the other pawl is midway between the tips of two teeth. It should also be noted that this type of ratchet, when used as a feeding mechanism, provides for feeding or indexing in multiples of one-half of a tooth space.

The friction ratchet shown in the central view of the illustration is also used to a considerable extent on talking machines. A close-wound coil spring *H* is assembled on the main spring shaft *J*, and has one end fixed at *K*. The inside diameter of the spring is slightly less than the diameter of the shaft *J* so that it normally grips the shaft. A torque in the direction indicated by the arrow tends to open the spring an imperceptible amount, beginning at the free end, until the friction is overcome. The shaft then turns freely. A torque in the opposite direction, however, increases the friction between the spring and shaft, owing to the "belt-like tension," and thus locks the shaft. Square wire instead of the round wire shown will perhaps prove more durable.

The view at the extreme right-hand side of the illustration shows the principle of a friction ratchet used for varying the quantity of tobacco fed to a certain make of tobacco machine. The flange *L* of the friction wheel is gripped between the body *M* and shoe *N*. The friction surfaces are kept in contact by means of a light spring *P*. When the arm *Q* moves in the direction indicated by the arrow *R*, body *M* and shoe *N* merely slide over flange *L*, but when it moves in the opposite direction, the mechanism is friction-locked, so that arm *Q*, body *M*, shoe *N*, and link *O* all move together as a solid piece with the wheel.

The advantage of this construction is that the sliding or friction surfaces have a comparatively large area and therefore great durability. This has the disadvantage, however, that, should a heavy film of oil accumulate on flange *L*, the ratchet will slip unless the angle *S* is made not larger than 7 degrees. A thin layer of oil absorbed on flange *L* will not cause the ratchet to fail. In designing this type of ratchet, care should be taken to see that body *M* is made very rigid. Provision should also be made for a radial movement of body *M*; this may be done by slotting the end to fit the central shaft *T*. Flange *L* and body *M* may be made of cast iron, and shoe *N* of soft steel.

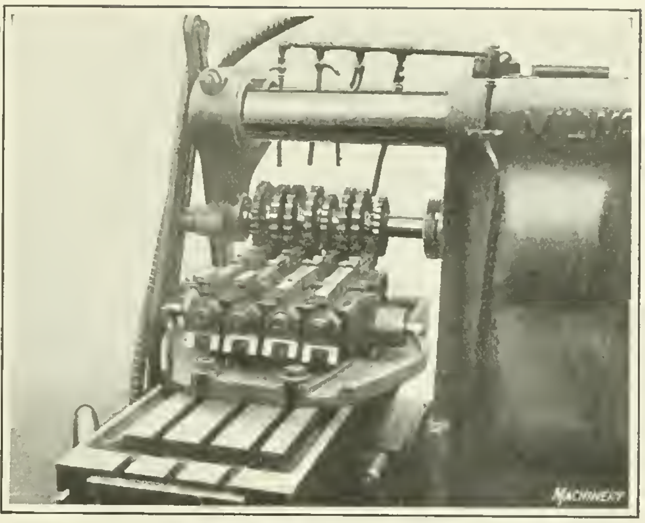
In the article in March MACHINERY, reference was made to cutting the acting side of the ratchet tooth at a considerable angle in order to insure the full engagement of the pawl and tooth. It has been the writer's experience that this practice is not permissible in some designs, as, for instance, in the standard type of pawl which is engaged by means of a spring; in this case the spring should be made strong enough to insure the engagement of the pawl. Undercutting the ratchet teeth is not always permissible in high-speed machinery, or where heavy parts are to be driven. With the under-cut type of ratchet tooth it is possible for the ratchet wheel or pawl—as the case may be—to gain considerable speed or velocity on the reverse movement before the pawl engages the ratchet tooth, thus resulting in shock to the mechanism.

In the article referred to, it was also stated that centrifugal force tends to assist the action of the pawl in an internal ratchet. While it is evident that centrifugal force tends to keep the pawls in engagement with the driven member (while the latter is being driven at high speed by the pawls), it is also evident that centrifugal force is of little or no assistance in forcing the pawls into engagement with the teeth on the driven member, because when the pawl is about to engage the ratchet teeth at the beginning of its stroke the velocity is very low and there is no centrifugal force acting. Centrifugal force would therefore seem to be of no assistance in forcing the pawl into engagement with the ratchet teeth, although it may tend to maintain the engagement after the mechanism is in motion.

Investigation of Tooling Methods

How a Careful Study of Tooling Equipment Often Results in Improved Methods

By JOSEPH P. LANNEN
Tool Supervisor, Paige-Detroit Motor Car Co.
Detroit, Mich.



THE executive confronted with the problem of reducing manufacturing costs may profit greatly by investigating the production possibilities of the available machine tool equipment. An investigation of this kind will often give valuable results if the fundamental principles governing this work are recognized and properly applied. The successful investigator in any line of endeavor is the man who constantly questions the "how and why" of the present way of doing things, and determines whether or not there is a better method of doing them, by turning over in his mind every conceivable means for improvement. He must be guided by the fundamental laws and principles governing the subject at hand, his past experience, and his ingenuity.

Principles Governing Efficiency of Machine Tool Production

The following principles govern the maximum efficiency of machine tool production:

1. The full capacity of the machine must be utilized.
2. The idle man and idle machine time must be reduced to a minimum.
3. The work must be clamped and released in the shortest possible time, except where the length of the process is limited by the speed of the machine.
4. The cutting process, except in planers and shapers, must be completed with the shortest possible table or spindle travel.
5. The cost of tooling must be commensurate with number of parts to be produced.
6. The required daily production must be attained.

Questions to be Considered in Investigation

The investigator or tool engineer who carries out this work may well ask himself the following questions embodying the principles stated.

A machine tool has a certain capacity limited by power and range; is it possible to use more of this capacity than is being used?

Can a number of identical parts be machined at one traverse of the cutting tools or the work?

Can a number of surfaces on a part be machined, or a number of holes be drilled, in one operation?

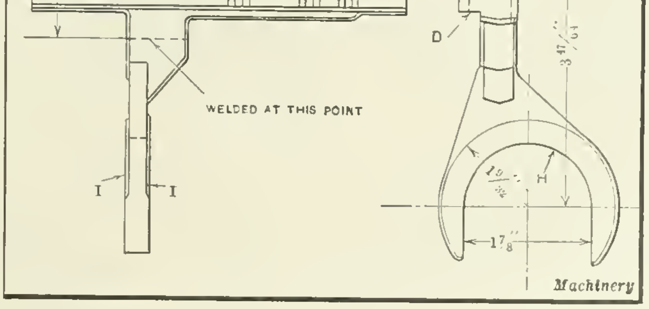


Fig. 1. Gear-shift Fork used on Paige Automobiles

Is the idle man and idle machine time reduced to a minimum by the use of reciprocating fixtures, indexing jigs, etc.?

Are the tools designed in a manner that will permit the cut to be completed with the shortest possible table travel?

Can the tool upkeep cost be reduced by a change in machining methods?

Can one operator run several machines?

Can the loading and unloading time be reduced?

Will the new method give the required daily production?

Will the cost of producing the ultimate number of parts required, combined with the cost of the tools, be reduced to the lowest possible figure?

While it is evident that all these questions cannot be applied to every machine operation investigated, no problem will arise that will not be governed by some of them.

Investigation of Cost of Manufacturing Gear-shift Fork

The results of an investigation instituted to reduce the cost of manufacturing the gear-shift fork used in the transmission of the Paige automobile will now be considered. This part is illustrated in Fig. 1; the reference letters refer to the different surfaces machined. The gear-shift fork was formerly furnished by an outside concern, but at the completion of the contract, the tooling equipment was taken over by the Paige-Detroit Motor Car Co., and used for manufacturing the part until an investigation pointed out the inefficiency of the tooling. The fork and shank are forged separately, and after the shank has been partly machined it is electrically welded to the fork, and the machining operations are then completed. Both the old and new methods of handling the part will be described, so as to give an idea of the efficiency of the new method as compared with the old.

Old and New Methods of Machining Gear-shift Fork

Fig. 4 shows the sequence of operations in the old method; the letters in this illustration refer to the same surfaces as those in Fig. 1. The operation sheet is presented in Fig. 2. It gives the loading and unloading time combined in the "Loading" column, and the cutting time

OPERATION SHEET Old Method				
No.	Name	Loading Time, Min.	Cutting Time, Min.	Daily Production
1	Straddle-mill ends of shank	....	0.63	762
2	Straddle-mill sides of shank	0.72	1.24	245
3	Mill bottom of shank	0.33	1.05	348
4	Weld fork to shank	0.40	0.08	1000
5	Mill flash raised by welding	0.36	0.11	1002
6	Mill top of shank	0.48	1.15	294
7	Mill shifter slot	0.59	0.87	328
8	Mill V-shaped grooves	0.64	0.52	414
9	Mill circular groove	0.46	0.30	632
10	Mill fork	0.97	3.08	118
	Total Time	4.95	9.03	

Fig. 2. Loading Time, Cutting Time, and Daily Production of Each Operation in the Old Method

OPERATION SHEET New Method				
No.	Name	Loading Time, Min.	Cutting Time, Min.	Daily Production
1	Straddle-mill ends of shank	....	0.63	762
2	Straddle-mill sides, bottom and top of shank	....	2.07	232
3	Weld fork to shank	0.40	0.08	1000
4	Mill shifter slot, flash raised by welding V grooves, and circular groove	....	1.90	252
5	Drill throat of fork	0.20	0.50	685
6	Straddle-mill fork and mill sides of throat	0.10	1.40	320
	Total Time	0.70	6.58	

Fig. 3. Operation Sheet of the Improved Method which shows the Reduction effected in Manufacturing Time

as well as the daily production for each operation. Fig. 3 shows the operation sheet for the new method, and Fig. 5 illustrates the sequence of operations in this method.

The first operation in the old method, as shown in Fig. 4, consisted of straddle-milling ends *A* of the shank to length. Two reciprocating fixtures were employed, one of which was fed past the cutters while the other was being loaded. The production on this operation was 762 pieces per eight-hour day. The loading and cutting time was so nicely balanced that nothing could be gained by changing the operation, and so it is still followed in the improved method. The second operation consisted of straddle-milling two sides *B* of the shank. Three pieces were loaded in the fixture and a gang of cutters employed, the daily production being 245 pieces. The third operation was milling the bottom *C* of the shank, three pieces being loaded, end to end, in a string of fixtures, and the stock removed by using an end-mill.

Investigation showed that the second and third operations were not tooled efficiently. The set-up of the second operation was not planned to eliminate idle time, and in the third operation, the machine was not loaded to its capacity. For these reasons the two operations were combined in the new method, together with the sixth operation of the old, in which surface *D* of the shank was milled. The sixth operation in the old method was also inefficient, because the full capacity of the machine was not utilized nor idle time eliminated. In the second operation of the new method, Fig. 5, sides *B*, bottom *C* and top *D* of different parts, are straddle-milled in one traverse past the cutters, two pieces being completed each time. Idle time is eliminated by employing an indexing fixture that permits one group of parts to be unloaded and replaced while the other group is being machined. This operation is shown in the heading illustration; the daily production obtained is 232 pieces.

The fourth operation in the old method, Fig. 4, consisted of welding the fork and shank together. No improvement could be made on this and so it is the third operation in the new method. The fifth operation in the original method was milling off the flash raised in the welding operation, and the seventh, eighth, and ninth operations consisted of milling shifter slot *E*, V-grooves *F*, and circular groove *G*.

Combining the Fifth, Seventh, Eighth, and Ninth Operations

When the fifth, seventh, eighth and ninth operations were performed separately in the original method, idle time was not eliminated and the machines were not loaded to their full capacity. By the new method these steps have been combined in the fourth operation. A series of fixtures is provided, mounted on a baseplate and furnished with means for adjusting their relative positions. This arrangement aids in setting up and permits compensation for wear and grinding of the cutters. The work is placed progressively

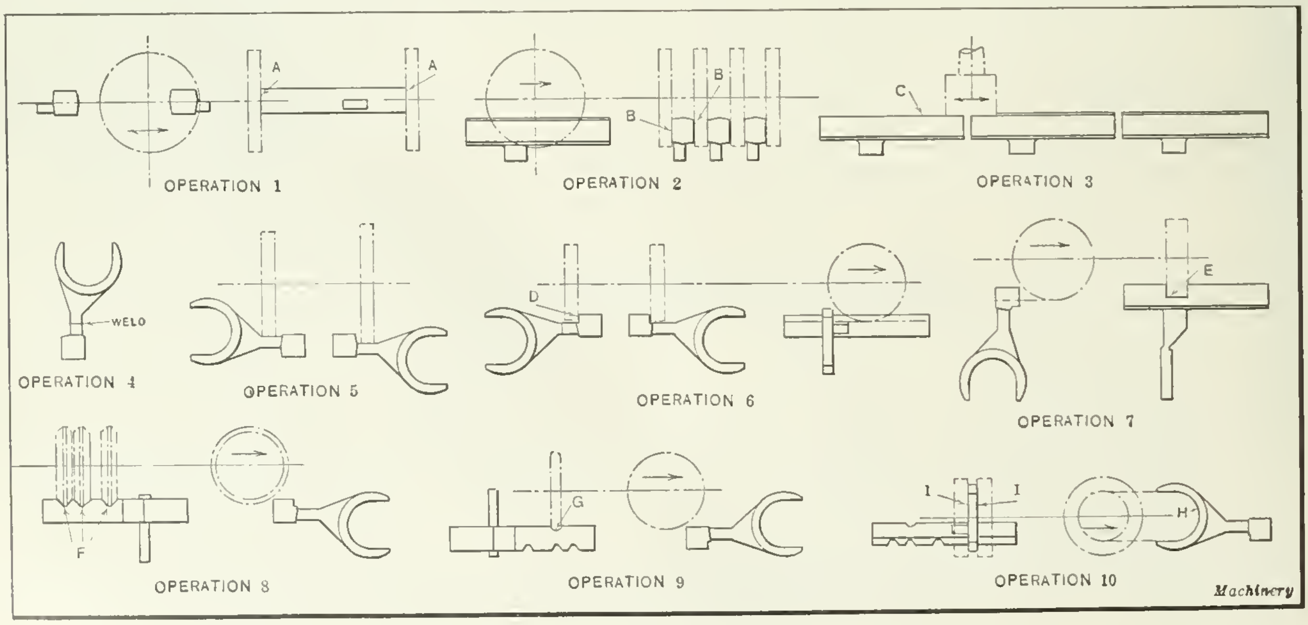


Fig. 4. Sequence of Operations in the Original Method of manufacturing the Gear-shift Lever

in these fixtures, the four operations on a part being completed during each cycle.

The flash raised by the welding operation is milled from one side of the fork while it is in the first fixture, and from the remaining side while it is in the second fixture. The slight radius left on the work by the contour of the cutters employed in this step is of no consequence. The shifter slot *E*, Fig. 5, is milled in the third fixture. These first three cuts are made while the milling machine table is fed to the right by power. Work is placed in the remaining two fixtures while this step is in process, and then when the power feed is released, the table is first fed by hand to a positive stop and then again by hand to the left, after which the power feed is once more engaged to mill the three V-shaped grooves *F* and the circular groove *G* on the remaining two pieces.

While these parts are being machined, the pieces in the first three fixtures are shifted, and when the cut is completed, the table is fed by hand to bring the work in these fixtures up to the cutters, the entire process then being repeated. This cycle of operations is accomplished in 1.90 minutes and gives an average production of 252 pieces per day. It will be apparent that the use of this set-up effects a saving of 1.95 minutes per part on the five cuts. This rate of production could not be obtained without employing cam-operated quick-acting clamping devices.

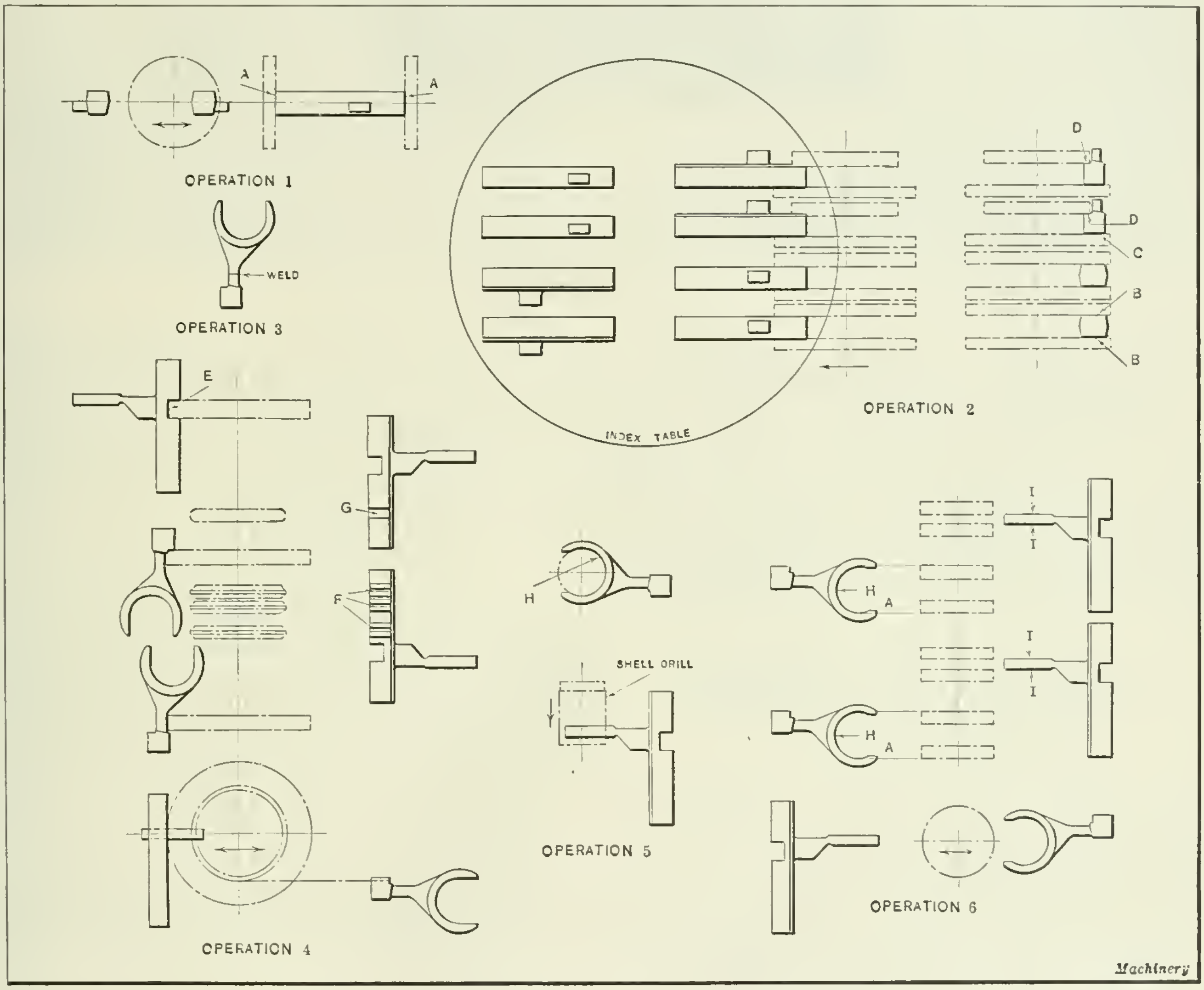


Fig. 5. Lay-out of the Six Operations performed on the Gear-shift Fork with the Improved Tooling

Final Operations on the Part

Milling opening *H* and sides *I* of the fork was the final operation in the original lay-out, one piece being milled at a time by a gang of three cutters. This method had several objectionable features: Chips would wedge between the two outside cutters and clog the teeth of the cutter used for milling the throat of the fork. Besides, the latter cutter had to scrape through the scale of the throat, and for this reason would not stand up well. To avoid tool trouble, this operation was subdivided in the improved method, the throat being drilled with a shell drill in the fifth operation; this step is illustrated in Fig. 6. The piece is clamped by a sliding plunger operated by cam *A* which forces the shank of the shifter fork into groove *B*. The lower side of the fork rests on a spherical equalizing washer *C*. The shell drill is piloted both above and below its cutting face so as to overcome the side thrust caused by the tool cutting only on one-half its periphery at a time. The daily production on this operation is about 685 pieces.

The final operation in the new method consists of straddle-milling sides *I* and removing the stock left on the sides of the throat. Fig. 7 illustrates the set-up employed for this step, fixture *A* being used to hold the work while the sides of the fork are being straddle-milled. Two pieces are held at one time, and while they are being milled two pieces that have previously been machined are placed in fixture *B* in which the semicircular surface drilled in the fifth operation is located in the proper relation to cutters *C* by means of cam-actuated swinging clamps, one of which is seen at *D*. The pieces in fixture *B* are milled while the work is being changed in the other fixture. This set-up gives a production of 320 pieces per day, the principle of loading the machine to capacity and reducing idle time being observed here as in preceding operations. The improved method of machining this gear-shifter fork saves the time of three men and three milling machines, and reduces the time per piece 6.7 minutes. The savings effected by the new method paid for the new tooling equipment in 193 working days.

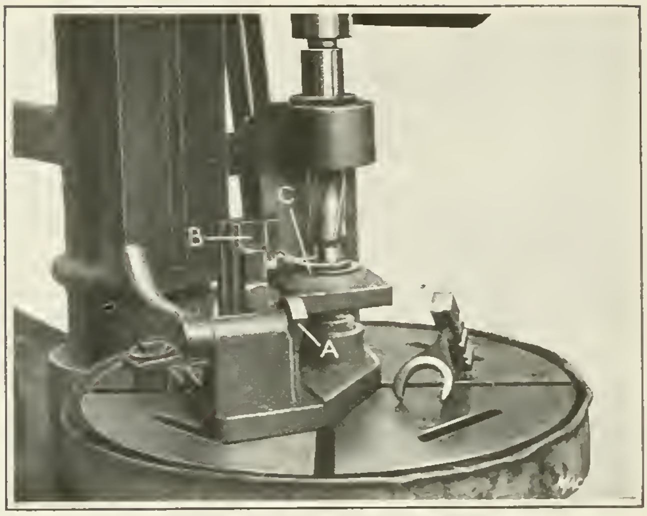


Fig. 6. Drilling the Throat of the Fork

The practice of grouping operations is common in screw machine work, but even more efficient results are obtained when the practice is applied to milling. The cutters used on a milling machine have a great number of teeth or cutting edges, while on a screw machine nearly all cuts are taken by tools having a single cutting edge. This means an advantage for milling in the length of time between resharpenings. Fig. 8 shows an operation on a multiple-spindle drilling machine in which ten holes are drilled in four faces of a water-pump housing casting at one passage of the drills, four parts being mounted on the machine at one time. The partly machined casting is first placed in the left-hand position of the twin drill jig *A*, and advanced consecutively to the right-hand position on and through jigs *B* and *C*. As each piece is advanced a new one is substituted in the left-hand position of jig *A*, so that one piece is finished at each passage of the drills.

The loading time is 0.72 minute, and the drilling time 0.33 minute. The machine is idle while the jigs are unloaded and loaded, an investigation having shown that the additional cost of an indexing table and a duplicate set of drill jigs would not be justified by the total number of parts to be produced. It was also determined that the present method of drilling effected a substantial saving as compared with locating the work in a jig and drilling one face at a time.

* * *

INDEXING DEVICE FOR DRILLING EQUALLY SPACED HOLES

By HOWARD W. HOUSE

The indexing fixture described in the following was devised by the writer for use in drilling twelve equally spaced holes through a machine steel collar about 3/4 inch in diameter by 3/16 inch thick, having a central hole 5/16 inch in diameter. The holes were required to be drilled on a circle having a diameter of about 9/16 inch. A gear approximately 4 inches in diameter with 60 teeth was selected from a lot of miscellaneous gears to serve as an indexing plate. Of course, any gear of a suitable size, the number of teeth of which could be divided by 12 without a remainder, would have served the purpose.

A machine-steel stud was next turned up with a pilot at one end which was a close fit for the central hole in the collar to be drilled, and the body of this stud was made a force fit in the hole of the hub of the tooth gear. When pressed into the hole in the gear, the body of the stud projected far enough beyond the face of the hub to give it a good bearing in a drilled and reamed hole in a cast-iron plate or base. A small hole was next drilled in the cast-iron base midway between two of the teeth of the gear. This hole was enlarged by drilling (with the gear removed) until a piece of close-fitting drill rod inserted in the enlarged hole would make contact with the sides of two of the gear teeth and thus prevent any play or movement of the gear.

This improvised indexing device was clamped to the drilling machine table and properly located under the drill spindle. A flat drill was used to spot the collar, which was mounted on the pilot end of the stud previously referred to. The work was held in place on the pilot by a screw and a washer. The indexing from one position to the next was accomplished by simply removing the drill rod plug, rotating the gear through five tooth spaces, and then inserting the drill rod plug again.

* * *

CATALOGUES DESIRED IN BRAZIL

W. L. Schurz, American commercial attaché at Rio de Janeiro, Brazil, desires to receive catalogues of machinery of all kinds that might be of interest in Brazil. Catalogues should be mailed to the Industrial Machinery Division, Bureau of Foreign and Domestic Commerce, Washington, D. C., and should be marked on the outside front cover: "To be forwarded to W. L. Schurz, American Commercial Attaché, Rio de Janeiro, Brazil." Manufacturers who have agents in Brazil should indicate their names and addresses on the printed matter. It would be well to furnish more than one set of printed matter, as it frequently is desirable to have extra copies to give to interested inquirers. The language employed in Brazil is Portuguese; if printed matter is not available in that language, French would be preferable to Spanish.

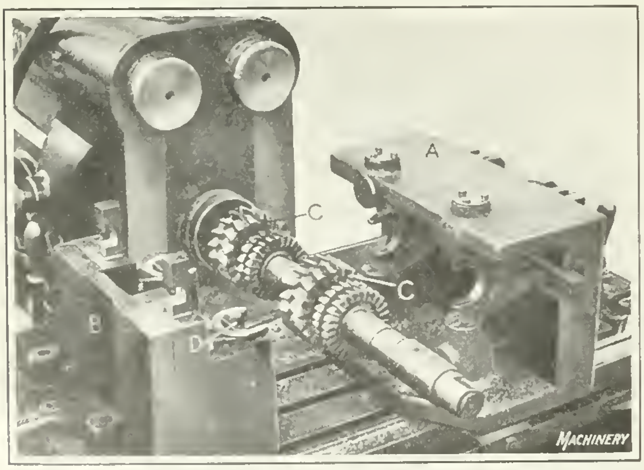


Fig. 7. Tooling employed for milling the Sides of the Fork and the Straight Sides of the Throat

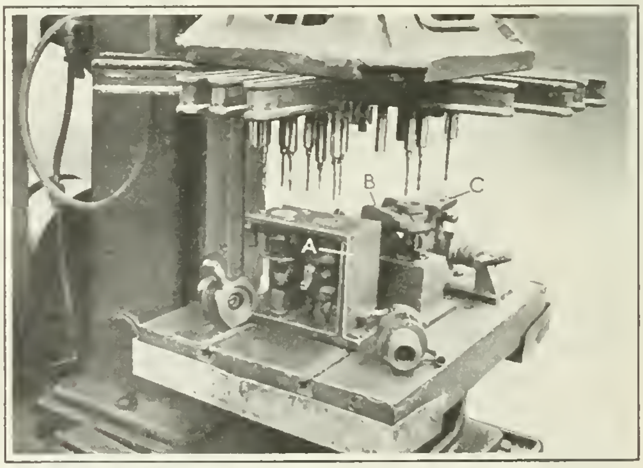


Fig. 8. Equipment by Means of which Ten Holes are drilled in a Part at Four Passes of the Drills

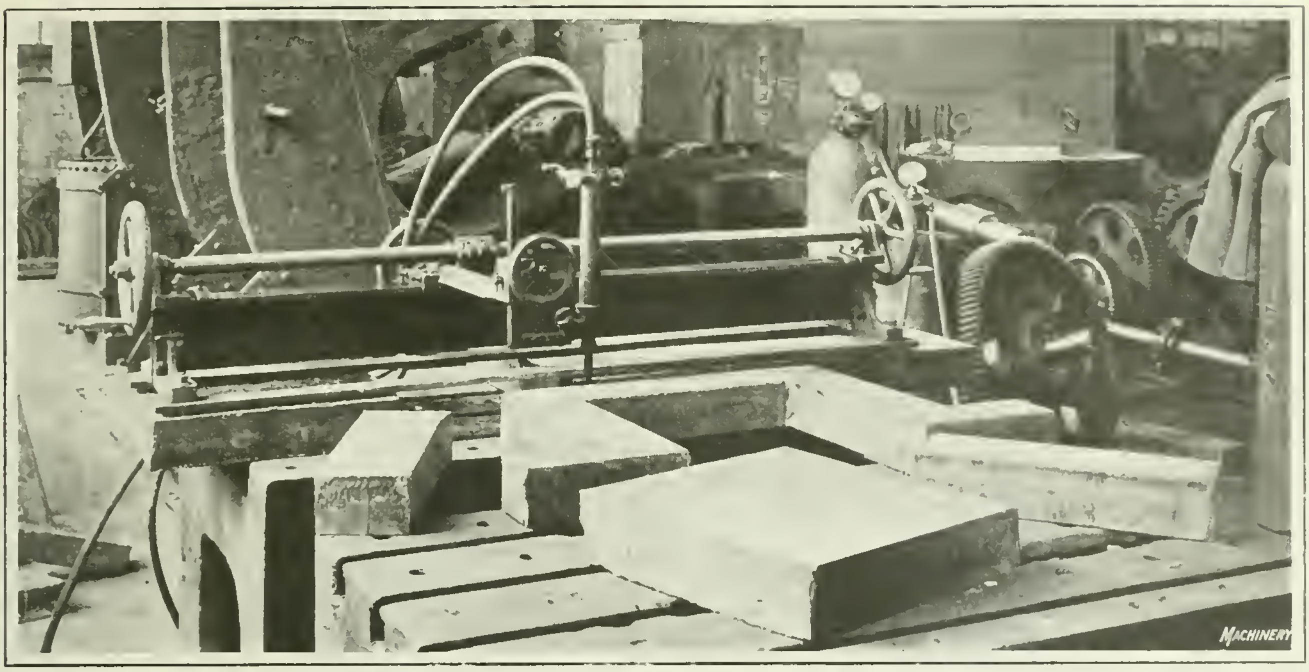


Fig. 1. Cutting Roll Housings from Steel Slabs with Oxy-acetylene Blowpipe in Conjunction with a "Straight-line" Cutting Machine

Oxy-acetylene Process of Cutting Metals

Advantages of This Method and Some Modern Applications

THE cutting of metals with the oxy-acetylene blowpipe is finding an increasing number of applications in the regular manufacture and production of machinery and machine tools. The savings made possible by these applications are in many cases as important and the benefits derived from the use of the process are as great as in the more spectacular and more widely known applications. The scrapping of a battleship, or the cutting with an oxy-acetylene blowpipe, of a tangled mass of twisted structural steel after a great fire, for instance, may attract front-page space in the newspapers; but the savings and economies effected daily in the production of machinery parts will not attract such wide attention, although in point of actual saving the latter may be far more important than the former.

Probably the greatest savings in the machinery field accomplished with the oxy acetylene cutting process are made through the elimination of special forgings and castings, and the substitution of parts cut from stock sizes of machinery steel, steel plate, bars, billets, angles, channels, and other readily obtainable material. In many cases the steel plate or slab construction is preferable to the use of forgings or gray iron or other castings, mechanical difficulties in shaping the former economically and accurately often having been the only serious deterrent to their use. The employment of oxy-acetylene cutting has now made it possible to handle this work speedily and with economy. The use of steel plate or steel slabs rather than special castings or forgings often makes possible the production of lighter, stronger machines. The cost is generally less than when special castings must be made, and in all cases the employment of stock material, by eliminating the delay incident to the production of special parts, cuts to a minimum the time necessary for production.

When a number of machines are to be built to specification, members shaped with the cutting blowpipe may be used to additional advantage. The cutting of the parts for a special machine may progress with the assembling, so that last-minute changes in design will not make it necessary to scrap costly parts; furthermore, such changes will not involve excessive delay for the preparation of the parts needed. In addition to cutting plate and shapes to size, and preparing frames, braces and supports, the oxy-acetylene cutting blowpipe is useful for cutting bolt and rivet holes, and slots and openings of all sizes and shapes. Straight or irregular cuts may be made with equal facility wherever needed, and at a saving in time.

On heavy material particularly, the savings in cost may be great. For one thing, the portability of the oxy-acetylene cutting outfit makes the transportation of the work from one part of the plant to another for shaping unnecessary. Then, too, billets, blooms, and slabs of such size as to make their handling with shears or saws difficult can be cut true to size easily and quickly with the blowpipe. This work may be done at or near the point of assembly, thus saving time and cost by reducing handling and transportation to a minimum.

Lately the practice has been finding favor, where important forgings are being cut to shape with the oxy-acetylene blowpipe, of preceding the cutting by preheating of the forging to a dull red if the depth of cut is more than five or six inches. Particularly in heavy sections of material of high carbon content this preheating will tend to eliminate strains and prevent checking. The cutting should be followed by normalizing the steel at a temperature of approximately 1650 degrees F., which will overcome any strains present after the cutting and put the grain structure of the metal in the best condition for service.

When time is an important factor, the use of forgings or castings may not be practical. Material is always available, however, from which machine parts may be cut, reducing the time necessary to produce special parts by other methods. Many manufacturers have found it much cheaper to prepare the parts required by oxy-acetylene cutting as they are needed than to carry a supply of special castings in stock. In experimental work this method of cutting metals has found an important field of usefulness. Full-size or part-size working models may be made without difficulty, eliminating the delay incident to the making of templets, castings, or pieces machined to shape and dimension. Changes in design suggested while the model is in the process of manufacture can be incorporated in the work at a minimum of delay, inconvenience, and cost.

When the oxy-acetylene cutting process is employed, it is generally unnecessary to provide specially designed mechanical equipment to form parts for extraordinarily large or otherwise unusual machinery. In practically every case, the cutting torch is all that is necessary to fabricate the parts, and a large investment in special and probably little used equipment is not required. The advantages of the use of oxy-acetylene cutting in forming new material are no more important than in working used and reclaimed metal. Often parts of obsolete equipment can be salvaged and, after being trimmed to the proper size and shape, employed in the making of new machinery. The possible reductions in cost through this application are evident. These may be particularly important when the oxy-acetylene welding blowpipe is employed to supplement the work of the cutting torch.

The possibilities of this application are almost limitless. In recent instances cases have been noted where machine guards, stair stringers, railings, passageway floors, small tanks for fuels or lubricants, idlers and guide rolls for belts, drip pans, and many other pieces of equipment have been made at very low cost from old pieces of angle and channel iron, steel sheet and plate, and wrought iron or steel pipe. In every case the material was salvaged and cut to size and shape with the cutting blowpipe; and in most cases it was formed by the oxy-acetylene welding process.

The large number of operations for which machinery builders are employing the oxy-acetylene cutting process illustrate the importance that has been attained by this method of cutting metals in the machinery industry. Recently a manufacturer of heavy machinery received an order that included thirty-two steel mill roll housings. The customer for whom the roll housings were to be made demanded rush delivery, and the time necessary to produce and deliver the forged housings would have made the fulfillment of the customer's demands impossible, had no other means been available for the production of the parts for which forgings had always been used.

In the emergency, however, the idea of cutting the parts from steel billets with the oxy-acetylene blowpipe was presented. (See Figs. 1 and 2.) It was tried out on a part of the order, with such immediate success that the entire order was completed with oxy-acetylene cut parts, and this cutting process was adopted by the management as standard practice for this and all similar work of the future. An accurate check on the costs of cutting these members from slabs 3½ inches thick demonstrated that the oxy-acetylene cutting process resulted in a substantial reduction. The cutting blowpipe used in this instance was mechanically guided in a so-called straight-line cutting machine, as shown in Fig. 1.

Straight-line cutting machines are also being used to advantage in plants where follower blocks for railroad cars are cut from steel slabs. In one plant a heavy shear was formerly used, and the blocks rejected as above or below the required limits ran up to 18 per cent of the total number cut. The principal difficulty encountered was the tendency to make a cut which, on the very heavy material used, either did not start true or finish square. In this plant the use of the oxy-acetylene cutting blowpipe reduced the proportion of rejections to less than 1 per cent of the total number of blocks cut. At another plant saws were being used to cut the follower blocks. The chief disadvantages of this method were the time necessary for each individual cut, and the expense entailed in replacing saw teeth ruined by the heavy work. The cutting of a single block with the saw required an average of twenty minutes. This time was reduced, by the use of the oxy-acetylene process, to an average of less than one minute and thirty seconds.

An instance of the use of oxy-acetylene cutting for special work is presented by a manufacturer of railroad contracting equipment whose products are largely made to customers' special requirements. The oxy-acetylene blowpipe makes possible the production of such equipment without delay for special parts, and minimizes the cost of effecting changes in design from corrections or alterations in the specifications. The railroad ditcher shown in Fig. 3 was built largely by means of oxy-acetylene cutting. The spreader arms were cut to size from tank steel sheets ⅝ inch thick. Manganese steel castings were cut to fit the irregular lower edges of the spreader arms. Channels, shapes, and angles were cut to size and shape for use as supports and manipulating mechanism. Likewise, the frames for the plows were cut to size and the car truck bolster and various supporting bars were prepared by cutting with the oxy-acetylene blowpipe. All of these operations resulted in savings over the methods formerly employed.

A manufacturer of press brakes uses the oxy-acetylene process for similar operations. In this instance 2½-inch

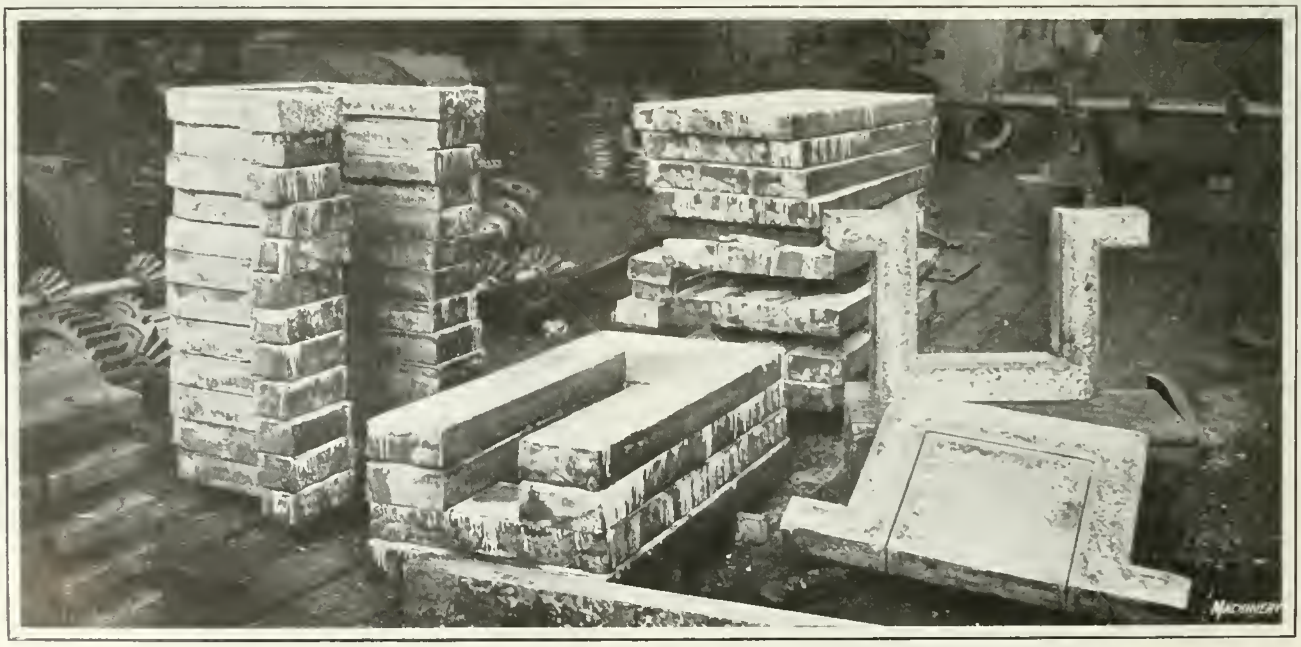


Fig. 2. Pile of Roll Housings cut from Steel Slabs by the Use of the Machine shown in Fig. 1

machinery steel plate is cut to size and shape. Here the oxy-acetylene cutting process is employed primarily to provide stronger parts than the special castings ordinarily used. The manufacturer found, however, that in addition to accomplishing the object he had in view, the use of stock plate cut to size was less expensive than the use of castings. The time saved in this instance in the regular production of the press brakes was also of great importance, since immediate delivery of the machinery plate could be had in the quantity required. This company builds special machines and, although there are nearly always eight or ten machines in process of construction, there are seldom two of the same size or design. The sizes of the parts necessary vary greatly with each job and each kind and style of press. The wide range of adaptability of the oxy-acetylene cutting blowpipe aids this company materially in keeping the production costs at a minimum.

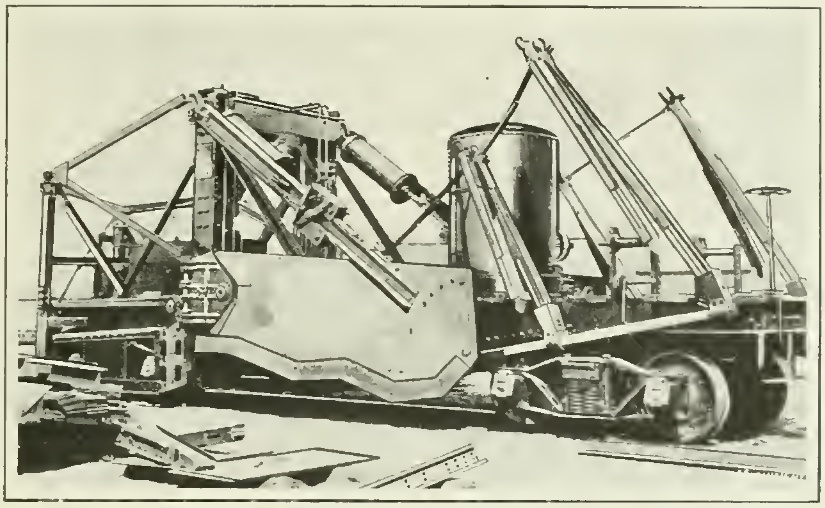


Fig. 3. Railroad Ditcher fabricated by Oxy-acetylene Cutting

In this plant the material for each machine is delivered to the point at which the machine is to be completely built. As the assembling progresses, special parts and pieces are cut to size and fitted to the work. No finishing of the parts prepared in this way is necessary, as the oxy-acetylene cuts are usually well within the limits of accuracy that are demanded.

These cited uses in the machinery trade illustrate some of the advantages of metal cutting by the oxy-acetylene process for the classes of work mentioned. There is no doubt that many others in the trade will be able to adapt the oxy-acetylene process to their own production work in ways similar to those described.

* * *

MEETING OF THE AUTOMOTIVE ENGINEERS

The summer meeting of the Society of Automotive Engineers was held at Spring Lake, N. J., June 19 to 23. The convention was opened by a meeting of the Standards Committee, acting upon several important recommendations, which are reported in full in the June number of the Journal of the society. The technical sessions covered a number of subjects of interest to automobile engineers. James E. Hale read a paper on large-section air cushion tires, discussing the effect of large tires on steering, skidding, and traction. He also dealt with the serviceability, cost, power consumption, and cushioning effect. Another session was devoted to four-wheel brakes. Four types of brakes were described by their makers: The Lockheed, hydraulic, Duesenberg hydraulic, U. S. Axle mechanical, and Renault mechanical. A general discussion was entered into in connection with this session on the advantages and the disadvantages of four-wheel brakes.

At a later session, R. N. Falge read a paper on head lamp glare, and Dr. C. H. Sharp, chairman of the Committee on Motor Vehicle Lighting of the Illuminating Engineering Society, discussed anti-glare legislation. The latest results of the society's fuel research test were presented by W. S. James and Dr. H. C. Dickinson. Professor G. B. Upton of Cornell University read a paper on the effect of spark advance on engine performance.

ALUMINUM SOLDERS

In a circular of the Bureau of Standards, it is pointed out that all metals or combinations of metals used for aluminum soldering are electrolytically electro-positive to aluminum. A soldered joint is therefore rapidly attacked when exposed to moisture and disintegrated. There is no solder for aluminum of which this is not true. Joints should therefore never be made by soldering, unless they are to be protected against corrosion by a paint or varnish, or unless they are quite heavy, such as repairs in castings, where corrosion and disintegration of the joint near the exposed surface would be of little consequence.

Solders are best applied without a flux or by using paraffin as a flux, after preliminary cleaning and tinning of the surfaces to be soldered. The composition of the solder may be varied within wide limits. It should consist of a tin base with the addition of zinc or of both zinc and aluminum, the chief function of which is to produce a semi-fluid mixture within the range of soldering temperatures.

Suggested Ranges of Composition

Tin-zinc Solders

Zinc, per cent	15 to 50
Tin	Remainder

Tin-zinc-aluminum Solders

Zinc, per cent	8 to 15
Aluminum, per cent	5 to 12
Tin	Remainder

The higher the temperature at which the "tinning" is done, the better the adhesion of the tinned layer. By using the higher values of the recommended zinc and aluminum percentages given, the solder will be too stiff at lower temperatures to solder readily, and the workman will be obliged to use a higher temperature, thus obtaining a better joint. A perfect union between solder and aluminum is very difficult to obtain. The joint between previously tinned surfaces may be made by ordinary methods and with ordinary soft solder. Only the "tinning" mixture need be special for aluminum. There is no reason why a good solder for aluminum need be brittle, as several commercial varieties are, and it is very undesirable that it should be.

* * *

The American Welding Society has just issued an outline of a course for the training of oxy-acetylene welders. This report was prepared by a committee and combines the experience of experts of the Federal Board of Vocational Education, the American Welding Society, and the National Research Council. For the information of the person who is selecting candidates, the text includes a discussion of the qualifications that the candidates for training should possess. For the information of the instructor, the text includes the fundamentals in gas welding, together with a detailed statement of content, classified under type welding jobs arranged in the order of difficulty. Copies may be obtained from the American Welding Society, 29 W. 39th St., New York City.

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THE INCREASING USE OF PRESSED STEEL

During the business depression from which the metal-working industries are rapidly emerging, the shops making stampings and pressed-steel parts have probably been the busiest—those engaged in automobile construction excepted. The rapidity with which pressed-steel parts can be made, and their relative cheapness when produced in quantities, are two important factors in their favor, compared with parts produced by other methods.

At present, a large new field for the use of pressed-steel parts is being developed. In many instances it has been found advantageous to replace gray iron castings with pressed-steel parts. Covers, frames, boxes and other metal parts that can be made conveniently from pressed steel are lighter, stronger and cheaper. An iron casting must be reasonably thick to permit molding and afford sufficient strength. The pressed-steel part can be made much thinner, and yet is stronger because of the greater strength of steel. It does not have the brittleness of cast iron, and can stand a remarkable amount of abuse without damage. Being thinner, the steel part is also lighter, an important consideration with present high freight rates, when the manufactured articles have to be shipped long distances. The only serious factor in this process is the cost of the dies, necessitating a considerable production in order to absorb the first cost.

Some examples of savings may be of interest: Cast-iron covers for instrument boxes, cleaned and ready for use, have been produced for about $4 apiece. Made from pressed steel, these covers cost only 85 cents, not counting the cost of the dies. The dies cost $1200. If a thousand covers were produced, the total cost per piece would be $2.05, including the die cost, the saving being $1.95 per cover. After the die cost has been absorbed, the saving per cover is $3.15.

Tool boxes formerly made by hand from sheet steel cost $7 apiece; the pressed-steel boxes cost $3 apiece. The dies in this case cost $2500. If a thousand boxes were made, the tool cost per box would be $2.50 and the total cost, $5.50, or a saving of $1.50 per box. After the die cost has been absorbed by the first thousand boxes, the saving per box for those made in excess of one thousand would be $4 apiece. These figures are given to indicate possible economies, and to point out the importance of investigating this method of manufacture. Sometimes, parts that cannot be made in one piece by the power press method can be produced in two pieces and welded together at a considerable saving over a casting.

At times, strength and lightness, and not saving in cost, may be the important factors; but in either case the possibilities of pressed steel are well worth investigating.

* * *

THE EFFECT OF LABOR-SAVING MACHINERY ON WAGES

When power looms were introduced in the textile industry of Great Britain not quite 150 years ago, labor fought bitterly the introduction of this mechanical means for supplanting the work of human hands. And for a century and a half labor has fought almost every mechanical advance, regarding them as steps toward the time when machines would supplant men and when there would be no manual labor to be done. But in actual practice the result has been entirely different. Never before has automatic machinery been employed to the extent it now is in this country. Nowhere else is it possible to perform so much work with so little human exertion as in the shops and factories of the United States, where automatic machinery is developed to the highest degree. Yet in this country the highest wages in the world prevail, and with all this automatic machinery there is such a shortage of labor that many plants are unable to operate to capacity because there are more jobs than workmen. Automatic machinery does not deprive labor of jobs—it creates jobs, and by reducing the cost of the product brings within the reach of the masses necessities and luxuries unknown to the workers of other countries.

The practical effect of labor-saving machinery on wages is nowhere more plainly visible than in the highly specialized automobile plants, where we find automatic machinery used to the greatest extent. There special single-purpose machines turn out their product with incredible rapidity, and comparatively unskilled operators run them. In fact, unskilled men in the automobile industry are often paid higher wages than many of the skilled men in other metal-working trades, because the use of automatic machinery makes it possible to produce work in such quantities that high wages are warranted. All classes have benefited by the development of labor-saving machinery; but most of all the masses of the people have benefited, and this is as it should be.

* * *

THE COMMERCIAL VALUE OF PATENTS

Many inventors are inclined to overestimate the commercial value of their patented inventions. They often assume that with the issue of the patent all obstacles on the road to fortune have been overcome, and take little account of the work to be done to make the new device commercially successful. They do not realize that often fully as much depends upon the manufacturing and marketing methods applied to the new enterprise, as upon the merits of the device itself.

Many patented inventions of great merit have failed of commercial success because the necessary business ability and direction have been lacking. On the other hand, many articles of only mediocre merit have become highly successful because they have been ably developed, manufactured and marketed. This does not mean that merit in an invention is not of commercial value; it means that something more than a patent issued at Washington is required to establish that value commercially. The business ability that utilizes a valuable patent as the foundation for a prosperous industrial enterprise, is often fully as responsible for the success of the business as the invention itself.

Yet patent protection is frequently a valuable aid in starting a new enterprise. Assuming that the patent is reasonably basic, it permits a new business to get under way without too severe competition; but as the business acquires strength, it needs less and less to rely on the protection afforded by patents. Many of the great manufacturing and business firms that now dominate their field have seen their original patents expire without jeopardizing their commercial standing. Their organization, production and selling methods, their experience in a specialized field, and the ability that originally built or continued the business, are now the principal factors of success, although they are constantly striving to cover with patents valuable improvements that their experience has enabled them to develop.

Ten Years of Cooperative Education

By HERBERT D. CASEY, Springfield, Vt.

COOPERATIVE education is an attempt to combine theory and practice in a single course. The work in the shop is so interwoven with school work that while the student is working on a machine he is also studying its mechanical principles in a school suited to his needs. The town of Springfield, Vt., is admirably adapted for such training. With a population only a little in excess of 7000, it has six machine shops, two foundries, and a shoddy mill. The manufacturers of the town have steadily and enthusiastically supported this plan, and without this support the course would have been impossible.

After careful investigation by a group of school officials and a committee of manufacturers, the cooperative course was organized as a department of the Springfield public schools in 1913. Governor James Hartness of the Jones & Lamson Machine Co., and E. R. Fellows of the Fellows Gear Shaper Co., took an active interest in the work. John M. Pierce is director of the course at the present time, and under his management it is steadily growing in spite of depressed industrial conditions.

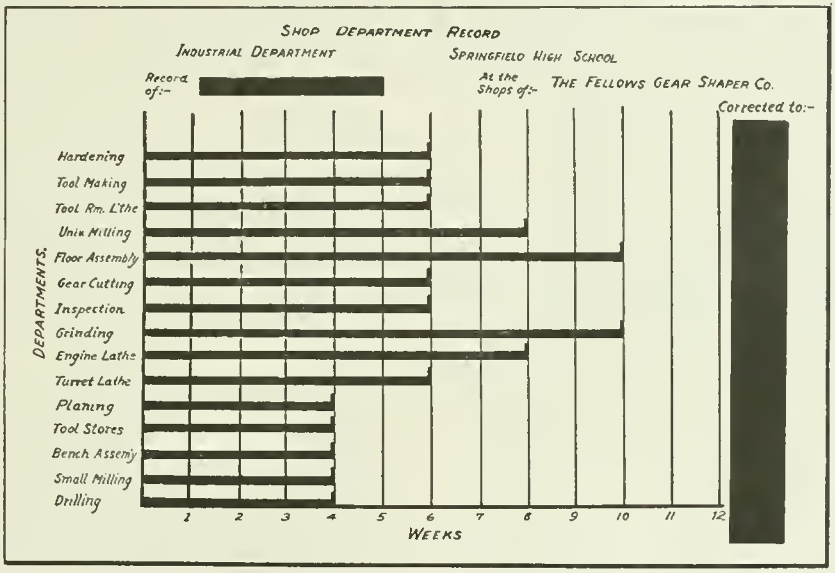


Fig. 1. Shop Department Record, showing graphically the Work completed by a Student in Each Department

The boys enter the course at the beginning of the second year of high school, at an average age of approximately fifteen years. Previous to entering in the fall they spend the summer in the various shops to which they have been assigned. At the end of the summer, if the shop men are satisfied with their work and the boys still feel that they wish to go ahead, their parents sign a contract agreeing to keep them in the course for three years. While in the shops, they are under the direct supervision and management of the shop officials, and the director of the course at the school has only advisory relations with the foremen. The boys observe the same hours in the shops and are under the same working conditions as the men. One of the important things that differentiate this course from the ordinary trade school is the shop atmosphere. The work they do is real work, and must meet commercial requirements. The competitive basis of factory work is emphasized, and the relation of cost to output is discussed with the students. Everyday economics are thus combined with actual shop work. The atmosphere is exacting and business-like, and this is not the least valuable part of the course.

Work in the shop is much more than a job. It is a practical school in mechanical problems. The officials give careful attention to the boys, correcting and encouraging them where needed. The course is carefully graded, beginning with simple machines, passing through the various departments, and completing the boy's mechanical experience in toolmaking and experimental work. A blueprint record sheet is kept for each of the students, showing the time devoted to the different processes. This schedule is completed early enough in the course to allow for extra training in the line in which each one has shown the most skill, because, after his "exploratory" work he is allowed to specialize. At the end of each fortnight every boy makes out a report of what he has done and gives it to the director. These reports are used in round-table discussions later in the school room classes.

The plan provides for dividing each of the three classes into two groups, as nearly equal as possible. One group of each class spends two weeks in the shop and the other group two weeks in the school. At the end of the fortnight these groups change places, and the work in each group is repeated.

The following is the program of studies: First year: Any regular high-school course. Second year: History, English, mechanical drawing, algebra, mechanisms, physics. Third year: Physics and chemistry, mechanisms, algebra and geometry, American history, mechanical drawing and English. Fourth year: Mechanisms, history, economics, mechanical drawing, mathematics, and English.

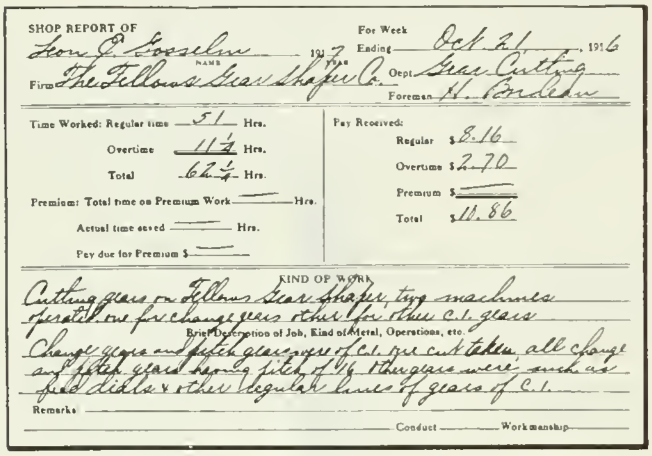
While the boys are working in the shops they receive pay ranging from 15 to 32 cents an hour, depending on the quality and quantity of work and the time the boy has spent in the course. Here, again, is a practical application of the economic law that quality and quantity determine earnings. During the three years these earnings amount to from $900 to $1000. In addition to this, the shops grant a bonus of $100 to each boy completing the course. The graduate, then, completes his four-year course in the high school with a fair knowledge of machine tool work, and the tidy sum of about $1000 which he has earned. He also has a definite knowledge of his abilities in a given field and a purpose to begin work at once.

He is not perplexed with questions such as "What am I to do now?" or bothered with "dead end" and "blind alley" jobs. If the boy wishes to go further with studies, he is free to do so, although in order to enter college he generally has to make up foreign languages. The Northeastern College, the University of Cincinnati, and the University of Vermont have received graduates from Springfield into their engineering courses, where they have graduated with engineering degrees. One of the companies has just completed an arrangement with the Northeastern College in Boston, whereby two boys are received on an alternating five-week basis between the shop and the college. Those responsible for the plan are not without hope that it may be the beginning of a new practice in engineering education in New England.

At the peak of the war rush, sixty-four boys were enrolled in the course. About forty-five are now taking the course, and the prospects are good for a greater number during the coming year. This is the tenth year that the course has been in operation, and seven classes have been graduated with a total number of fifty-seven completing the course. Of these, twenty-three are now employed in shop work; fifteen in drafting-room, office or on the road for machine-building concerns; five are engaged in automobile repair and driving; seven are in college; and one is teaching.

The Purpose of the Course

This is not a course for slow or retarded pupils. The student should be as keen and alert in order to make a success in this as in any other calling. Sometimes it happens that boys who have not done very well in other academic branches are awakened by the concrete problems of the shop and do excellent work; but, primarily, this is technical work brought into the high school, and to obtain the best results, the best material is necessary. As there is no laboratory or machine shop to maintain, the expense of the department is low. About $6000 a year is the entire cost of the course in Springfield, and of this amount two or three of the shops have, from the first, assumed one-half.



SHOP REPORT OF
Leon P. Gosselin 19 7 Year
NAME
For Week Ending Oct. 21, 1916
Firm The Fellows Gear Shaper Co.
Dept. Gear Cutting
Foreman H. Borden

Time Worked: Regular time 51 Hrs.
Overtime 11¼ Hrs.
Total 62¼ Hrs.
Premium: Total time on Premium Work — Hrs.
Actual time saved — Hrs.
Pay due for Premium $ —

Pay Received:
Regular $8.16
Overtime $2.70
Premium $ —
Total $10.86

KIND OF WORK
Cutting gears on Fellows Gear Shaper, two machines operated, one for change gears other for other C.I. gears
Brief Description of Job, Kind of Metal, Operations, etc.
Change gears and pitch gears were of C.I. one cut taken, all change and pitch gears having pitch of 16 other gears were, such as feed dials & other regular lines of gears of C.I.
Remarks
Conduct Workmanship

Fig. 2. Shop Report, on which are recorded the Time worked by the Student, Wage received, and Class of Work done in Each Department

After ten years of experience, certain results can be noted. The boys who have taken the whole course seriously, have a sense of mastery. They have attained definite results in a field that requires precise workmanship, and they are more sure of themselves than those who have not had this training. Association with men and with real men's problems gives them a maturity of judgment and a fixity of purpose not generally found in academic students of their age.

Another good feature of the course is the notable change in the attitude of the "Co-ops" toward school and life in general. The question of what to do for a living and what is his place in life are questions of greater interest to the boys after working in the shops. They realize more and more fully what it means to earn a living, and how much easier it becomes with an education. Having earned money in the shops by real work, they realize the value of a dollar more than ever before.

The department has about an average rank in scholarship. It carries a heavy line of studies with only half time to devote to it. If another year could be given to the course—two full years in high school—it would be beneficial. As it is, the boys of this department take a fair share of school honors, and some of them have made a brilliant record at college. Literature, history, and economics are stressed in the course, which supplies the cultural element in so far as books can do so. The fundamental idea of schools is to train the learner to think, and correlated shop work is a constant stimulus to thought processes. Ideas must stand the acid test of workability.

* * *

WORK DONE BY THE GEAR MANUFACTURERS' STANDARDIZATION COMMITTEES

A considerable amount of standardization work is being done by the various sub-committees on standardization appointed by the American Gear Manufacturers' Association, with headquarters at 2443 Prospect Ave., Cleveland, Ohio. B. F. Waterman of the Brown & Sharpe Mfg. Co., Providence, R. I., is chairman of the general standardization committee of the association, and communications relating to gear standardization may be addressed to him.

A brief resumé of the work of the different standardization committees shows that the following items are now being considered: Spur gear nomenclature; rules for the strength of spur gearing; standards for bevel pinions of ten teeth or less; bevel gear nomenclature; proportions of worms and worm-wheels for single- double-, triple-, and quadruple-threaded worms; rules for calculating the proportions of worm-wheels for existing hobs; standards for roller chains, adopted in conjunction with committees of the American Society of Mechanical Engineers and the Society of Automotive Engineers; means for inspecting gears for noise; recommendations for the treatment of various gear steels; the testing of steels by the spark test; recommendations relating to the use of standard gear hobs for cutting herringbone gears; standards for electrical railway gear pinions; standard forged steel gear blanks for electric railway service; standards for keyways; nomenclature for differential gearing, to be adopted in conjunction with the Society of Automotive Engineers; and a standard stub tooth form.

* * *

LARGE-SCALE RAILWAY ELECTRIFICATION

In order to increase the traffic capacity and to secure operating economies, the Virginian Railway has decided to electrify 213 miles of its track in Virginia and West Virginia, involving an expenditure of $15,000,000. The Westinghouse Electric & Mfg. Co. has been awarded the contract for the electrical equipment, which is said to form the largest railroad electrification contract ever placed. The division of the railroad to be electrified crosses the Allegheny Mountains. The electric locomotives will develop 20,000 horsepower, and will haul trains of 9000 tons up the grades of the road at a rate of fourteen miles per hour. Provisions have been made for increasing this power in the future so that 12,000-ton trains can be handled at the same speed. The power for the operation will be supplied by a 90,000-horsepower hydro-electric generating plant, supplying 88,000-volt current to the main transmission line. This high-voltage current is stepped down to 11,000 volts by transformer stations, and thence it enters the trolley wire from which the locomotives draw their power.

* * *

For some time past a study has been in progress in the metallurgical laboratories of the Bureau of Standards on the properties of various grades of boiler plate through a temperature range of from 20 to 465 degrees C. (68 to 869 degrees F.) The results of this work have been published in Technologic Paper No. 219, which describes the special apparatus employed for making high-temperature tensile tests and the differences in behavior of the steel that were noted in the temperature range specified.

Requirements in Cutting off Metal

By M. E. ERSKINE, President, Racine Tool & Machine Co., Racine, Wis.

IT seems that at present further development in cutting off metals by the power hacksaw machine is limited by the quality of the hacksaw blade, and that the next step in the development of cutting-off equipment must come from the hacksaw blade manufacturers. In any discussion of metal sawing, the first consideration is the speed at which the blade should travel to secure the best results. For all practical purposes, the writer is confident that three speed changes are ample for cutting 90 per cent of all the metals ordinarily cut on a hacksaw machine. These metals may be arranged under three heads as follows:

1. Mild steel and iron bar stock, and all metals of equal or less degree of hardness.
2. Steel over 0.35 per cent carbon, annealed tool steel, and tough materials such as nickel steel and bronze.
3. Unannealed tool steel and all very hard metals.

With a machine of modern design, having a 6-inch stroke, these classes of metals should be cut at about 125, 90, and 60 cutting strokes per minute, respectively. Faster cutting speeds may be possible, but when reasonable economy in blades is considered, these speeds are the most practical.

Pressure on Blade while Cutting

The average power hacksaw machine of today is arranged so that a definite limit is set on the amount of pressure to which the blade may be subjected. The pressure is regulated by weights acting through gravity, by spring pressure, or by what is known as "force feed." Unfortunately, a large number of machines do not provide any ready means for determining the amount of pressure applied to the blade at any given time; it is, however, preferable to have the pressure definitely known and limited, as the teeth of any blade will quickly give way under severe cutting pressure. The width or gage of the blade is of little consequence under these conditions, because it is the cutting edge or point of the teeth that breaks down. Metals in the first class mentioned, for average conditions, require that the full limit of pressure be applied; in the second class from one-half to three-fourths of the full pressure may be used; and in the third class, the minimum pressure that the design of the machine permits, should be used.

These general rules must not be followed too literally. Common sense plays a large part in obtaining the best results in the use of cutting-off machines. The rules given for speed and pressure are for average conditions. When fast production is required, regardless of cost, greater pressure or higher speeds may be used at the expense of blades and accuracy. Furthermore, a new blade requires less pressure to cut a given amount of metal than a used blade. As the blade loses its sharpness, the pressure should be increased; and as the pressure is increased, the faster will be the wear on the teeth. This leads to the conclusion that it is a waste of time to use a blade after it has ceased to cut freely. There is a very definite point in the life of a blade when it ceases to cut freely and starts to "ride" over the material. This point is readily determined by any operator familiar with metal-cutting, and judgment as to when this point is reached counts for more than any general rule.

Effect of the Design of the Hacksaw Machine

The manner in which the blade is applied to the metal by means of the machine has a great deal to do with the maximum efficiency in cutting off metals and the life of the blades. Machines without means of lifting the blades on the non-cutting stroke are still in use in many places. This is the main reason for looking upon the hacksaw machine as the discredited member of the machine tool family, and the manufacturers of modern high-speed power hacksaw machines must live down this reputation and educate users to an understanding of the possibilities of the modern machine.

Everyone will agree that the hacksaw blade is made to cut one way only, and that it ought to be applied in such a way that it will clear itself of chips on every stroke. When it is allowed to drag back, the chips naturally clog in the teeth and are pulverized into an abrasive which quickly wears away the set of the teeth and dulls the cutting edges. It is safe to say that one back stroke, dragging the teeth on the metal, dulls the blade more than ten cutting strokes. Therefore, the important point in any machine of this type is the lift on the non-cutting stroke. The lift should be mechanically positive, and should work unfailingly under all pressures.

A simple test for determining whether the saw is lifted free of the work on the return stroke is to operate the machine and notice whether all the chips are deposited on one side of the cut. If the chips are divided between both sides of the cut, it is evident that there is not sufficient lift of the blade on the non-cutting stroke. Another test is to examine the chips under a magnifying glass and determine whether they are long and curled up, as if they had been cut in a lathe, or whether they have been broken up or ground into powder. The latter test can naturally be made only on soft steels or free-cutting materials.

Savings Effected by Correct Means for Cutting off Metals

The average shopman does not realize the great savings that are possible in cutting off metals. The abuse of hacksaw machines constitutes one of the greatest hidden sources of waste in any metal-working shop. Suppose, for example, that it is required to cut off 3-inch cold-rolled shafting all day long. If the machine is designed to lift the saw properly from the cut on the back stroke, and pressure is correctly applied, one blade should last a full day of ten hours, cutting at the speeds and pressures specified. If the machine is out of adjustment so that the lift on the non-cutting stroke is inoperative, or if the machine is designed without a lift, the blade would last only one-tenth of the time mentioned. This means a saving by the first machine of ten to one on blades, or, expressed in dollars and cents, about $1.50 per day or $450 a year on one machine alone. In addition, production is slow and crooked cuts are generally the result of using a machine which is continually wearing out blades.

Let us take another example: In a certain tool steel warehouse, an antiquated machine is in operation, which cuts all day long at 60 strokes per minute. The blade drags back and forth. The cuts run out from 1/8 to 1/4 inch, owing to the fact that the blade has lost its set during a few dragging back strokes. On an average, this machine will cut 1/2 inch per minute of solid metal, or 30 inches per hour. It will waste from 1/8 to 1/4 pounds of solid metal per minute by cutting crooked which requires that the ends be trued up later on. With tool steel at 20 cents per pound, this machine will waste $1.50 to $3 worth of stock per hour in cutting only 30 inches of stock. The modern high-speed power hacksaw will cut an inch a minute easily, and should be able to cut any number of pieces with a limit of plus or minus 0.010 inch. In that case there should be less than 20 cents waste of metal per hour, and the production would be doubled.

Increasing Production

The examples given in the foregoing show, first, the savings possible in blades; and, second, the savings possible in material. It remains to give a typical example of increased production. The average old-style machine in use in many shops, at 60 strokes per minute will cut off, at best, one piece of one-inch square stock every two minutes, or thirty per hour. Three hundred pieces per day of ten hours might be possible, but improbable. A modern high-speed machine does the same amount of work in five hours, and the saving in labor cost will amount to at least $2 or $3 per day at present wages. At the present time it is estimated that about 50 per cent of the machines in operation are of the old type, that increases the production costs as indicated. The average small shop, as well as many of the larger ones, operate hacksaw machines that do not have the modern improvements that make for economy and accuracy. Most of these shops would save the price of a modern high-speed machine in a short time.

It is astonishing how difficult it is to convince many good mechanics that both rapid and quite accurate work is now possible on the modern hacksaw machine. The following examples will illustrate what can be accomplished. On a modern machine, in which are embodied the principles outlined at the beginning of this article, one blade will cut off 600 pieces of one-inch square or round mild steel in one day, operating at high speed and full pressure. This represents the cutting of 50 feet of solid metal. One blade will cut off twenty-five pieces of 5-inch cold-rolled shafting with limits of plus or minus 0.010 inch, and with a difference of only five minutes in cutting time per piece between the first piece and the last.

As for cutting time it is reasonable to allow one square inch per minute on all mild steels. In estimating the average cutting time of a round bar, therefore, if the square of the diameter is multiplied by 0.7854, the result will give the possible cutting time in minutes. In the case of flat stock, the area in inches will also indicate the approximate cutting time. However, this rule is merely given as a convenient guide, and carefully conducted tests may show that better results can be obtained under favorable conditions.

It has not been the author's intention to present a technical article on metal-cutting, but to give a few practical illustrations of work actually performed every day. It would not be practicable to produce complete tables for metal-cutting speeds for every class of material, because actual results are dependent upon too many conditions which cannot be directly controlled; for example, the blades may vary in uniformity of hardness and in the set of the teeth; the stock may vary inch by inch in hardness, and the machines may vary widely in cutting capacity.

In order to train the user to recognize the difference between the modern power hacksaw and the older types, many manufacturers have eliminated the use of the word "hacksaw machine" in reference to their product, and are referring to their machines as metal cutting-off machines. It is well to note this distinction, and it is the part of wisdom to provide the best machine rather than the cheapest one for future use.

* * *

An indication of the fact that machinery manufacturers are making increasing use of the services offered by the Bureau of Foreign and Domestic Commerce is found in recently published figures of inquiries received by the bureau. During the period June 27, 1921 to July 1, 1922, 11,178 inquiries were received from machinery manufacturers, while from July 2, 1922 to May 26, 1923, 41,098 were received.

CUTTING OFF BAR STOCK AT A HIGH RATE OF SPEED

The cutting of heavy bar stock into pieces of the required length is an important operation in the manufacture of many products. The rate at which this operation is performed varies considerably in different plants, even in cases where cutting-off machines of the same kind are used under similar conditions. In this article, data are given on the results obtained in various plants in cutting off bars ranging from 2½ to 7 inches in diameter, on Gorton machines.

Cutting off Carbon Steel Bars

In the plant of one large steel company, seven cutting-off machines employed regularly in cutting off 3½-inch steel bars averaged 55 cuts per hour for each machine. The cutter travel was 50 feet per minute, and two bars were cut off at a time. The carbon content of the bars was 0.50 per cent, and the manganese content 0.76 per cent. In another plant of the same company, 41 cuts per hour were made by one machine on 4⅛-inch bar stock in the initial tests, but this rate could not be regularly maintained owing to the crooked condition of the bars and the lack of proper facilities for handling the stock.

In still another plant four machines were regularly operated at the rate of 16 cuts per hour, on each machine, cutting 6¾-inch diameter shell steel of 0.50 per cent carbon with a high manganese content. A representative of the manufacturer of these machines obtained a production of 240 cuts per 10 hours in a test made under unfavorable conditions.

Cutting off Brass Bar Stock

During a test at the plant of a large brass concern, 5-inch common round leaded brass bars were cut off in 12 seconds. The time for cutting off a bar 6 inches in diameter of the same material was 20 seconds. These are actual cutting times and do not allow for handling the work. The regular production time for 7-inch stock in this plant was 70 cuts per hour. In another plant, common round leaded brass 7 inches in diameter was cut off in 9 seconds, actual cutting time. Naval bronze bars 7 inches in diameter required 15 seconds per cut.

Tests Made to Determine Practical Cutting-off Speeds

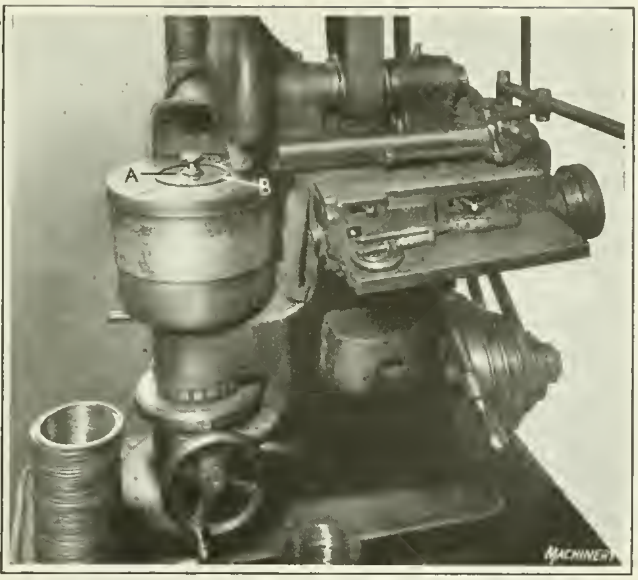
In a series of tests made by a large concern for the purpose of determining the most economical feeds for cutting off steel bars, it was found that 2½-inch bars having a carbon content of from 16 to 25 points could be cut off in 20 seconds. In this test, the cutter made 35 revolutions per minute, which gave a surface cutting speed of 91 feet per minute. The cutter feed was 6½ inches per minute. The total time for setting and cutting off the bar was 50 seconds. With the same cutter speed and a feed of 5 inches per minute, 3½-inch steel bars of 35-point carbon were cut off in 42 seconds; the total time for setting and cutting off being 77 seconds. The quickest time in which 4-inch stock was cut off was 35 seconds. With a cutter speed of 91 feet per minute, 6-inch round stock was cut off in 64 seconds.

As a result of these tests it was decided that 28 seconds was a good minimum time to allow for cutting off 2½-inch steel bars, 37 seconds for 3-inch bars, 52 seconds for 4-inch bars, 76 seconds for 5-inch bars, and 105 seconds for 6-inch bars. The machines used in all the cutting-off operations described in this article were made by the George Gorton Machine Co., Racine, Wis., using their internal-tooth type of saws. In special tests made at this company's plant to determine the strength of the saw teeth or cutters, a 6-inch 9-point carbon steel bar was cut off in exactly 40 seconds, with a feed of 9 inches per minute. In another test 1000 pieces of 3¼-inch round steel stock were cut off in a day of 10 hours. In this test the stock was bundled, special jaws being employed to hold one bar directly above the other.

Machining "V-plex" Piston-rings

A Leak-proof Automotive Piston-ring and Tools and Methods Used in its Manufacture

By EDWARD K. HAMMOND



VARIOUS forms of leak-proof piston-rings have been developed to increase the efficiency of operation of automobile engines. In this article a brief description is given of the "V-plex" type made by the Krasberg Piston Ring Co., 536 Lake Shore Drive, Chicago, Ill., together with a detailed description of the successive machining operations performed on the ring members.

V-plex piston-rings consist of a central wedge-shaped ring and two outer so-called "pressure rings," which are assembled together to make a packing for one groove in the piston as shown in Fig. 1. The advantage claimed for a composite ring of this kind, as compared with the commonly used solid type of ring, is that it completely fills the groove in the piston and also expands to fit tightly against the wall of the cylinder, thus preventing leakage around the rings which wastes power and oil, causes spark plugs to become covered with soot, and allows carbon to be deposited in the cylinders.

It is claimed that the wedge-shaped center ring of the V-plex piston-ring forces the two outer rings firmly against the walls of the groove to form a complete seal; and as years of service wear down the edges of the ring members that fit snugly against the cylinder walls, the rings automatically compensate for this wear, so that there is no leakage between the cylinder wall and the outside of the rings. In assembling the three parts of a V-plex piston-ring into its groove, care should be taken to stagger the split ends of each ring, so that they are uniformly distributed around the circle.

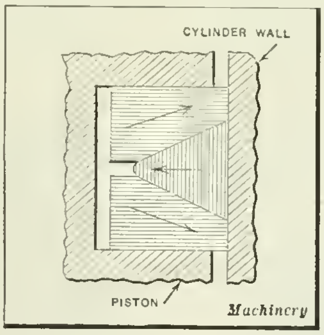


Fig. 1. Cross-section of "V-plex" Piston-ring

Preliminary Machining of Outer Rings

The outer members of the V-plex piston-rings are machined from individual castings. It is claimed that when this procedure is followed, the rings have more resiliency than those cut from the so-called "pot" casting, and as a result, are better adapted for the purpose intended. As the castings for the outer rings come to the machine shop, the first step is to face one side of each ring, which is done on a short-bed lathe built by the Porter-Cable Machine Co., of Syracuse, N. Y. As shown in Fig. 4, this machine is equipped with an air chuck operated by a pedal *A*, which provides for centering and clamping the work. This method of controlling the chuck leaves both of the operator's hands free for rapidly handling the small pieces of work, and is found to be the means of increasing production. The facing tool indicated at *B* is carried by a cam-actuated rocker-arm which swings the tool forward into position to feed it across the casting.

Next in the sequence of operations comes the snagging of the inside of the ring. This work is shown in process in Fig. 5, where it will be seen that the casting is held by a pair of tongs which are provided with a flexible rim *A*. This rim embraces the outside of the work, so that when the tong handles are pressed together, it grasps the casting. Inside the flexible rim there are three pins against which the previously faced surface is located, so that the ring is held perpendicular to the snagged inner surface. It will be apparent by reference to the illustration that a grinding wheel is used that is of a diameter slightly less than that of the ring. The inside diameter of the ring is ground to fit a plug gage.

Grinding the Sides of the Outer Rings

It is necessary to have both sides of the outer rings smooth and parallel, and in order to obtain this condition, each of the sides is ground. For this purpose, use is made of a Heald rotary surface grinder, as shown in the heading illustration. The machine is equipped with a magnetic chuck, at the center of which there is attached a disk *A* of slightly smaller diameter than the snagged inside diameter of the work. By simply dropping the ring *B* over this disk, a convenient method is provided for quickly locating the work, so that it may be rotated in constant contact with the grinding wheel.

After locating the work from the snagged inside diameter and chucking it from the faced side, the opposite side of the ring is ground down to a smooth surface. The object of this grinding operation is to obtain a uniformly smooth surface, and still leave as much of the hard outer scale as possible, because the scale is said to increase the resiliency of the ring. After this operation has been finished, the work is turned over to grind down the previously faced surface to the desired condition of smoothness and parallelism with the opposite side which has just been ground; also the ring must be reduced to the required thickness.

Turning the Outside Diameter

The inside diameter and the two side faces of the rings have now been finished, but it still remains to machine the outside diameter. For this purpose, the rings *A* are loaded on a mandrel of the form shown in Fig. 2. This is of simple design, consisting of a body with a shoulder *B* at one end and a removable collar *C* at the opposite end, which is held in place by four bolts. The piston-rings are located on the mandrel so that they come into contact with the

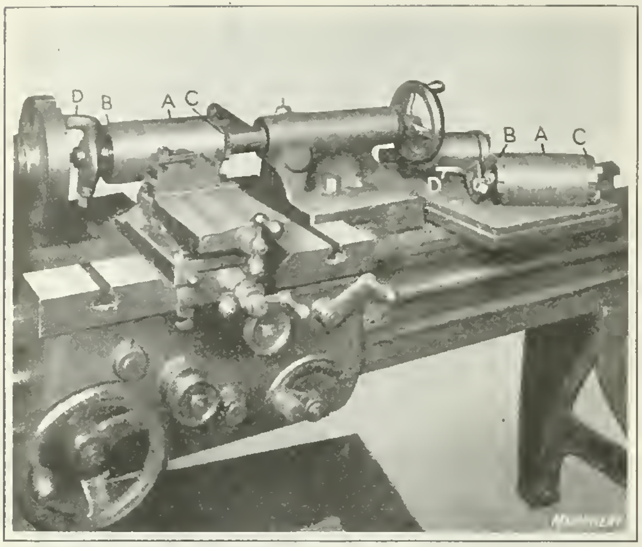


Fig. 2. Multiple Work-holding Arbor used for setting up a Load of Outside Rings on a Lathe for rough-turning the Outside Diameter

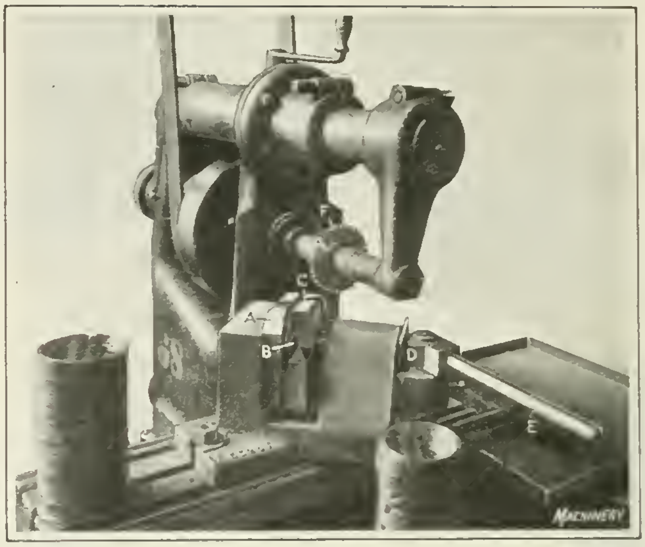


Fig. 3. Hand Milling Machine equipped with a Special Vise for holding the Outside Piston-rings while cutting a Diagonal Slot

shoulder, after which the removable collar is put into place and bolted to secure the work for turning. The mandrel is furnished with the usual driving dog *D* and holes to receive the lathe centers, so that it may be set up on an engine lathe, for turning the outside diameter of the entire load of rings, just as if they were a single piece of work.

Splitting the Rings and Finish-turning Outside Diameter

Fig. 3 illustrates a hand milling machine built by the Rockford Milling Machine Co., which is equipped with a hand-operated fixture that provides for clamping four of the piston-ring castings while they are being split. This fixture consists of a fixed jaw *A* with a pilot *B* for centering the rings from their snagged inside surface, and a movable jaw *C*, which is operated by a cam *D* and a hand-lever *E*. Four piston-ring castings are placed in position between the jaws, and then the hand lever is pulled over to close the clamp, after which the milling machine table is pulled over to feed the work under the two saw blades *F* which are spaced a sufficient distance apart so that they remove the required amount of metal from the wall of the piston-rings.

Next in the order of operations on the two outside members of V-plex piston-rings comes the finish-turning of the outside diameter. For this purpose, the rings are loaded on an arbor *A*, as shown in Fig. 6. It will be recalled that when the rings were rough-turned, they were located on the arbor (Fig. 2) from the snagged inside surface. This was sufficiently accurate for rough-turning, but for finish-turning, it is necessary to obtain a more precise setting. This is accomplished by the means shown in Fig. 6. As far as general appearance is concerned, it will be seen that the arbors *A* used for finish-turning are of similar design to those employed for roughing. The difference lies in the method of loading the piston-ring castings on the arbor.

Method of Holding the Work

For loading, the arbor is held vertically in a vise, so that the rings may be easily put into place, care being taken to stagger the splits around the arbor. The clamping collar *B* and nuts *C* are next put in place, but not tightened up. Then the arbor and work are transferred to a setting fixture *D*. The collars at *B* and *E* are of a slightly smaller diameter

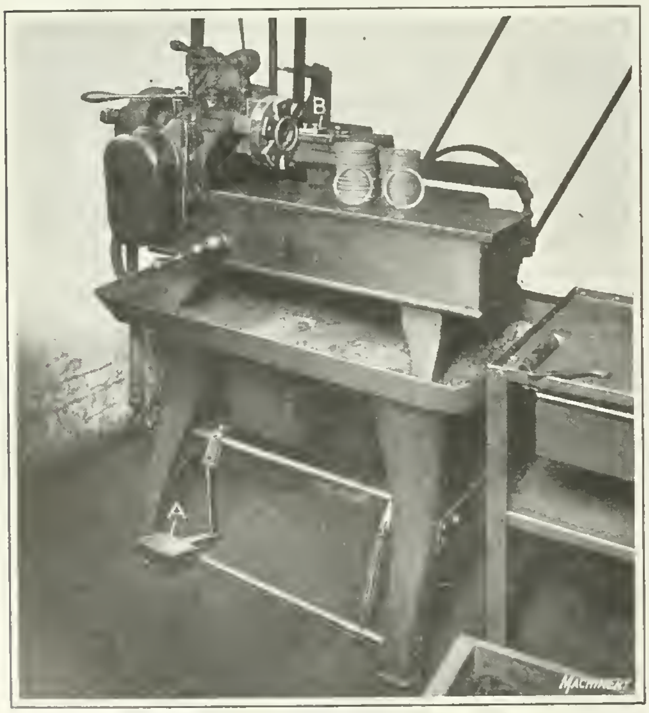


Fig. 4. Short-bed Lathe equipped with Pedal-operated Air Chuck and Cam-actuated Facing Attachment for machining the Outer Ring

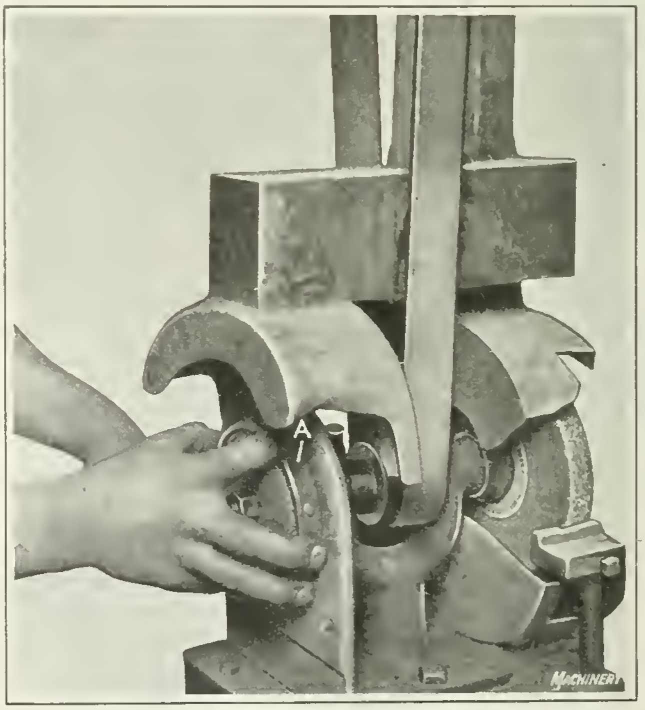


Fig. 5. Grinding Stand and Hand Clamp for holding the Outside Piston-rings while performing a Snagging Operation on the Inside

than the outside of the work, and the purpose of this setting fixture is to bring the outside of the piston-rings concentric with the lathe center holes at the ends of the arbor, rather than to have the rings located from their snagged inside diameter, as was the case in performing the rough-turning operation referred to in the preceding.

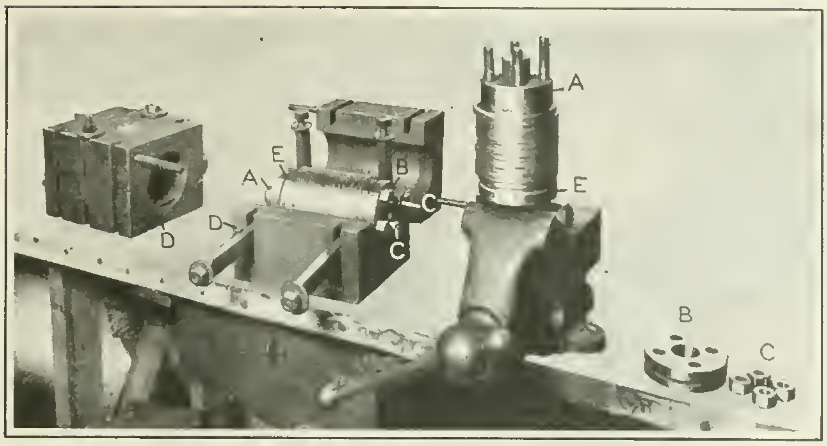


Fig. 6. Special Form of Arbor for holding Outside Rings while finish-turning, and Fixture for centering the Rings on the Arbor

It will be seen that the setting fixture consists of two blocks which fit together to form a cylindrical opening of the same diameter as the piston-rings that are to be finish-turned. With the clamping collar *B* and the nuts *C* still loose, the work is placed in this fixture as shown at the center of Fig. 6, after which the upper block is swung down and bolted tightly over the work. This brings the work concentric with the lathe center holes in the arbor, because the collars *B* and *E* on the arbor are supported in openings at the ends of the fixture that are concentric with the larger opening that holds the work. This fixture serves the additional purpose of preventing the piston-ring castings from shifting in a sidewise direction while the clamping nuts *C* on the arbor are being tightened.

When the work has been secured firmly in place, a finishing cut is taken over the rings, after which the arbor and its load are removed from the lathe and reset in a fixture of the type shown in Fig. 6. This fixture has a cylindrical opening 0.025 inch in diameter larger than the one used for the first setting. As the split piston-rings were somewhat compressed in placing them in the first fixture, when the clamping nuts *C* and collar *B* of the arbor are released, the work will expand, so that in resetting, the rings are clamped somewhat further open than previously. Held in this way, the arbor is replaced in the lathe for taking a final finishing cut over the outside surface.

Turning the Bevel on the Inner Side of the Rings

After the rings have been finish-turned, it is necessary to bevel their inner sides, and for this purpose Porter-Cable short-bed lathes, furnished with a tool equipment of the type illustrated in Fig. 7, are used. As the rings have been split and are subject to a springing action, it is necessary to provide means for holding them securely in place, and this is done by the use of a special type of male center *A* and a female center *B*, between which the ring *C* is held. The female center is counterbored to such a diameter that the ring can just be slipped into place, and the male center engages the inside of the work so that there is no chance for slippage or distortion. Both of the centers are beveled in such a way that the tools can reach the work to perform the required beveling operation.

At the back of the lathe, there is a formed tool *D* that is first brought into contact with the work to "hog off" the excess metal, after which a single-point tool *E* carried on a compound rest at the front of the lathe cross-slide is fed across the work to take a finishing cut. The roughing tool *D* is carried by an auxiliary tool side to which a rack is secured. This rack meshes with gear *F*, which is turned through the rotation of pinion *G*, the entire mechanism being operated by handle *H*.

Finish-grinding the Inside Diameter

The final operation in manufacturing the outer piston-rings consists of finish-grinding the previously snagged inside diameter. This is done by locating a number of the castings in a pot fixture, so designed that the rings are compressed and slipped into this fixture, when they expand and are held from their finish-turned outside diameter. At the front end of the pot are a collar and clamping bolts, and the pot fixture is loaded with piston-ring castings until the last ring projects slightly beyond the end of the pot. When the clamping bolts are tightened and the collar of the fixture is forced against the end casting of the row, the whole load is secured firmly in place. The pot fixture is mounted on the spindle of a Heald internal grinding machine, and an abrasive wheel is reciprocated inside the piston-ring castings to grind the inside concentric with the outside.

Mention has already been made of the fact that the two outer members of the V-plex piston-rings are machined from

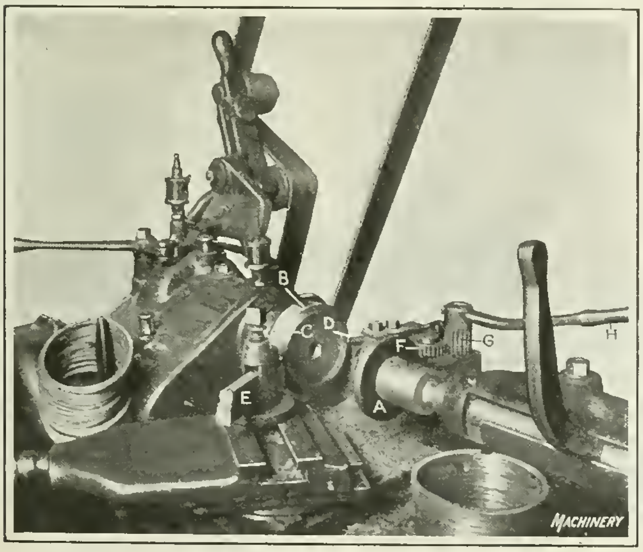


Fig. 7. Short-bed Lathe equipped with Special Centers and Facing Attachment for turning Beveled Surface on Outside Piston-rings

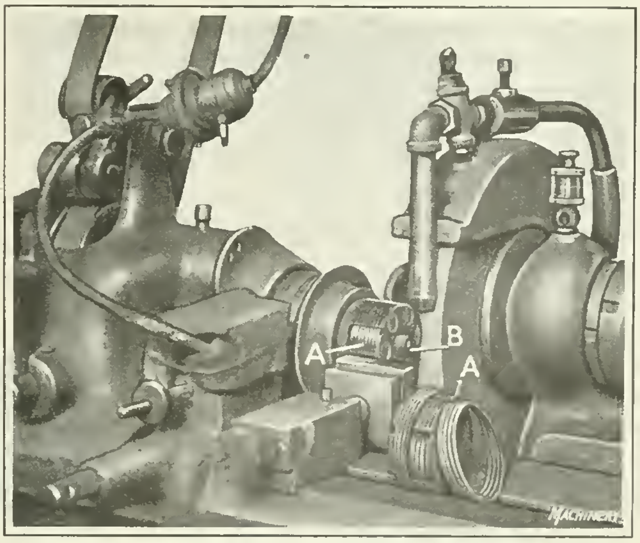


Fig. 8. Special Magnetic Chuck Adapter used for holding the Inner Piston-rings while grinding the Outside Diameter

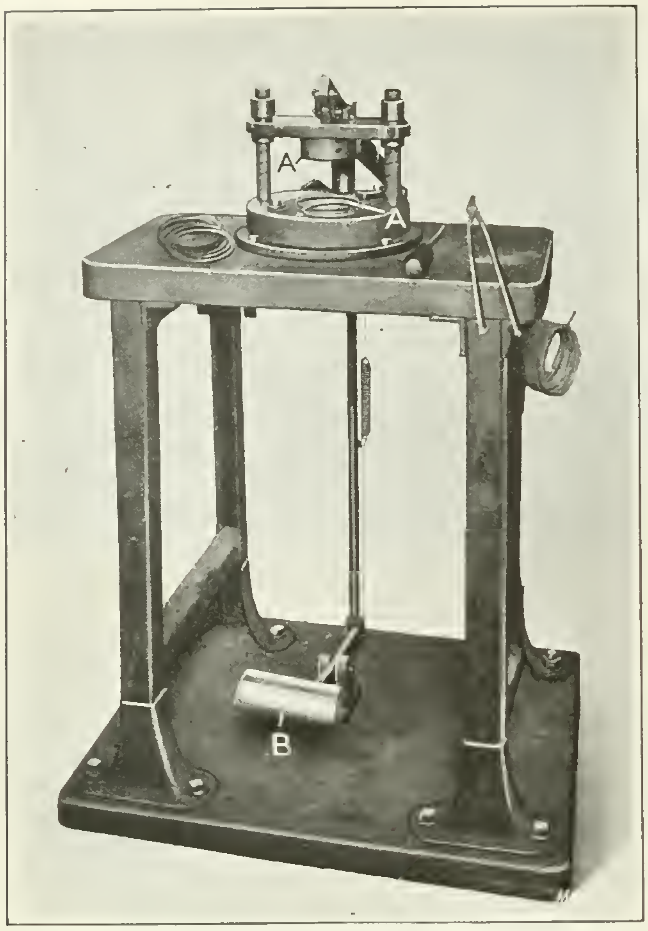


Fig. 9. Combination Straightening and Tempering Die used in making the Inner Rings

individual gray iron castings. For making the central member of this three-part ring, a special steel is used. The rings are formed to a V-shape, and after they have been machined to the proper form, they are sent to the heat-treating department, where the temperature of the steel is raised to between 1400 and 1500 degrees F. in a special gas furnace. Upon removal from this furnace, the rings are dropped successively into a die shown at *A*, Fig. 9, which is operated by a foot-treadle *B*. This operation serves the double purpose of bringing the rings into a truly round form and of giving them a spring temper, as the closing of the die not only sets the ring in the required shape, but it also withdraws the heat rapidly enough to give the steel the required physical properties.

Grinding the Outside Diameter of the Inner Rings

For grinding the outside diameter of the inner rings, which is the only surface on these parts that is machined, use is made of adapters of the type shown at *A*, Fig. 8, which are slotted in such a way that eight of the rings can be ground at a time. This adapter fits on a special magnetic chuck, which has a pilot *B* that passes through the opening in the adapter, and there are electromagnetic windings that pull the adapter back against the face of the chuck, where it is held firmly in place. Aside from the method of holding the work, this is an ordinary cylindrical grinding operation.

Gaging the Finished Rings

V-plex piston-rings are required to have the beveled face concentric and of a uniform angularity. They are tested for this condition by means of special gages *A* shown in Fig. 10, which are furnished with dial test indicators. The piston-ring is dropped into place on this gage, the beveled surface being held under the needle of the indicator. Then the ring is rotated, and in order to pass inspection the concentricity or angularity of the beveled surface must not vary enough to deflect the needle more than 0.001 inch.

Next, the rings are tested for freedom from flaws by forcing them over a plug gage *B*. which is 1/32 inch larger in diameter than the piston on which the rings are to be assembled. The importance of this test will be readily appreciated when it is borne in mind that the two outer rings of each set are made of cast iron, and if there were any serious flaw in a ring, it would be likely to result in breakage when the ring was spread to put it in place on the piston.

For testing whether or not the sets of inner and outer rings can be assembled together with satisfactory results, use is made of special plug and ring gages *C*, which correspond in size to a piston and to the cylinder in which such a piston would operate. The plug gage is grooved so that the set of piston-rings can be assembled in place, and after it is filled, the plug gage is pushed into the ring gage. In this way, the action of the three assembled rings may be inspected under conditions that duplicate those of actual service in an automobile engine. Finally, the "spring," or the amount of resistance to compression offered by the cast-iron outer piston-rings, is tested by means of a simple fixture consisting of a platform scale *D* on which the ring is supported, and a lever *E* carrying a yoke that engages the top of the ring. This lever is pushed down until the slot in the ring has been closed, and the inspector then reads on the scale the direct measure of the resistance that the ring offers to compression.

* * *

INCREASED EFFICIENCY IN PRODUCTION

We must get our minds away from the notion that prewar standards of living and volume of business would be normal now. "Normalcy" is a vastly higher and more comfortable standard than that of 1913. We must not judge the state of business activity by pre-war figures, but by a hugely increased base. We must not be frightened when our output of steel or textiles or automobiles, lumber, corn, or hogs, or our car loadings amount to figures far in excess of those implied in a normal growth of population.

There has been in the last decade an unparalleled growth of our industrial and commercial efficiency and our consequent ability to consume. We are producing a larger amount of commodities per capita than ever before in our history. Precise comparisons are difficult to adduce, but exhaustive study from many angles of production over average periods ten years apart, before and since the war, would indicate that while our productivity should have increased about 15 per cent, due to the increase in population, the actual increase has been from 25 to 30 per cent, indicating an increase in efficiency of somewhere from 10 to 15 per cent.—*Herbert Hoover*

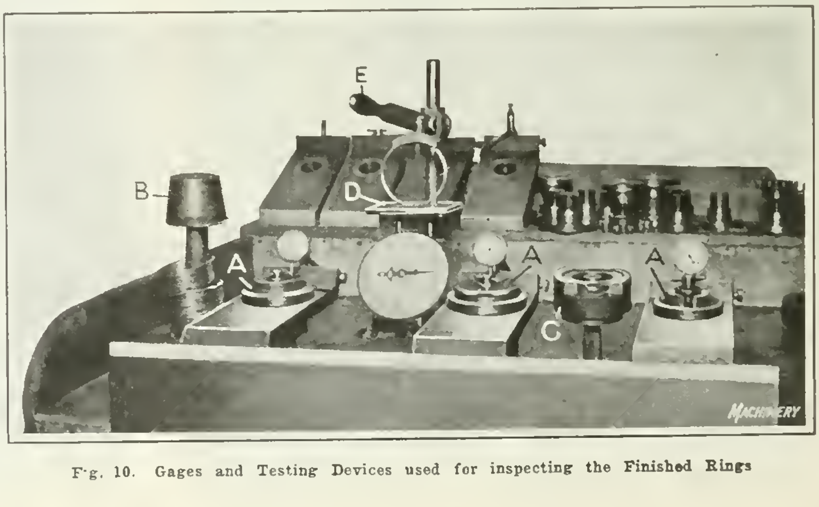
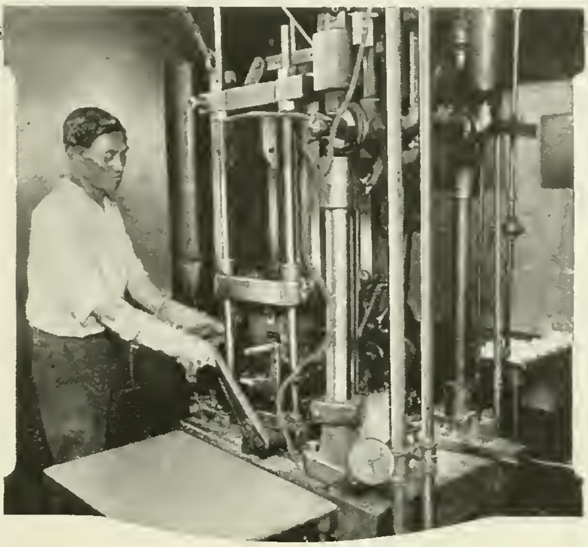


Fig. 10. Gages and Testing Devices used for inspecting the Finished Rings

Die-castings Requiring Two Operations

By CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



WHILE, in a sense, all die-castings have special features, there are certain designs of castings that tax the ingenuity of the die designer to find a method for their commercial production. The production of die-castings which at first glance would seem impossible of accomplishment, is often made possible by employing two operations. The casting produced by the first operation in reality becomes an insert in the second casting, but being of the same metal, it is fused with the second casting, the two thus becoming one solid piece. Examples of work of this kind include tubular shapes having a projection or other irregularity that prevents the ready removal of the central core. In this article, three such castings are to be considered. They are the syrup dispenser top shown in Fig. 1 and two graphophone tone-arms, both of which are used on well-known phonographs.

The syrup dispenser top is a tin-base casting, and the difficulty encountered in producing it was due to the spout being at an angle with the remainder of the cored section. This casting was made in the following manner: A straight copper tube *A* was cast into the first operation casting *B*, to form the spout. This casting was then bent to the proper angle, inserted in the die, and the remainder of the part cast around it. This is a very simple procedure after the method has once been evolved, but the solution of the problem at first glance appears much more difficult.

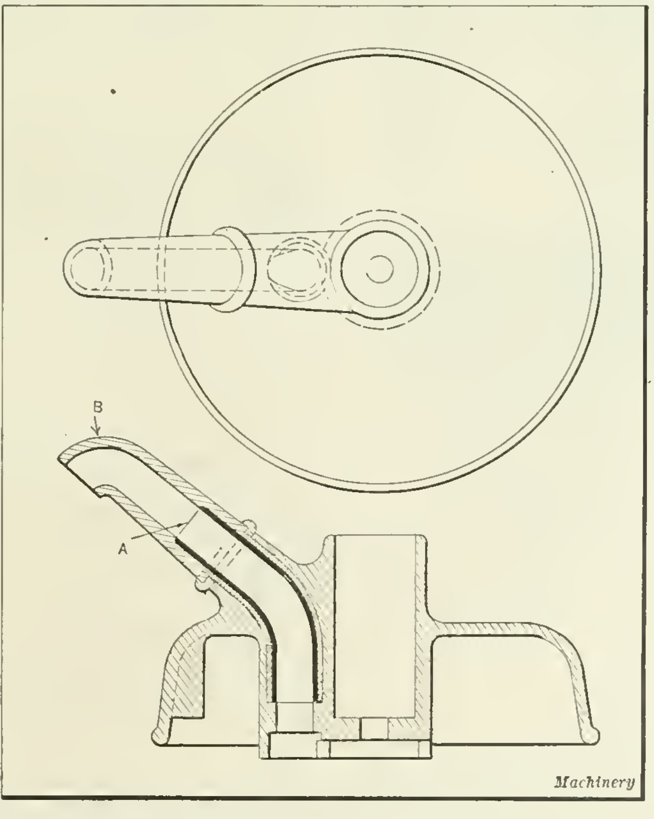


Fig. 1. An Example of a Two-operation Die-casting

Casting a Graphophone Part

The appearance of the first-operation casting for a Columbia graphophone tone-arm is shown at *A*, Fig. 2, while a sectional view of the finished tone-arm is shown at *B*. This tone-arm is a zinc-base casting. The first-operation dies are partially illustrated in Fig. 3. This illustration shows a sectional view of the ejector die in alignment with the cover die, a partial plan view of the ejector die and a sectional view through the ejector die, showing one of the cores. The die contains two impressions, which are symmetrically arranged and fed by one gate *A*. The plan view shows only half the die. The other half is identical in construction with the portion shown in the plan view, but the impression is reversed.

The sectional view through the small elbow core shows the arrangement for withdrawing the two cores that form the elbows. These cores join the long tapered core at a 45-degree angle, and are constructed so that as much of them can be removed at right angles from the tapered portion as is possible. The pinion *B* by which these cores are drawn is shown, as well as the means for locking the cores after they have been advanced to the casting position. The design of these two-impression dies cannot be regarded as out of the ordinary, the point of interest being the unusual method of producing the castings. The two die members are aligned by posts in the regular way, and they fit together with a shoulder and are locked by the locking member *C*, which contains a slot in which a stud on the ejector die becomes wedged. Not only are the dies properly cooled, but a water line is also run through the sprue-cutter *D*.

The long tapered core which is operated by pinion *E* not only produces the tapered hole in the tone-arm, but also forms an opening through the elbow from which it is withdrawn. Referring again to the view *A*, Fig. 2, it will be seen that the edges of the opening are beveled and that the metal at this end of the casting is somewhat thinner than the remaining section; also there are annular beads *D* and *E* cast on the elbow. This casting is used as an insert for producing the finished tone-arm, the method being protected by patents.

Second Operation on Tone-arm

The beads on the first casting are the means for anchoring the newly added metal which is cast on this end of the casting in the second operation. By this means the exterior surface is made uniform around the elbow, and the core opening produced in the first operation is closed.

The die used is also shown in Fig. 2. It is a two-impression die, but only the large end of the first-operation casting is placed in the die for casting on the additional metal. A core fits into the open end, as shown at *G*. This closes the end, and the core is so shaped that a uniformed curved surface is cast on the interior of the elbow. Special sleeve cores are also fitted into the die to form the shoulder, as indicated at *H*. These sleeves are advanced into the die impressions by two 5/8-inch pinions, and locked by a suitable clamp. The cores *G* which pass through the sleeves are operated by a single pinion.

The metal is admitted through a central gate to both impressions, this gate being shown in the plan view of the cover die. The water lines for cooling both members of the die are shown in the illustration, as well as the ejector-plate *J* and the rack and pinion arrangement for operating it. This is a case where the ejector-pins must not project into the die impressions so far as to cast a shallow hole in the work, for that would be difficult to obliterate with a file. The plan view of the ejector die shows that two ejector-pins are sufficient for each casting.

Another Example of Two-operation Work

The third example of a two-operation die-casting is the Aeolian tone-arm, which is a tubular part having a compound curve, presenting a unique problem in die-casting. This tone-arm is shown in detail in Fig. 4. The patented scheme employed in casting this piece consists of first making two hollow castings, then fitting them together and casting the metal as in insert work, to complete the tone-arm. The first-operation dies shown illustrate how this is done.

The two special castings used as inserts in the second operation are produced in this two-impression die. One casting is an elbow, produced in the left-hand impression. For this part, two cores are employed, which meet at a 45-degree angle and are drawn at right angles to each other by racks and pinions. The shape of the casting is indicated at *A*. The other casting is produced in the right-hand impression, as indicated at *B*. Castings *A* and *B* fit together, as shown in the plan view of the work in the lower right-hand corner of the illustration, and form a sectional core for all but the large end of the tone-arm, in the second operation.

Casting *B* is made by means of a curved tapered core, which extends beyond the ends of the die impression and is located by two pins *C*. These pins hold the ends of the core tightly in pockets in die-block *E*. This construction stops off

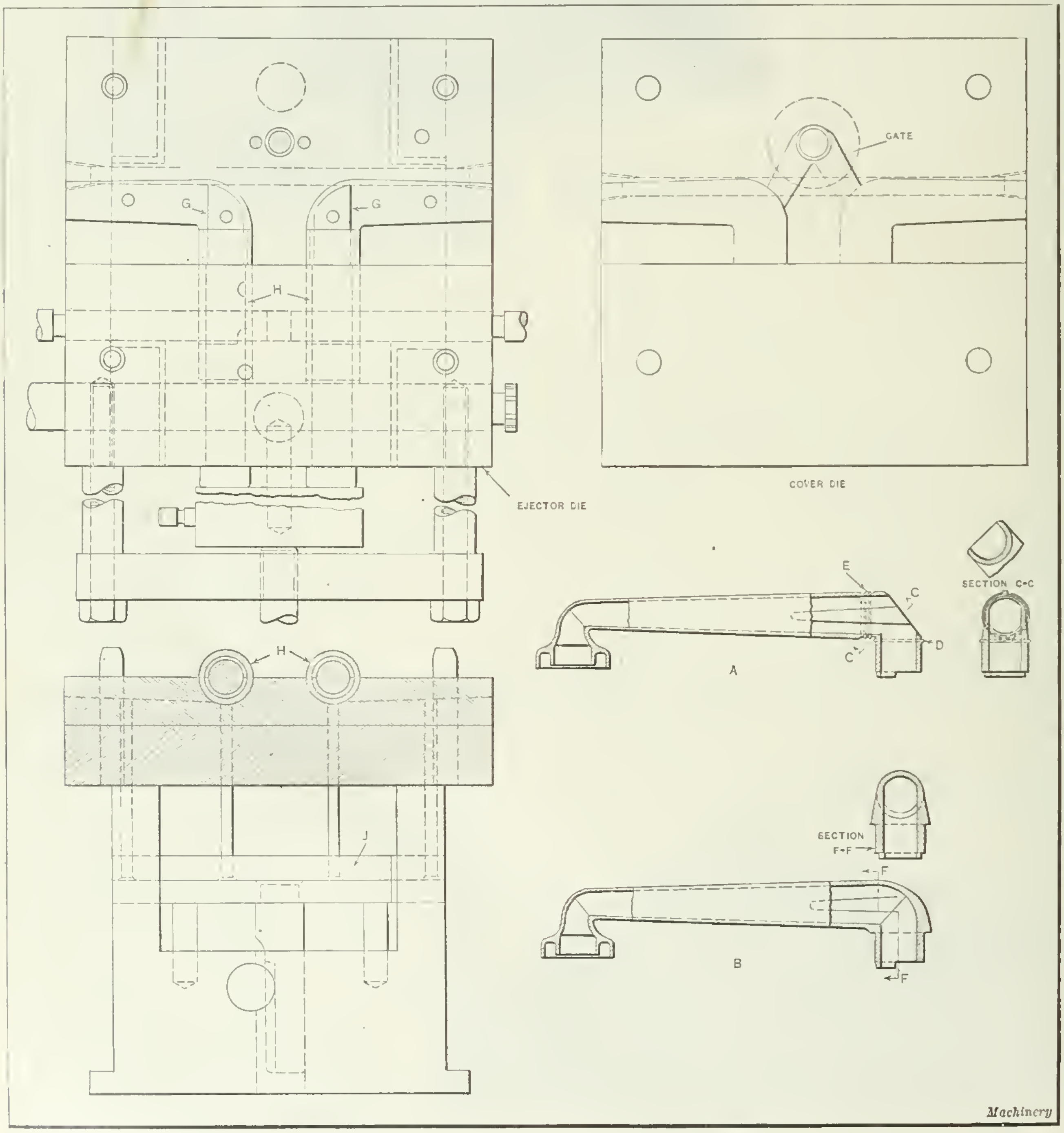


Fig. 2. Second-operation Die used in casting the Graphophone Tone-arm, and Detail Views of the First- and Second-operation Castings

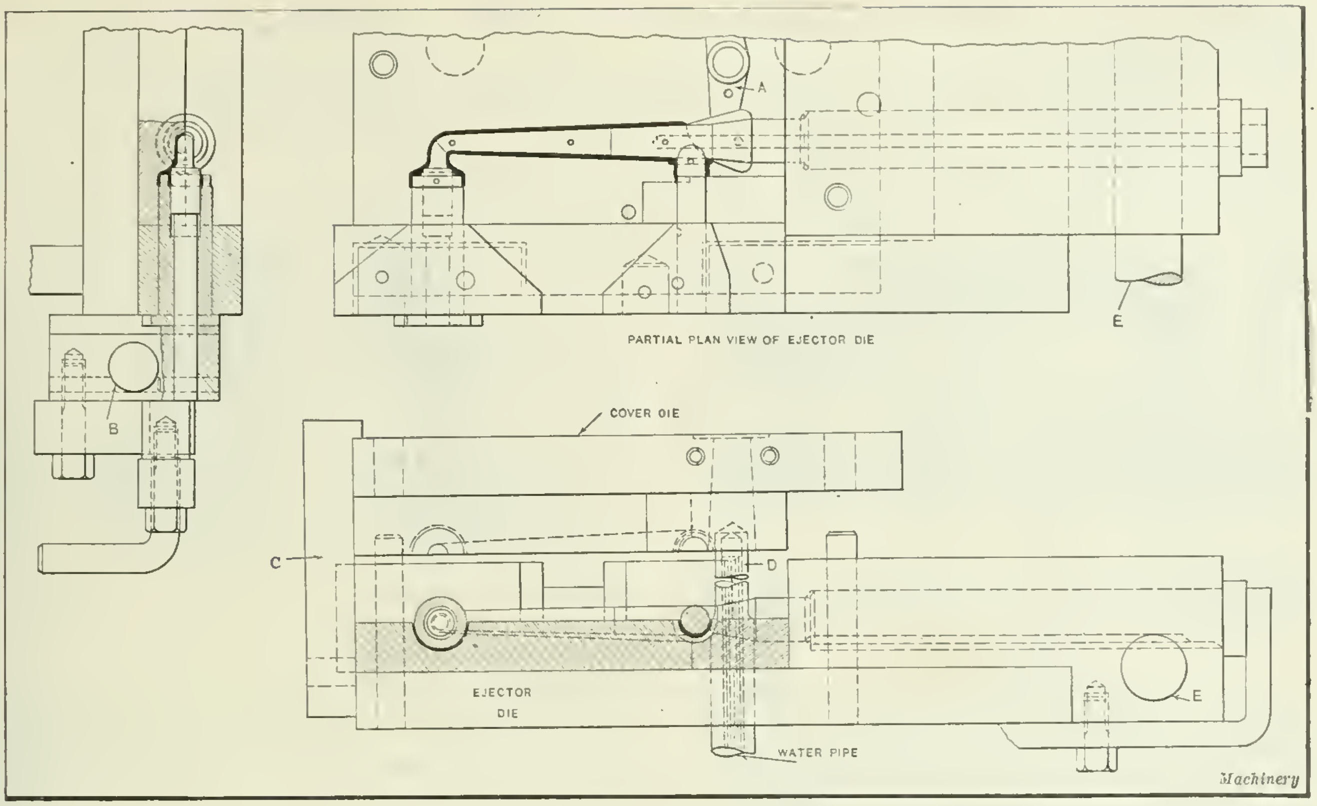


Fig. 3. First-operation Dies employed in casting a Graphophone Tone-arm. Only One of the Two Impressions in the Ejector Die is shown

the metal in the casting on the line where die-block *E* matches the die-block containing the casting cavity. The core is located by a projection on the small end. After the casting has been made, it is ejected from the die with the core in place. The core is then pushed through the casting and removed.

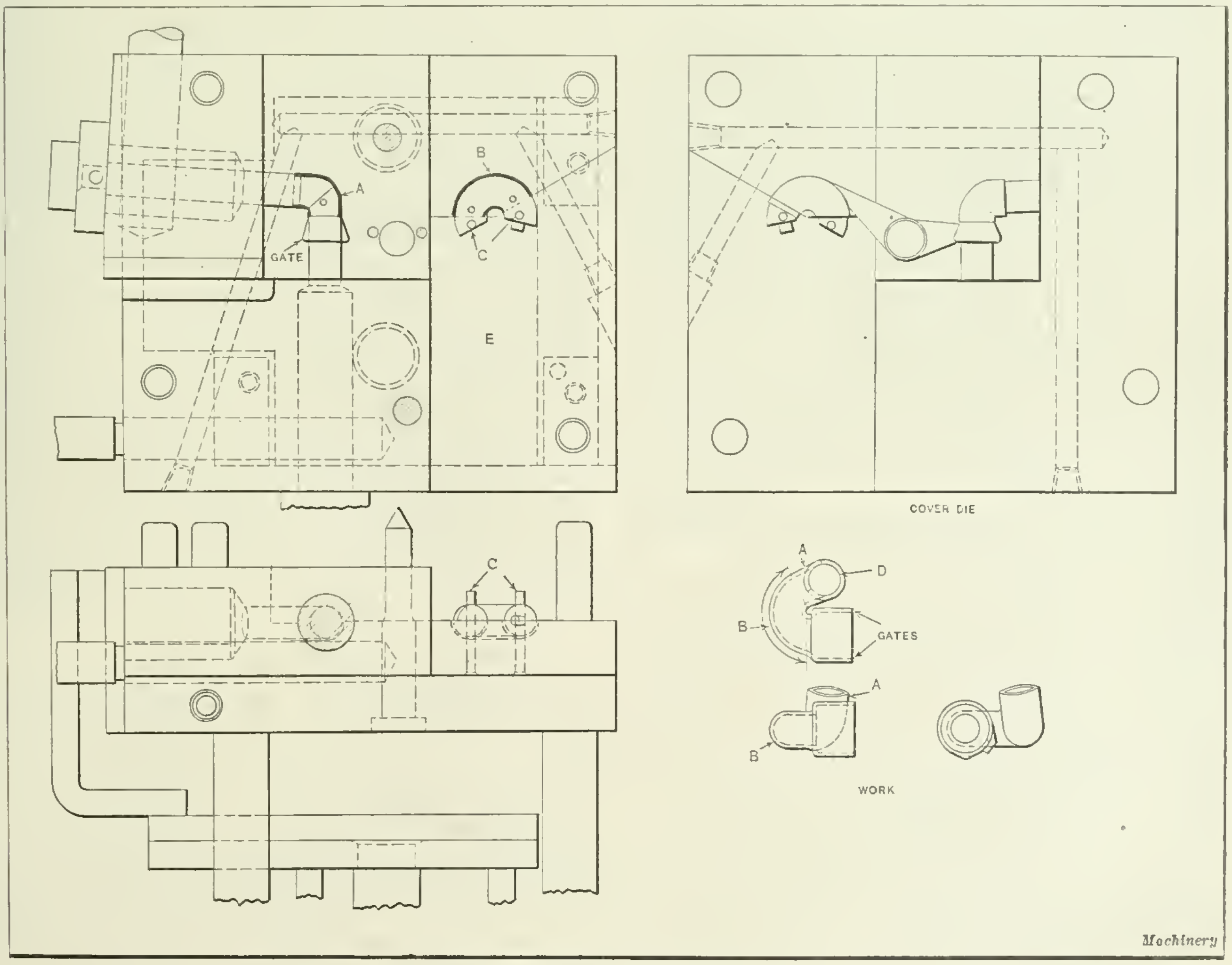


Fig. 4. Two-impression Dies for making Two Castings. This is the First Casting Operation for producing the Tone-arm shown in the Lower Right-hand Corner

The plan view of the cover die shows the method of gating both impressions from the sprue passage. It will be noticed that the gate for the small elbow leads to the end of the casting, whereas that for the other casting leads to the side. This is not objectionable here, because the fin left by the removal of the gate is cast over in the second operation. Dies for the second operation are not shown, but this is accomplished by the use of two plug cores, one to close up the hole *D* and the other to form the interior of the hole at the opposite end. The metal is fed through gates connecting at the large end of the tone-arm, this end being cast complete and metal being added, like a shell, to unite the two separate castings *A* and *B*.

This die is a good illustration of how sectional construction may be adopted to advantage to facilitate machining the die impressions. The ejector die in this case is constructed of separate sections fitted together, each of which offers no particular difficulty in machining. This principle is extensively used in die construction.

* * *

CLOSE RELATION BETWEEN ENGINEERING AND PATTERN DEPARTMENTS

By B. RUPERT HALL
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The connection between the engineering department and the pattern shop of a manufacturing plant is a close one. Both the designing engineer and the patternmaker are confronted with the same general condition, namely, the necessity of creating something from nothing. Every other manufacturing department in a commercial organization has some tangible object to work on. The pattern shop, alone of all the production divisions, shares with the engineering department the responsibility for displaying creative power.

It is for this very reason, perhaps, that most modern pattern shops are not operated more strictly on a production basis. In the average shop, each patternmaker is to a great extent allowed to exercise his own judgment in constructing a pattern. Comparatively little effort is made to supervise processes or to systematize methods. As a result, efficiency has suffered somewhat, although not so much perhaps as would have been the case in some other branch of craftsmanship. The result of this system apparently has been to raise the standard of workmanship of the individual artisan, and as a consequence the system has been fairly satisfactory, although wrong in theory. Nevertheless, there is plenty of room for improvement in the present-day pattern shop. A certain tendency is noted in the direction of constructive change, marked by a constantly increasing effort to separate the work of planning from the manual construction of patterns. Such a change in method will, of course, tend to result in specialization, with a corresponding decrease in all-around proficiency. However, the efficiency of production is sure to be very much increased.

The proper construction of patterns is a matter of vital importance to any manufacturing plant. An error in making a pattern that is to be used in large production will inevitably cause a serious monetary loss. It is fully as serious an error and just as costly to design a part for which the pattern and casting may be easily made, but which is difficult and expensive to machine. In cases of this kind, a few words of criticism from a competent advisor, offered while the design is taking form, would result in alterations that might effect a great saving. These are the conditions under which the engineering department and the pattern shop should establish closer contact. If the cooperation between the engineer and the patternmaker were close enough, most serious errors would be avoided, and a great deal of the trouble at present encountered in the machine shop and on the assembling floor would be eliminated.

How Cooperation can be Effected between the Drafting-room and Pattern Shop

It is evident that the proper place to determine the method of making a pattern is in the engineering drafting-room; in other words, the casting must be so designed as to facilitate molding to the greatest degree. However, the average designer cannot be expected to be a specialist in every branch of production methods, and when it comes to the refined detail of pattern construction, a specialist is needed. The logical way to take care of this requirement is to obtain a man, well informed as regards both pattern shop and foundry practice, and to place him in the drafting-room and have him check all pattern drawings before they are issued to the shop. He is thus in a position to change any expensive features in the original design of the casting. At the same time, he can plan the method of constructing the pattern and core-boxes, if any are required, so that this does not need to be done in the pattern shop later on. The real thinking required in the manufacture of the casting from the original blueprint is done in designing and making the pattern. Consequently, it is obvious that a capable, trained man from the pattern department should make the best man for the purpose outlined.

There can be little doubt that a definite method of cooperation between the engineering department and the pattern shop, as outlined in the foregoing, would vastly improve the results obtained at present. This can be effected by more systematic methods and by organizing the two departments so as to function as one in the matter of planning for the production of castings.

* * *

PROPOSED STANDARDIZATION WORK

The American Engineering Standards Committee has prepared a list of more than 1000 items in connection with which standardization work or simplification of practice could be undertaken. This list has been prepared at the request of Secretary Hoover, and is in the form of a summary of answers to a questionnaire sent out by the American Society of Mechanical Engineers. The suggestions for standardization work relate to the automotive industry, the building industry, the electrical industry, the machine shop equipment field, the power plant field, the railroads, paper and printing, and miscellaneous subjects.

In the machine shop field, some of the standardization subjects are as follows: Ball bearings; bronze bushings; driving chain; conveyor chain and sprockets; chucks; cotter-pins; flexible couplings; rigid couplings; direct-connected machinery; die notches and die tongues; flat taper files; file handles; gears and gear reductions; gear tooth forms; hammers; hangers; lathe centers; lathe and drill press spindle tapers; grinding wheels; micrometers; lubricating oils; cutting compounds; core oils; rivets; screws; screw threads (pipe and bolt); heads on bolts and screws; nuts (hot punched and cold punched); spindle noses; tapers; taper pins; universal joints; acetylene welding and cutting blow-pipe; wrenches; and wire and sheet-metal gages.

* * *

STEEL USED FOR GAGES

A very satisfactory steel to use for gages for interchangeable manufacturing work—both working and inspection gages—contains from 0.15 to 0.25 per cent of carbon, from 0.90 to 1.20 per cent of manganese and from 0.04 to 0.06 per cent of phosphorus and sulphur. It should contain no silicon, as silicon causes warping in hardening and hence is undesirable in a gage steel. Gage steels with compositions as follows, however, may be accepted as satisfactory: Carbon, from 0.10 to 0.35 per cent; manganese, from 0.50 to 1.20 per cent; phosphorus and sulphur, not more than 0.12 per cent; and no silicon. It is generally believed that it is best to have the carbon at a low limit of about 0.15 per cent.

Replacing Castings with Stampings

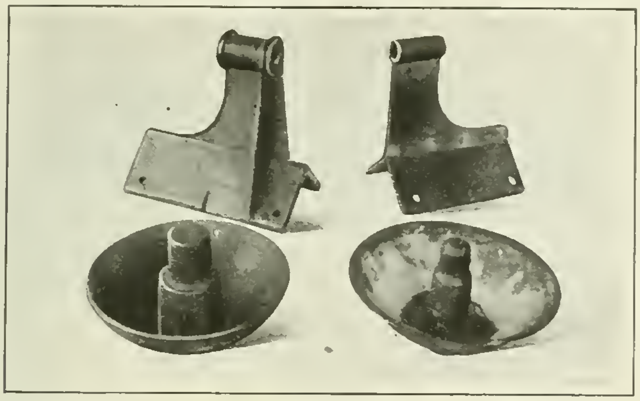


Fig. 1. Humidifier Castings and Pressed-steel Parts used to replace them

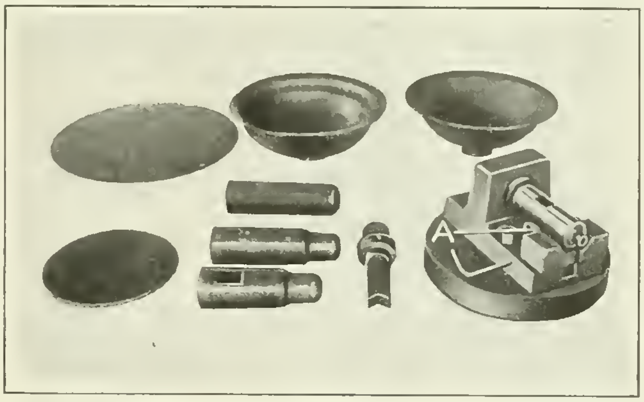


Fig. 2. Blanks, Shells and Piercing Die used in making Drip Bowls for Humidifiers

PRESSED metal is beginning to be used to a considerable extent to replace thin cast shells. Several interesting substitutions of this kind have been made by the Worcester Pressed Steel Co., Worcester, Mass., and the examples here presented may suggest similar uses of pressed metal to others. If this substitution can be successfully made, there are obvious advantages to be gained, not the least of which is increase in strength with reduction in weight. If it can be shown that greater productive costs are not entailed, a more general use of pressed steel will result.

Changes in Design Often Necessary

There are certain things, however, to which attention should be called before specific cases are cited. These may have a bearing on the ultimate decision regarding the use of pressed steel where cast metals were formerly employed. When pressed metal is used, it is often necessary to redesign the piece that has previously been cast, eliminating reinforcement ribs, cast-on bosses, etc., and to devise other constructional details in their place. When the work is cast, lugs and other irregular projections can be cast on, but in pressed-steel work, it is usually preferable, and often necessary, to attach such portions of the part either by welding or riveting. Invariably the thickness of stock used for pressed-steel work is much less than the sectional thickness of castings.

The best results can frequently be obtained by spot-welding two or more thicknesses of metal together, as was done in the manufacture of the parts shown in Fig. 1. By this means the cost of manufacture can often be greatly reduced. Some manufacturers, however, feel a certain amount of apprehension regarding the dependability of a welded joint; but if the welds are made in the correct way, results will be obtained which are comparable, at least, to a riveted joint. In fact, tests have been made in which two thicknesses of pressed steel that had been spot-welded were pried open with a cold chisel and sledge hammer, and it was found that the original metal had failed—not the welded spot. It tore away around the weld, leaving a homogeneous solid thickness of metal, like a circular boss.

Humidifier Bracket Made of Pressed Steel

Contrary to what may be the general conception, the use of pressed steel in place of castings need not always involve complicated dies; nor is it always necessary to completely redesign the part to be replaced. In fact, it has been observed that, in general, the press work, where substitutions have been made, is extremely simple—so simple that in the examples here selected for description, little attention is paid to the dies themselves.

Two cast-iron humidifier parts are shown at the left in Fig. 1, while at the right are shown the redesigned pressed-steel parts that replace the castings. In redesigning the humidifier bracket casting, the reinforcing web for the upper bearing was entirely dispensed with. Some other changes to simplify the design were also made, as the illustration clearly shows. The bracket is now made from 0.187 inch thick stock and blanked to the shape shown at *A*, Fig. 3. The blank is then formed at the center with a slight offset, as at *B*. This offset is the beginning of the eye or bearing hole. The third operation bends the ends at an angle as shown at *C*, after which the eye is partially formed by bending. All this work is of the simplest nature, and the dies employed are regular blanking and bending dies.

Closing the eye is done in two operations performed at the same time on one press. These are illustrated in Figs. 4 and 5. A ¾-inch arbor is driven into the partly closed eye, and the bracket held in a vertical position on edge at the front of the die, the slide of the press being used to partially bend the two ends together. The operator next changes the work, which then appears as shown on the bed of the press, Fig. 5, to a horizontal

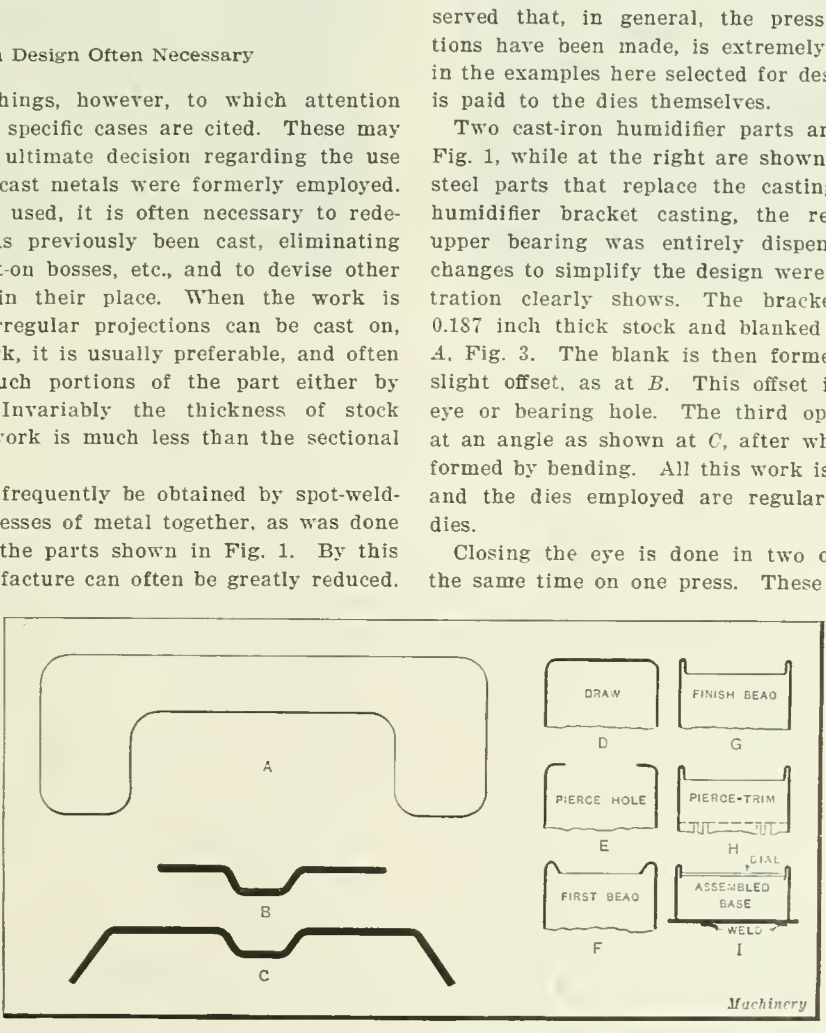


Fig. 3. Diagrammatic Views showing Operations in making Pressed-steel Bracket for Humidifier, and Movement Case for Fire-alarm Box

position, laying it in the die as shown in the illustration. This closes the sides of the bracket together, after which they are spot-welded.

Four welds are made along the lower part of the bracket and three adjacent to the eye. The bolt-holes are pierced after the welding has been completed. The original casting weighed 10 pounds 9 ounces, and the stamping 4 pounds 10 ounces. Thus a gain of approximately 6 pounds in weight has been made, and this has been done without weakening the bracket in any way.

Making Another Pressed-steel Humidifier Part

The drip-bowl casting for a humidifier is shown in the lower left-hand corner of Fig. 1, and its appearance when replaced by pressed steel in the lower right-hand corner. In redesigning this casting, it was found more practicable to make it in two pieces—a bowl and a socket—and to weld these together. The bowl is drawn up from a blank 9⅝ inches in diameter of 0.063-inch stock. Seven operations are employed as follows: (1) Blank; (2) draw in a double-action press; (3) form neck; (4) pierce hole in neck; (5) restrike hole to form shoulder on neck; (6) trim edges; and (7) pierce several small holes. The blank, and the shells after forming the neck and trimming, are shown in the upper part of Fig. 2. As in the case of the bracket, no unusual equipment is required for making the bowl in this way.

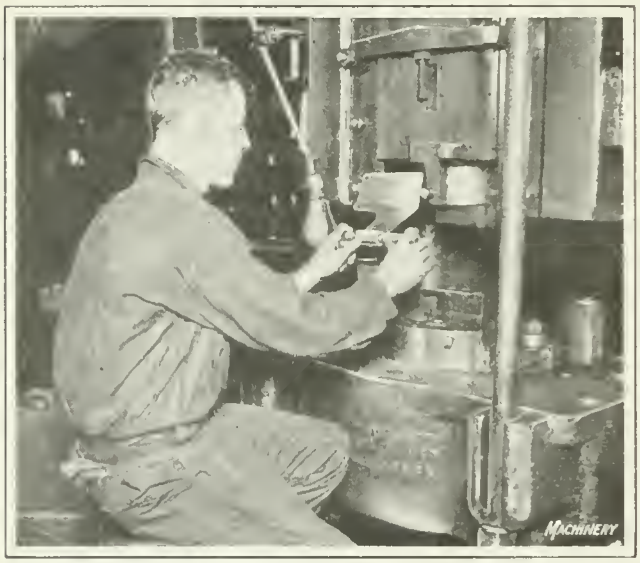


Fig. 4. First Step in closing the Eye of the Humidifier Bracket

The socket member is made from a blank 5 5/16 inches in diameter, of 0.187-inch stock. After blanking, five drawing operations are required to produce the plain cylindrical shell shown in Fig. 2. The first of these operations is performed in a double-action press, and the remainder in single-action presses. This shell is 1 9/16 inches outside diameter and 5⅛ inches long. In the course of drawing the shell, two annealing operations are necessary. The seventh operation consists of necking, and this is followed by piercing two rectangular holes in the sides.

The shell and the punch and die used in piercing the holes are also shown in Fig. 2. The die carries an arbor over which the shell is passed, and there is a loose piece under the outer end of the arbor to support the shell during the piercing operation. The rectangular punch is shown at the left of the die, from which it will be seen that it is V-shaped at the end to furnish the proper shear along the sides of the hole and to give the least cutting resistance. After a hole has been produced in one side of the shell, the work is located 180 degrees from the first position by a latch-block *A* which enters the previously punched hole, the latch-block being raised from beneath by the small lever shown on the die. The casting weighs 4 pounds 10 ounces, and the pressed-steel drip bowl 1 pound 14 ounces.

Pressed-steel Fire-alarm Box

The inside case for the Gamewell fire-alarm box and the movement case confined in it, are shown at the right in Fig. 6. This is the pressed-steel substitute for the cast-iron unit which has been used heretofore. The case or box is drawn up from a blank (shown at the left) the shape and size of which were determined empirically. The rough dimensions of this blank are 16 by 18½ inches, and steel 0.057 inch thick is used. After being blanked, the work is drawn in a double-action press, the shell produced being shown on the blank. This shell is roughly 10¼ inches wide, 12½ inches long, and 3 inches deep, inside dimensions.

The box is then redrawn and annealed, after which it is restruck or sized to form the square corners and several slightly raised bosses. The next operations are trimming the edge and curling, which completes the manufacture with the exception of the minor operations of piercing holes, welding on the door jamb, and assembling steel inserts in the pierced holes for attaching the movement case, etc. It might be mentioned that these holes are slabbed on one side to accommodate the slabbed inserts and prevent them from turning. These inserts are threaded bushings, and are assembled by spinning from the outside of the box.

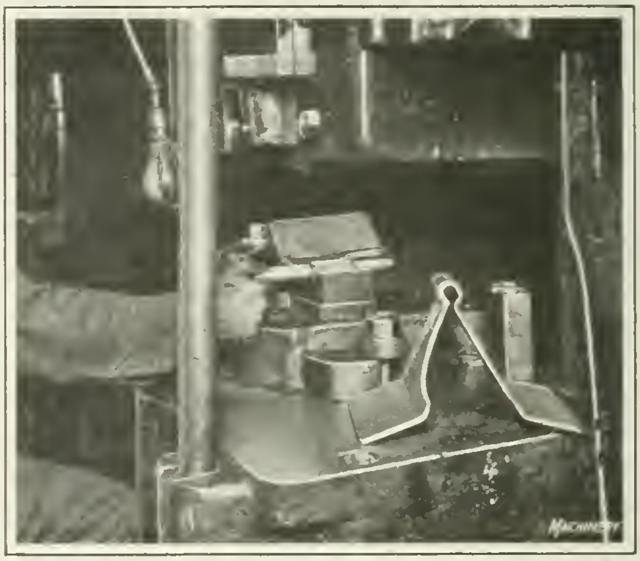


Fig. 5. Closing the Eye, using the Same Set-up as shown in Fig. 4

The movement case is cylindrical, and is made from a drawn shell with a base of thicker stock welded on. The blank for the case is 11⅝ inches in diameter, and the stock is 0.035 inch thick. The blank is first drawn in a double-action press to a shell 7 3/16 inches in diameter and 3 5/16 inches deep. This shell is shown diagrammatically at *D*, Fig. 3. It will be seen from Fig. 6 that a boss is formed on the outside of the shell by flattening the sides, and this operation is next in sequence. The bottom of the shell is then pierced out to form the rim, as shown at *E*, Fig. 3, after which the metal surrounding the hole is formed into a bead, as shown at *F* and *G*. This bead receives the retaining spring for the glass dial on the movement case.

The shell is then held horizontally in the press while three sets of notches, equally spaced, are pierced at the edge, as illustrated at *H*. In the following operation, the shell is trimmed along the dotted line, producing three lugs which, when bent in at right angles, are used to weld through, in assembling the base. The numerous holes are next pierced, and then the base, which is a flat blank with projecting ears for attaching it to the inside of the box, is assembled. This base is 6¾ inches in diameter and 0.125 inch thick. It is, of course, properly shaped to fit the flattened sides of the case, and in this way serves also to locate the lugs so that the pierced holes will come in the right position when the movement case is fastened in the box.

The cast-iron fire-alarm box weighed 15 pounds 6 ounces, but when replaced with pressed steel as described, there was a gain of nearly 6 pounds in weight, the pressed-steel box and case weighing 9 pounds 9 ounces. These examples are typical, and illustrate common methods of replacing castings not involving prohibitive die cost.

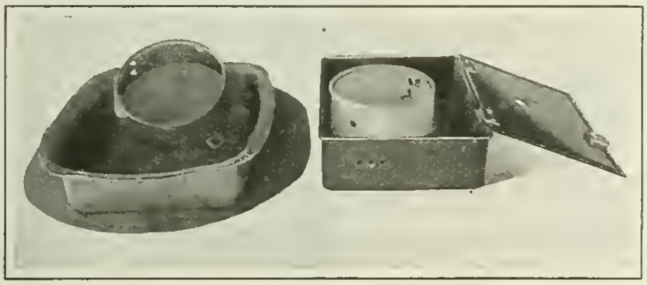


Fig. 6. Pressed-steel Fire-alarm Box with Blank and Shells in Different Stages of Completion

* * *

BREAKDOWN TESTS FOR TOOL STEELS

An important method of comparing tool steels is known as the lathe breakdown test. In this test the tool is used for cutting into a steel of definite composition, and works at a known speed and rate of cutting until it is worn out. A report on such tests has been issued by the Bureau of Standards. Important conclusions drawn may be summarized as follows:

1. Breakdown tests are not satisfactory as a basis for the purchase of high-speed tool steels.
2. Competitive comparisons of brands having nearly similar performance is not justified, owing to the qualitative nature of this type of test; but relatively large differences may be determined with certainty, provided sufficient tools are tested and averages of at least two grinds are used in interpreting the results.
3. Certain severe breakdown tests were made with roughing tools on 3 per cent nickel steel forgings, and high frictional temperatures were produced. It was found that the performance of commercial low-tungsten high-vanadium and cobalt steels was superior to that of the high-tungsten low-vanadium type of special steels containing about ¼ per cent uranium and ¾ per cent of molybdenum. The average power consumption in these tests was practically the same, so this factor need not be introduced in comparisons which may be made on the basis of endurance of the tools.
4. Modification of the test conditions, including small changes in tool angles but principally changes in cutting speed, had a more marked effect on the performance of steels containing cobalt or special elements such as uranium or molybdenum than it did on that of the basic types such as plain chromium, tungsten, and vanadium steels.
5. The high-tungsten steels showed relatively poor endurance under severe working conditions, but did much better in more moderate tests. The latter were made on the same test log and with equal cutting speed and depth of cut, but with reduced feed. The frictional temperatures were not so high. Also, in these latter tests the performance of the cobalt steels was better than that of either low- or high-tungsten steels.
6. Hardness determinations and examinations of fractures indicate that the various types of commercial high-speed steel show differences in behavior under heat-treatment and in physical properties which are of importance under moderate working conditions and might counterbalance slight advantages in performance.

STOCK-CLAMPING ARRANGEMENT FOR PUNCHING DIE

By R. H. KASPER

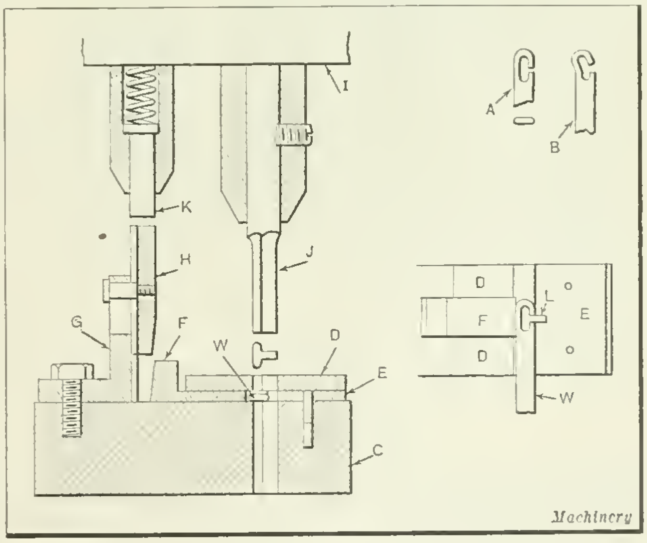
The work shown at *A* in the accompanying illustration was bent or deformed, as shown at *B* when the slot was punched. As this was objectionable, it was decided to provide means for clamping the work on the sides as the punch passed through. This necessitated an arrangement that would hold the work securely and still release it automatically to permit its removal.

The illustration shows a sectional view of the die which was designed for the work and which proved satisfactory. The die member *C* is constructed in the conventional manner. The stripper plate *D* is provided with guide plates *E* and *F*. Plate *E* is held stationary by a pin which enters the die. This plate is grooved, as shown at *L* to permit the tongue of the punch to pass through. The groove is made to correspond accurately with the outline of the die, so as to form practically a continuation of the die, although it does no cutting.

Plate *F* slides in a groove in stripper plate *D*, and is provided with a heel at its back end. The back face of this heel is ground to an angle of 5 degrees with its base. In back of plate *F* is screwed an angle-piece *G*, which carries a sliding plate *H*. Plate *H* is ground at its lower end to an angle of 5 degrees, so as to coincide with the heel of plate *F*. The punch-holder *I* carries the punch *J* and the plunger *K*, which is free to slide in its shank and is backed up by a spring. The work *W* is shown in position between the guide plates.

Operation of Clamping Arrangement

In operation, as the ram of the press descends, plunger *K* comes in contact with sliding plate *H*, and forces it downward. Plate *H* comes in contact with the heel of plate *F*, and, owing to the angularity of the two surfaces in contact, plate *F* is moved to the right, pressing the work against plate *E*. At this point punch *J* has not yet entered the stock. When the punch enters the work, the stock is prevented from being distorted by plate *F*, which is wedged against the work by plate *H*. The angular faces on plates *F* and *H* permit the latter plate to serve as a wedge in back of plate *F*, so that motion cannot be imparted by plate *F* to plate *H*. The result is that plate *F* becomes immovable when it touches the stock, holding it so securely that it will not be bent. As the ram ascends, plates *F* and *H* are returned automatically to their original positions by springs (not shown in the illustration).



Punching Die provided with Clamping Arrangement designed to prevent Work from being deformed

Design of Inclinable Power Presses

Proportioning the Frame, Flywheel, and Other Parts—Second of a Series of Articles

By P. A. FRIEDELL

In designing any type of machine, there is always a proper place at which to start. In the case of a power press, this place is the crankshaft; then follow the reciprocating parts, the frame, and the driving mechanism. The crankshaft may be considered as the foundation on which the press is built, and a press, uniform in strength and pleasing in outline, can only be produced by this method. Many errors in the design of presses can be attributed to the fact that the frame is designed first, and the other parts, including the crankshaft, are made to suit the frame; this results in a machine with weak points and unsatisfactory lines.

Calculations covering the crankshaft, main bearing and connection caps, connection, connection screw, ball cap, and slide for an inclinable press of specified capacity were presented in the first article of this series which appeared in January MACHINERY. The present article covers the design of other important members of the same press. Some of the dimensions calculated in the first article will be used in this article; these values are given in the following, together with the figure numbers of the first article in which they were shown:

D, Fig. 1 (crankpin diameter) = 5 9/16 inches;
d, Fig. 1 (crankshaft diameter) = 4⅜ inches;
t, Fig. 1 (throw of crank) = 1 inch;
J, Fig. 5 (length of gibway on slide) = 23⅛ inches;
R, Fig. 5 (width of gibway on slide) = 1⅞ inches;
G, Fig. 2 (length of main bearings) = 7 11/16 inches;
L, Fig. 5 (length from end of thread to center of ball on connection screw) = 6¼ inches;
K, Fig. 5 (distance from center of connection ball to bottom face of slide) = 11 9/16 inches;
G, Fig. 3 (length of connection) = 13 3/16 inches minimum;
F, Fig. 2 (height of boss on main bearing) = 9/16 inch;
W, Fig. 5 (width of slide) = 12 inches;
G, Fig. 5 (dimension on slide) = ¼ inch;
S, Fig. 2 (diameter of main bearing cap studs) = ⅞ inch;
M, Fig. 5 (dimension on slide) = 1⅝ inches.

Designing the Gibs

Gibs for an inclinable power press should preferably be made of the straight pattern shown in Fig. 6. Several other good designs are shown in MACHINERY'S ENCYCLOPEDIA, Volume III, pages 413 to 418, inclusive. However, the design illustrated in Fig. 6 has been almost universally adopted for the inclinable press. Referring to this illustration,

$L_1 = 2D + 1.5t + 10 = (2 \times 5.56) + (1.5 \times 1) + 10 = 22.62$ or 22⅝ inches

$S_1 = 0.15d + 0.25 = (0.15 \times 4.375) + 0.25 = 0.91$ say ⅞ in.

$T_1 = R + 0.125 = 1.875 + 0.125 = 2$ inches

$C_1 = T_1 + 0.5S_1 = 2 + (0.5 \times 0.875) = 2$ 7/16 inches

$W_1 = C_1 + S_1 + 0.125 = 2.437 + 0.875 + 0.125 = 3$ 7/16 inches

$E_1 = 1.5$ to $2S_1$

$P_1 = 7$ to $9S_1$, about $8S_1$ desirable.

As $8S_1 = 8 \times$ ⅞ $= 7$ inches, it will be necessary to take a slightly lower value, say 6½ inches for P_1. For three spaces this will total 19½ inches and leave 3⅛ inches for the two ends, making $E_1 = 1$ 9/16 inches. This value falls between the limits of 1.5 to $2S_1$, and is therefore satisfactory. The holes S_1 in the left-hand gib should be made ⅛ inch oblong sideways to enable side play of the slide or ram to be eliminated by adjustment.

Determining the Frame or Housing Dimensions

The frame will next be considered, first laying out the parts of which the proportions are known, and then building the gib and main-bearing section of the frame around these parts. The faces of the main bearings should be made to suit the main bearing caps dealt with in the first article, and the slide section shown in Fig. 7 should be made to suit the slide and gib. It is customary, in the case of inclinable presses, not to allow the bottom face of the slide to enter the gibs at the top of the stroke. This permits the use of dies and punches that are larger than the bottom face. Under such circumstances the slide face may come within ⅛ or ¼ inch of the gibs. This practice, of course, is not to be recommended, especially in blanking or similar work where it can be avoided; the more thoroughly the slide is supported at the point of maximum load, the less chance there is of shearing the dies or producing ragged edges on the blank.

After laying in the main bearings, the distance H_1, Fig. 8, from the horizontal center line of the crankshaft to the bottom of the gibways may be calculated. It is necessary to find the minimum distance from the center of the connection bearing calculated in the first article to the bottom of the slide. This equals $G + L + K$ (in which G is the dimension given in Fig. 3 of the first article and L and K are given in Fig. 5) = 13 3/16 + 6¼ + 11 9/16 = 31 inches. Adding the throw of the crank (1 inch) gives 32 inches for length H_1, Fig. 8. Therefore

$$G_1 = H_1 - L_1 = 32 - 22\tfrac{5}{8} = 9\tfrac{3}{8} \text{ inches}$$

If the press is designed so that it will take dies wider than the slide face, dimension H_1 should be less than the value given, an amount equal to the throw of the crankshaft plus ⅛ inch. Then,

$H_1 = 13\ 3/16 + 6\tfrac{1}{4} + 11\ 9/16 - (1 + \tfrac{1}{8}) = 29\tfrac{7}{8}$ inches

and

$$G_1 = 29\tfrac{7}{8} - 22\tfrac{5}{8} = 7\tfrac{1}{4} \text{ inches}$$

Dimension G_1 should never be less than $1.2d + 1$ when the bottom slide face is to enter the gibs; in the present case this equals $(1.2 \times 4.375) + 1$ or 6¼ inches. When the slide face may enter the gibs, G_1 should not be less than $1.2d + 2t = (1.2 \times 4.375) + (2 \times 1)$ or $7\frac{1}{4}$ inches.

Designing Various Frame Sections

Referring to the cross-section of the gibways shown in Fig. 7, which is taken along line X–X, Fig. 8, U_1 should be made equal to T_1, Fig. 6, or 2 inches, and, of course, S_1 is the same as in Fig. 6, or $\frac{7}{8}$ inch. $S_2 = S_1 - \frac{1}{8} = \frac{7}{8} - \frac{1}{8} = \frac{3}{4}$ inch. The set-screws should be placed midway between the gib studs, as shown in Fig. 8, and are used for adjusting the gibs so as to obtain proper alignment of the slide, a matter which is very important for efficient operation of the dies.

$$B_1 = 0.5\ T_1 + 0.25 = (0.5 \times 2) + 0.25 = 1\tfrac{1}{4} \text{ inches}$$

Dimension A_1 must equal one-half the distance across the slide and gibs $= \dfrac{W + 2G + 2W_1}{2}$ in which G is the dimension given in Fig. 5 of the first article. Therefore,

$$A_1 = \frac{12 + (2 \times 0.25) + (2 \times 3.4375)}{2} = 9\ 11/16 \text{ inches}$$

and

$$C_1 = A_1 + 1/16 = 9\ 11/16 + 1/16 = 9\tfrac{3}{4} \text{ inches}$$

The main bearing is subjected to shear above the crankshaft, and therefore sufficient metal must be allowed to withstand the shearing stresses. A load of 25 tons, or 50,000 pounds, is transmitted to each bearing, and so with an allowable shearing stress of 2000 pounds per square inch, which leaves a satisfactory factor of safety for cast iron, a minimum shearing area of 50,000 ÷ 2000 or 25 square inches will be required. The main section of the bearings should be 6 9/16 inches long to suit dimension G minus $2F$ (Fig. 2); therefore, the minimum thickness Q_1 (Fig. 8) should equal $25 \div 6.56 = 3\frac{7}{8}$ inches.

The next section of the frame to be considered is the head, taken along the horizontal line Z–Z through the main bearings, as shown in Fig. 9. The method used by the writer is to assume the dimensions of a section and calculate it; if the stresses indicated are not desirable, the section dimensions are changed and the stresses recalculated. The tensile stress should be from 2000 to 2500 pounds per square inch, and the compressive stress preferably from 4000 to 5000 pounds per square inch. Stresses below these values are not desirable from the standpoint of metal economy, while higher stresses do not insure safety and rigidity.

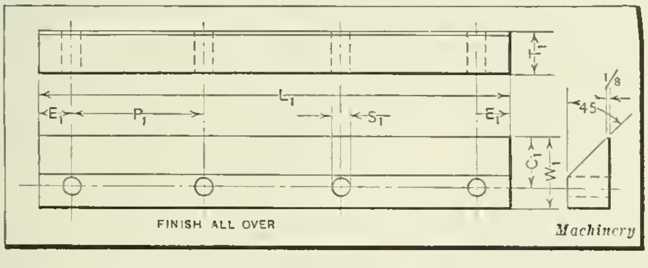


Fig. 6. Design of Gibs extensively used on Inclinable Power Presses

Referring to Fig. 9, section Z–Z, dimension F_1 should match the boss on the main bearing cap, which was made 1 5/16 inches wide.

$M_1 = 0.25d + 0.25 = (0.25 \times 4.375) + 0.25 = 1.34$ or $1\frac{3}{8}$ inches

$Y_1 = G\,(\text{Fig. } 2) - 2F = 7\ 11/16 - (2 \times 0.56) =$ about $6\frac{5}{8}$ inches

O_1 may, for trial purposes, be taken as equal to $d = 4\frac{3}{8}$ inches

$$K_1 = 0.5Y_1 = 0.5 \times 6.625 = 3.312 \text{ or } 3\ 5/16 \text{ inches}$$

$$J_1 = 0.5K_1 = 0.5 \times 3.31 = 1.656 \text{ or } 1\tfrac{5}{8} \text{ inches}$$

R_1 should be made large, say about $0.5d$, so as to avoid complications in casting, or the web section of thickness M_1 may be tapered, making it thicker at the front. Length X_1 may be assumed for trial purposes to be approximately equal to $3d = 3 \times 4.375 = 13\frac{1}{8}$, say $13\frac{1}{4}$ inches.

Before finding the strength of section Z–Z with the assumed figures as a basis, it is necessary to find the center of gravity of the section. The radii may be neglected in the computations, as the variation they may cause would not affect the results appreciably. The center of gravity cannot be determined until the area of each element of the section is multiplied by the distance the center of gravity of the element is located from face f of the section. Thus, the area and area moment of each element are found as follows:

	Area	Area Moment
(a)	$1.312 \times 7.688 = 10.08$	$0.656 \times 10.08 = 6.61$
(b)	$3.063 \times 6.625 = 20.29$	$2.843 \times 20.29 = 57.68$
(c)	$7.25 \times 1.375 = 9.97$	$8.000 \times 9.97 = 79.76$
(e)	$1.625 \times 3.313 = 5.38$	$12.44 \times 5.38 = 66.93$
	Total area = 45.72	Total area moment = 210.98

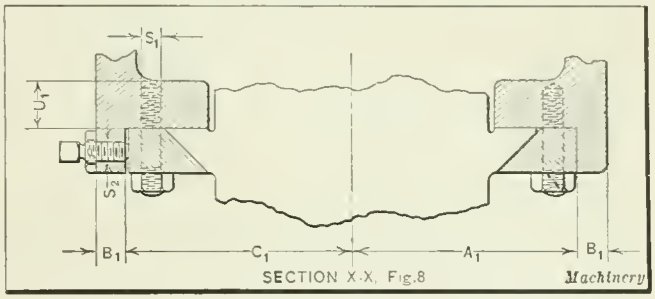


Fig. 7. Section through the Gibways of the Power Press Frame shown in Fig. 8

The distance to the center of gravity of the entire section from face f may now be determined by dividing the total area moment of the elements by the total area of the section. Thus, $210.98 \div 45.72 = 4.62$ inches = the distance to the center of gravity of the entire section from face f. The centers of gravity of the various elements are located from the center of gravity of the entire section as follows:

(a) $4.62 - 0.66 = 3.96$ inches

(b) $4.62 - 2.84 = 1.78$ inches

(c) $8.00 - 4.62 = 3.38$ inches

(e) $12.44 - 4.62 = 7.82$ inches

The moment of inertia I of the entire section may now be calculated by using the general formula

$$I_1 = I_g + (a_1 \times d_1^2)$$

for each element and adding the results. In this formula,

I_1 = moment of inertia of any element in question about an axis through the center of gravity of the entire section;

I_g = moment of inertia of the element about its own center of gravity;

a_1 = area of the element; and

d_1 = distance from the center of gravity of the element to the center of gravity of the entire section.

The moment of inertia of a rectangle with respect to an axis through its center of gravity may be determined by means of the formula

$$I_g = \frac{b_1\ h_1^3}{12}$$

in which

b_1 = width of rectangle in inches; and

h_1 = height of rectangle in inches.

Thus, I_1 for each of the elements in Fig. 9 is as follows:

$$(a)\ I_1 = \frac{7.68 \times 1.31^3}{12} + (10.08 \times 3.96^2) = 159.50$$

$$(b)\ I_1 = \frac{6.63 \times 3.06^3}{12} + (20.29 \times 1.78^2) = 80.11$$

$$(c)\ I_1 = \frac{1.38 \times 7.25^3}{12} + (9.97 \times 3.38^2) = 157.73$$

$$(e)\ I_1 = \frac{3.31 \times 1.63^3}{12} + (5.38 \times 7.82^2) = 330.19$$

Moment of inertia I of the entire section = 727.53

Tensile and Compressive Fiber Stresses

The action of the load on the crankshaft produces a tensile stress on section Z–Z to the left of the center of gravity, and a compressive stress to the right, both of which are due to flexure. In addition, there is a tensile stress distributed uniformly over the section. Before determining these stresses, it is necessary to calculate the tensile and compressive section moduli which are equal to the moment of inertia I divided by the distance from the center of gravity to faces f and m, respectively. Thus the tensile section modulus = 727.53 ÷ 4.62 = 157.44, and the compressive section modulus = 727.53 ÷ 8.63 = 84.3.

The tensile fiber stress due to flexure equals the bending moment of the section divided by the corresponding section modulus, and the bending moment is determined by multiplying the load on each crankshaft bearing by the distance from the center of the crankshaft to the center of gravity. Thus, 50,000 × (2.187 + 4.62) = 340,350 inch-pounds = bending moment. Dividing 340,350 by 157.44 gives 2160 pounds per square inch as the tensile fiber stress due to flexure. The tensile stress uniformly distributed over the section is found by dividing the load on each crankshaft bearing by the area of section Z–Z. Thus 50,000 ÷ 45.72 = 1090 pounds per square inch. The maximum tensile fiber stress then equals 2160 + 1090 or 3250 pounds per square inch. This value is greater than the high limit specified in the foregoing, and so the section Z–Z should be more amply proportioned and recalculated. The flexure compressive stress is found by dividing the bending moment by the compressive section modulus. Thus, 340,350 ÷ 84.3 = 4040 pounds per square inch. This stress would be reduced considerably by subtracting the tensile stress uniformly distributed over the section.

The distance X_1, Fig. 9, may be increased somewhat when the remainder of the head is designed so as to obtain neat and sturdy lines. A tie should be placed between the housings at the rear, as shown in Fig. 8, where it will not interfere with the movement of the slide connection.

Dimensions of the Bolster Plate and Gap

The "shut height" of a press is considered as the distance from the bottom of the slide to the top of the bed, when the slide is at the bottom of the stroke and the connection screw is screwed into the connection as far as it will go. In other words, it is the distance from the bed to the bottom of the slide, stroke down and adjustment up. The "die height" is the distance from the bottom of the slide to the top of the bolster, stroke down and adjustment up.

The thickness of the bolster plate may be made equal to $0.5d + 0.5$ inch to the nearest quarter inch. In this case the thickness would equal (0.5 × 4.375) + 0.5 = 2.6875 or 2¾ inches. The bolster plate should match the top of the bed, and in the smaller sizes of presses up to about 5 tons in capacity, it may be held by two bolts. Above this capacity, four or more bolts should be used, depending upon the size of the bolster plate. The bolts should preferably be made the same size as the studs in the connection cap. These were made 1 inch in the preceding article. When parts are to be pushed through the die, it is, of course, necessary to provide a hole through the bolster plate for this purpose.

It has been found that the distance from the center of the crankshaft to the bottom of the slide, stroke down and adjustment up, is 32 inches. Let it be assumed that a die height of 8 inches is desired, that the slide face is allowed to enter the gibs, and that the bolster plate is 2¾ inches thick. Then dimension N_1 to the top of the bed will equal 32 + 8 + 2¾ = 42¾ inches. H_1 was made 32 inches; therefore the gap height should be 42¾ — 32 or 10¾ inches. If the slide face were not permitted to enter the gibways, the gap height would equal 42¾ — 29⅞ = 12⅞ inches. The depth of the gap should be made a little greater than one-half the width of the deepest die to be used in the press. For purposes of calculation, a depth of 10¼ inches will be here assumed for dimension F_2.

Calculating Housing Section Y-Y

A section of one housing, taken on line Y–Y, Fig. 8, is also shown in Fig. 9. The method of calculating this section is similar to that given for the sectio Z–Z. By laying out the preliminary design of the gap, it will be found that a value of about 22 inches for X_2 gives a uniform and neat design. This dimension will therefore be used as a trial value. Y_2 may be made a little less than G, Fig. 2, say, 7½ inches; $M_2 = M_1 =$ 1⅜ inches; $O_2 = 0.7Y_2 = 0.7 \times 7\frac{1}{2} =$ 5¼ inches; $K_2 = 0.5Y_2 = 0.5 \times 7\frac{1}{2} = 3\frac{3}{4}$ inches; and $J_2 = 0.5K_2 = 0.5 \times 3\frac{3}{4} = 1\frac{7}{8}$ ins.

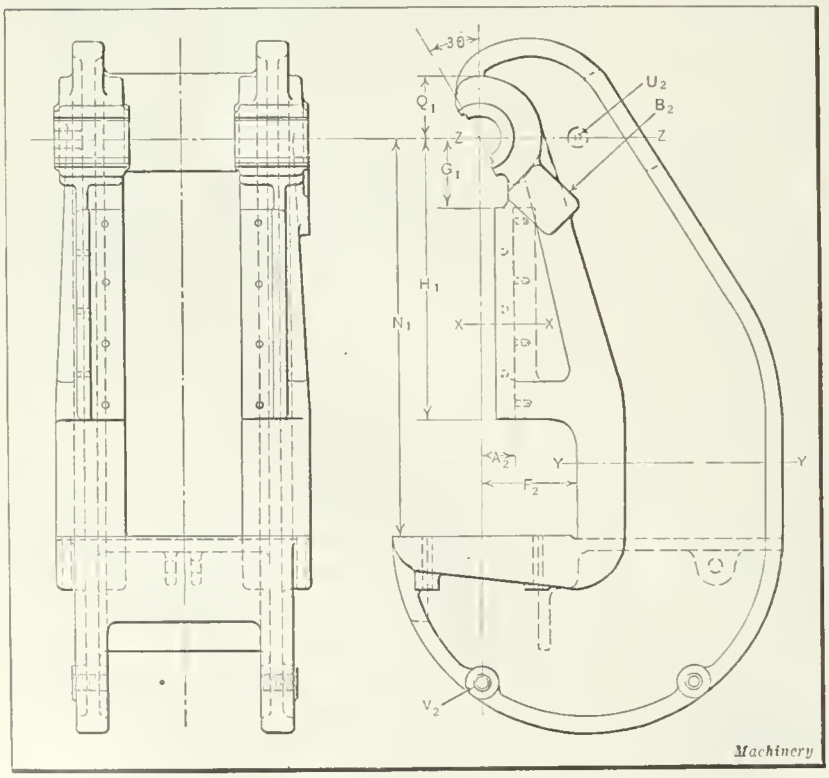


Fig. 8. Detail View of the Frame

The center of gravity of this section is determined by dividing the section into elements h, i, and j, and making the following computations:

Area

(h) 5.25 × 7.5 = 39.38
(i) 14.88 × 1.38 = 20.53
(j) 1.88 × 3.75 = 7.05

Total area = 66.96

Area Moment

(h) 2.63 × 39.38 = 103.57
(i) 12.68 × 20.53 = 260.32
(j) 21.06 × 7.05 = 148.47

Total area moment = 512.36

The distance from face k to the center of gravity then equals 512.36 ÷ 66.96 = 7.65 inches. The distances from the center of gravity of the various elements to the center of gravity of the entire section are determined as follows:

(h) 7.65 — 2.63 = 5.02 inches
(i) 12.69 — 7.65 = 5.04 inches
(j) 21.06 — 7.65 = 13.41 inches

The moments of inertia I_1 of the elements may now be calculated as follows:

$$(h)\ I_1 = \frac{7.5 \times 5.25^3}{12} + (39.38 \times 5.02^2) = 1082.82$$

$$(i)\ I_1 = \frac{1.38 \times 14.88^3}{12} + (20.53 \times 5.04^2) = 900.38$$

$$(j)\ I_1 = \frac{3.75 \times 1.88^3}{12} + (7.05 \times 13.41^2) = 1269.86$$

Moment of inertia I of entire section = 3253.06

Then the section modulus with respect to face k equals $3253.06 \div 7.65 = 425$, while the section modulus with respect to surface l equals $3253.06 \div 14.35 = 226$. The bending moment equals $50{,}000 \times (7.65 + 10.25) = 895{,}000$ inch-pounds. The tensile fiber stress due to flexure equals $895{,}000 \div 425 = 2100$ pounds per square inch. To this should be added the tensile stress uniformly distributed over the section. This stress equals $50{,}000 \div 66.96 = 750$ pounds per square inch. Thus, $2100 + 750 = 2850$ pounds per square inch, the maximum tensile fiber stress on the section. This stress is a little high, and so the section should be increased somewhat in area. The compressive fiber stress due to flexure equals $895{,}000 \div 226 = 3960$ pounds per square inch.

Details of the Frame

The bed member is subjected to bending stresses along an imaginary vertical line drawn downward as a continuation of the face of the gap. It may be calculated as a cantilever beam, loaded at the slide center line. Calculations will show that the distance to the rounded bottom of the housings from the intersection of the top of the bed with the gap face need only be 16 inches if the contour of section Y–Y is maintained. A plate or shelf is cast between the two housings with the top about 1/4 inch below the bed level. This shelf acts as a tie for the frame, as well as a support for the lug which takes one end of the inclining mechanism. It may also serve as a chute to remove parts which are lifted out of the die or knocked out of the punch when the press is inclined.

The diameter of the tapped holes V_2, Fig. 8, which receive studs for clamping the legs to the frame, may be made equal to twice the diameter of the studs used in the main bearing caps, or, in the present case, 2 × 7/8 = 1 3/4 inches. A boss and stud should be provided at U_2 on the left-hand housing to take the free end of the brake strap. The stud may be the same diameter as the main bearing cap studs, or 7/8-inch. $A_2 = R + M + 1/8 = 1\ 7/8 + 1\ 5/8 + 1/8 = 3\ 5/8$ inches, R and M being given at the beginning of this article. Pad B_2 should be cast on the frame for attaching the clutch bracket, the size and location of the pad depending on the style of clutch used. The height from the top of the bed to the floor may be made to suit different conditions, the customary height being from 30 to 34 inches.

Flywheel

On a direct-acting press the flywheel should have sufficient energy to carry the ram through the stroke and complete the operation without the speed being reduced over 20 per cent, because if it is reduced more than this, the belt may slip off the wheel. Irrespective of the design of other parts, the press will not have the desired capacity unless the flywheel has the necessary energy to carry the die through the operation without the belt slipping off. Direct-acting presses may be run at various speeds depending upon the distance from the center of the crankshaft to the point where the clutch pin or jaw engages, and upon the quickness with which the clutch can be operated. A press equipped with a rocker-arm or rolling-key clutch can be operated at a higher speed than one equipped with other types of clutches. A block or jaw clutch is especially slow in action.

A flywheel can be designed to have such energy that should there be an overload at a particular point in the stroke, the flywheel will stop. However, suppose the flywheel were intended to stop one inch from the bottom of the stroke in case of an overload, and the overload occurred when the ram was within 1/16 inch of the bottom of the stroke; then the flywheel would not stop and the machine members would be unduly stressed.

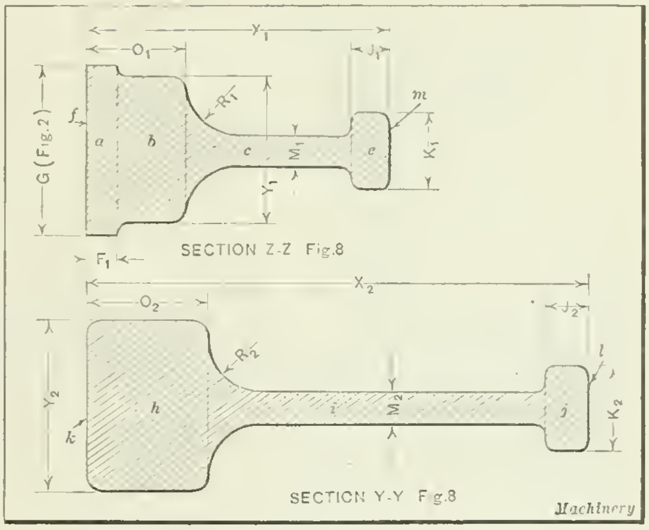


Fig. 9. Sectional Views of the Housings at the Head and Gap, respectively

Direct-acting presses are generally used only for such operations as blanking or shallow drawing, and the flywheel need only have sufficient energy to carry the tonnage through a maximum of about 1/4 inch of stroke. Therefore, for the direct-acting press here considered, the flywheel energy E_2 required to perform an operation through 1/4 inch of the stroke would be:

$$E_2 = 100{,}000 \times 1/4 = 25{,}000 \text{ inch-pounds} = 2080 \text{ foot-pounds}$$

Considering a speed of 120 revolutions per minute for the flywheel and a mean rim diameter of 50 inches, the weight of rim required may now be calculated. The velocity V_1 at a point on the mean circumference is determined as follows:

$$V_1 = \frac{50 \times 3.1416 \times 120}{12 \times 60} = 26.18 \text{ feet per second}$$

Counting on a reduction of 20 per cent in the flywheel speed during the working portion of the stroke, the reduced velocity V_2 is determined as follows:

$$V_2 = 26.18 \times 0.80 = 20.94 \text{ feet per second}$$

The weight W of the flywheel rim may now be determined by the following formula, which is given in MACHINERY'S HANDBOOK on page 288:

$$W = \frac{E_1 \times 64.32}{v_1^2 - v_2^2}$$

in which

E_1 = energy in foot-pounds which a flywheel will give out while the speed is reduced from v_1 to v_2;

W = weight of flywheel rim, in pounds;

v_1 = velocity at mean radius of flywheel rim before any energy has been given out, in feet per second;

v_2 = velocity of flywheel rim at end of period during which the energy has been given out, in feet per second.

Then

$$W = \frac{20.80 \times 64.32}{26.18^2 - 20.94^2} = 542 \text{ pounds}$$

If it is desired to have the flywheel carry the tonnage through 1/2 inch of the stroke, the weight of rim should be 2 × 542 or 1084 pounds.

Before it is possible to calculate the minimum width of face, it is necessary to determine the horsepower required to do the work. Considering that the work is done through 1/4 inch of the stroke, the horsepower can be determined by the following formula:

$$\text{H. P.} = \frac{2000 \times T \times d \times N}{396{,}000}$$

in which

T = tonnage capacity of press;

d = distance through which work is done; and

N = revolutions per minute of flywheel.

Then,

$$\text{H. P.} = \frac{2000 \times 50 \times 0.25 \times 120}{396{,}000} = 7.58 \text{ or } 7\tfrac{1}{2} \text{ horsepower}$$

The foregoing is based on the assumption that the press will be worked to capacity. If the press were to operate at the same capacity 120 times per minute through ½ inch of the stroke, obviously double the horsepower would be used in doing the work.

If a double belt is used on the press, the width required can be determined by the formula

$$W = \frac{1925 \text{ H. P.}}{DN}$$

in which

W = width of belt in inches;

D = diameter of flywheel in inches;

N = revolutions per minute of flywheel; and

H. P. = horsepower consumed in doing the work.

Then,

$$W = \frac{1925 \times 7.5}{50 \times 120} = 2.4 \text{ or } 2\tfrac{1}{2} \text{ inches}$$

The flywheel face should not be less than 3 inches in width for a belt of this size, though it may be greater. Obviously, if it were desired at any time to use increased power, it would be necessary to have a greater width of face and a wider belt. Therefore, the rim may be designed with a wider face and narrower rim to provide for both conditions. A table in MACHINERY'S HANDBOOK, page 291, gives the dimensions of flywheel rims for punches and shears. According to this table, a flywheel 54 inches outside diameter should have a face width of 4¾ inches and a rim depth of 5½ inches. This width of face would allow the use of a wider belt, should it be desirable to increase the power.

Assuming a width of 4¾ inches for the face, the outside and inside diameters of the flywheel may then be estimated by referring to the tables of circumferences and areas in MACHINERY'S HANDBOOK, and applying the weight of cast iron per cubic inch, which is 0.26 pound. The weight of the rim inside of the assumed mean circumference should equal the weight outside of this circumference or $\frac{1}{2} \times 542 = 271$ pounds. The volume of the rim should equal $542 \div 0.26 = 2084$ cubic inches. The area between the outside and inside circumferences equals the volume divided by the width of face or $2084 \div 4.75 = 439$ square inches. The area of a 50-inch diameter circle (the mean diameter) is 1963.5 square inches; then the area corresponding to the inside diameter should equal $1963.5 - 439 \div 2 = 1744$ square inches. This corresponds to a diameter of approximately 47⅛ inches. The area corresponding to the outside diameter should equal $1963.5 + 439 \div 2 = 2183$ square inches, which corresponds to a diameter of approximately 52¾ inches. This would give a weight of 544 pounds with a rim cross-section of 4¾ by 2 13/16 inches.

* * *

AUTOMOBILES IN GREAT BRITAIN

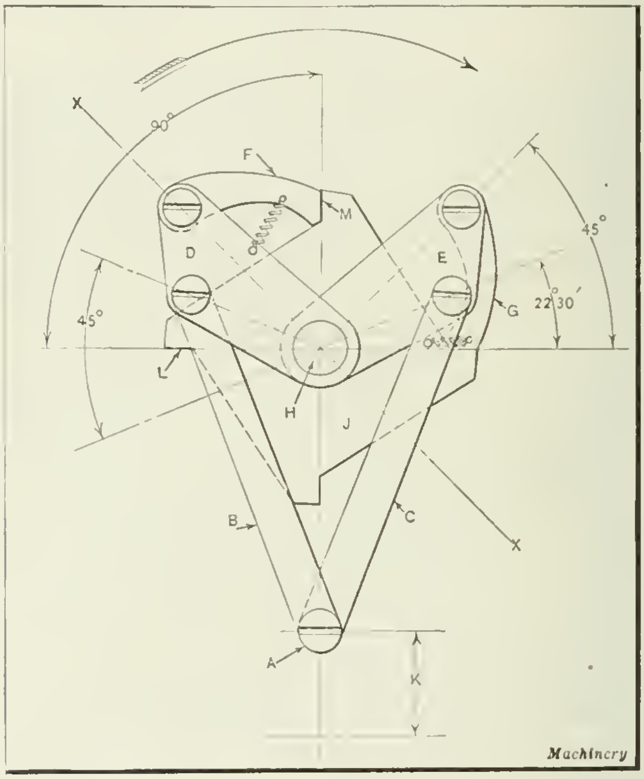
The total number of motor vehicles licensed in Great Britain on November 30, 1922, was approximately 919,000. Of these 294,000 were passenger automobiles used by private owners, 72,000 taxicabs, 159,000 motor trucks, and 352,000 motorcycles, which in Great Britain are included under the general heading of motor vehicles. The license fees and taxes brought in about $50,000,000 to the government. The average tax for passenger automobiles used by private owners is about $80 a year, and for commercial trucks about $100 a year.

INDEXING MECHANISM

By E. E. LAKSO

A 90-degree indexing mechanism which has no idle return throw and which can be operated by a short stroke of the indexing member or lever is shown in the accompanying illustration. The screw or stud A is connected to the part of the machine that produces the indexing motion. The links B and C are connected to the arms D and E which carry the pawls F and G. Arms D and E are free to revolve on the indexing shaft H to which the index-wheel J is fastened.

To impart an indexing movement of 90 degress to wheel J, pawls F and G are given a movement of 45 degrees in one direction and then returned to their normal position. A downward movement of stud A of the right distance, as indicated by dimension K, will draw levers D and E down so that they are rotated through an angle of 45 degrees. This downward movement brings pawl F backward, so that its point will coincide with the center line X–X, and pawl G will move forward until its point also coincides with center line X–X. Thus pawl G indexes wheel J through an angle of 45 degrees so that pawl F will catch on the tooth face L of the index-wheel. The return movement of stud A causes pawl F to move forward and to index wheel J the remaining 45 degrees, while the pawl G moves backward to its former position into contact with the face M of the succeeding tooth ready for the next indexing movement.



Mechanism for producing a 90-Degree Indexing Movement

* * *

The Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce has published a report in which it is pointed out that India now imports approximately $100,000,000 worth of machinery of all kinds annually, of which about 15 per cent comes from the United States. The industrial development of India is indicated by the fact that in the fiscal year 1913-1914, the imports of machinery were valued at about $30,000,000, whereas in 1920-1921 they were more than three times that amount. New enterprises are constantly being started; new capital issues for Indian concerns amounted to about $16,000,000 in the last six months of 1920, as compared with $110,000,000 in the last six months of 1922.

The Manufacture of Buffing Wheels

By BRADFORD H. DIVINE, President Divine Brothers Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

OWING to the chaotic way the metal-finishing business has grown up since the advent of nickel plating, little or no standard terminology has been adopted. Many branches of the industry making different articles have their own local names for the tools and processes used, and confusion results from this lack of uniform terminology. This is particularly true as to the terminology in use in the United States compared with that in use in England. What is known in America as a polishing wheel is known in England as a polishing bob; and what is known in America as a buffing wheel is known in England as a mop or dolly. The operations involved in the metal-finishing industry are likewise confused in name, but inasmuch as this article pertains to the manufacture of buffing wheels, the question of nomenclature that does not refer to buffing wheels will be left to another article.

In the United States, certain polishing operations that produce the highest luster on bare steel, such as pocket-knife blades, are incorrectly called buffing operations, and the wheels employed for the operation are similarly called buffing wheels. As a matter of fact, the process is polishing with polishing wheels.

Buffing wheels, according to the nomenclature adopted as standard by the Metal Finishers' Equipment Association, are wheels manufactured from disks, either whole or in pieces, of bleached or unbleached cotton or woolen cloth, and are used as the agent for carrying abrasive powders such as tripoli, crocus, rouge, lime, etc., which are mixed with waxes or greases, as a bond. These buffing compositions are applied to the face of the wheel as the metal-reducing or luster-producing intermediary between the buffing wheel and the article being buffed.

Materials Used in Buffing Wheels

During the lifetime of the industry, buffing wheels have been manufactured from a great many varieties of cotton fabric, running all the way from very light flimsy muslins intended for ladies' underwear and other such purposes, up to heavy compact army duck—probably the strongest form of cotton goods that could be used in buffing wheels. Between these two limits, the variety of constructions of cotton goods used in buffing wheels has been almost unlimited. During the early days of the industry and up to the time when the business of manufacturing buffing wheels reached such tremendous proportions that standards were introduced, the predominating idea of most buffing wheel manufacturers was to produce, and likewise that of the users was to purchase, something cheap, and they believed that any kind of cotton cloth would make buffing wheels, regardless of the work it had to do, as long as it could be cut into circles and assembled into sections.

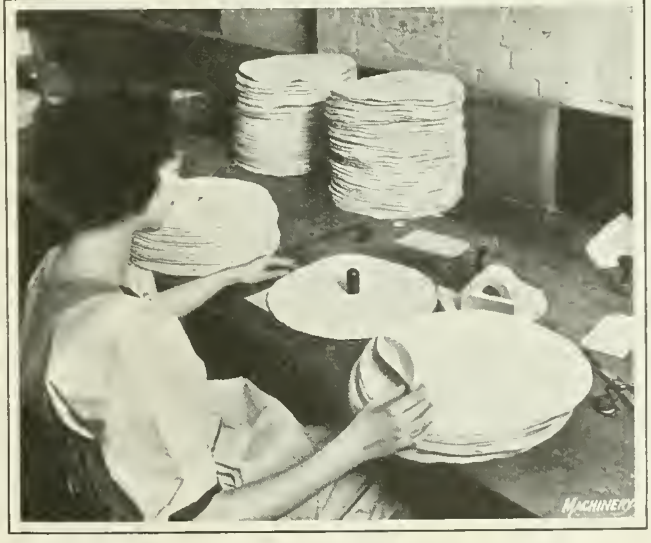


Fig. 1. Turning and assembling Disks into Sections

It was quite the custom, in the early days, to make buffing wheels from remnants and small pieces of indiscriminate texture of cloth too short for sale as cotton piece goods. This idea worked out as a boomerang both to the manufacturer and user. To the buffing wheel manufacturer, it created an idea that quality, standards, and uniformity of production were unnecessary. To the user, it created the idea, roughly speaking, "that buffs were buffs anyhow," and the man who could offer buffs at the cheapest price was the man to purchase from. However, this industry, like all others, had to go through a period of infancy and development until experience demonstrated the necessity for adopting some kind of standard. Furthermore, the time arrived when the buffing wheel manufacturer could not depend solely upon a supply of remnants to meet the constantly growing demand for his product.

In the cotton cloth industry, the lengthwise threads are called the warp, while the cross threads are called the filling or "weft," and the specifications of cotton goods are based on the number of threads per inch in the warp and filling in connection with the width of the goods and the weight per running yard. For instance, 68-64, 3.50 buff is understood to mean a buffing wheel made from a piece of cloth having 68 threads per inch one way, 64 threads per inch the other way, weighing 3.50 yards per pound, when 36 inches wide. Out of this confusion many years ago, there finally arose an understanding, by a sort of mutual consent, that cotton sheeting and shirtings of good weight and body, averaging about 68 by 64 threads per square inch, were more suitable for use in the manufacture of buffing wheels than other kinds of cloth.

Need for Standardization of Wheels

The lack of standardization of buffs produces the varying costs shown in buffing rooms where non-standard goods are used. The Standards Committee of the Metal Finishers' Equipment Association has recently taken up the question of standardizing materials to be used in the manufacture of buffing wheels, and has given it serious consideration in an endeavor to eliminate the confusion in the industry. In connection with this work, the same committee is considering the question of what may and can be produced to the best advantage, as standard diameters. At present, diameters run from 3 to 18 inches in variations of 1 inch. The diameters of buffs in common use were never determined with reference to the widths of cloths commercially available, and consequently there is a great waste of material which someone has to pay for. It is hoped that the committee referred to may be able to work out a set of standards for buffs that will do away with the needless waste, and in this way benefit both the maker and the user.

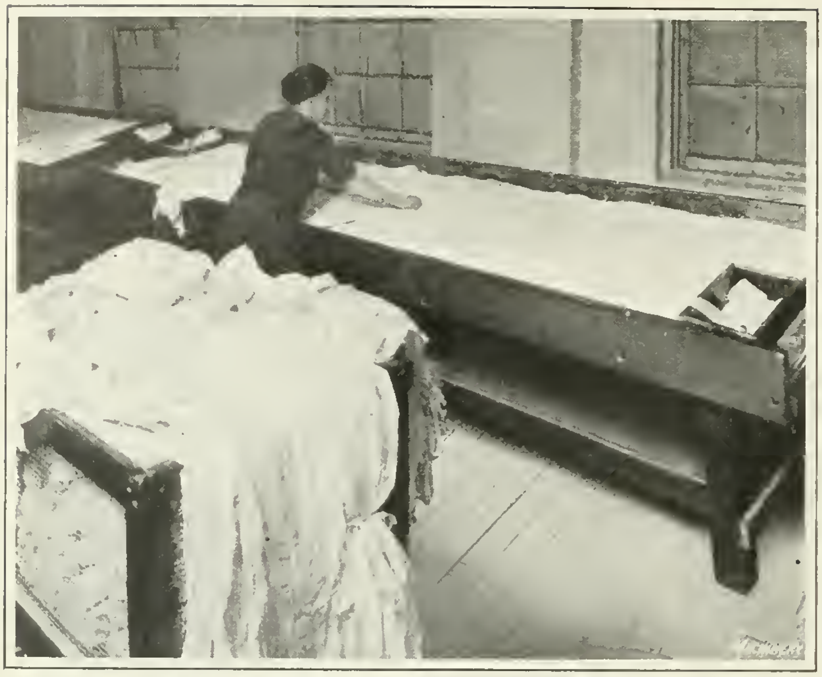


Fig. 2. "Booking" the Strips for Pieced-sewed Buffs

The additional development of buffing processes requiring harder wheels of a material that would stand up and keep its face to the work, without the edges turning over, brought into use finer count cloth, with the yarns tighter together, woven as high as 92 by 96 threads per square inch.

Inasmuch as this industry was founded on the manufacture of a mechanical tool, using such classes of raw material as it could conveniently find in the market, it soon found itself subject to the vagaries of the manufacturer of cotton cloth; that is to say, a buffing wheel manufacturer would begin to use cloth of a certain style from a certain mill, and in the course of time the mill would cease to manufacture that cloth. Then the manufacturer had to get as nearly the same thing as possible from another mill. This is a condition that has never really been eliminated up to the present time, and consequently there is little or no standard for the raw material used.

The manufacture of buffs finally settled itself down to the use of cotton cloths of the following constructions, not necessarily because they were mechanically advantageous, but because they were for sale in the open market and could be secured. They finally came into common use and thus became, in a sense, standard. They are as follows:

Width, Inches	Yards per Pound	Threads per Square Inch
36	2.85	48 by 48
36	3.75	68 by 64
36	3.50	68 by 64
40	3.20	72 by 68
40	3.40	84 by 80
40	3.20	92 by 84
40	3.05	96 by 88

Canton Flannel—No Specifications

In addition to those mentioned, cloths of many counts and weights have been used in buffs—mostly job lots—and occasionally some permanent make of cloth of a different character has been adopted by some manufacturer, but such goods usually enjoyed a short life in this industry. The styles of cloth enumerated in the table are those that are conceded, by the majority of the buff manufacturers and by the buff users, as the nearest to a standard that may prevail today. These goods are standard as to classification of construction only, but there are a great many other things that enter into the manufacture of cotton cloth causing varients. For instance, of two mills making cloth of the same identical specifications of count, width, and weight, the cloth produced by one mill may be much more valuable in a buffing wheel than that produced by the other.

An essential economic requirement in the manufacture of buffs is that practically the entire area of cloth purchased must be cut and manufactured into disks and sold as buffing wheels. The exact size of the buffs and the quantities of each into which the cloth is to be cut, not being known when the cloth is purchased, the ultimate cutting often produces a loss instead of a profit. Therefore, buffing wheel manufacturers realize that economical sizes must be adopted, and they must confine themselves to such grades of cloth as can be used for the different buffing processes, and permit them to sell as buffs practically all the material they purchase in the form of cloth. The desire of many buff manufacturers to put something "special" on the market in the line of a non-standard or a cheap buff cloth, in order to cut prices or for some other reason, has invariably, for the reason stated, resulted in their bankruptcy.

As conditions exist today in the manufacture of cotton goods, the buff industry is still up against the hazard of being unable to purchase an absolutely uniform standard run of cloth from any one mill. Strikes, changes in policy of mills, change in mill ownership, changes in the character of cotton produced in various years, and other contingencies cause this condition, and the buff manufacturer has no remedy. All these things lead to contentions between the buff manufacturer and the consumer, and usually result in claims that certain lots of buffs are not up to standard. The buff purchaser and user will be in a better position if he will sit down with the buff manufacturer, and learn something about the conditions and the difficulties encountered in the manufacture of buffs.

Importance of Aging the Buffs

A condition exists in the manufacture of cotton cloth over which no one but Father Time has any control, but it has considerable influence upon the value of any particular shipment of buffs to the user. That condition is the effect of the drying out and aging of the cloth. When cotton yarn is woven into sheetings, the weave shop atmosphere must be very humid; otherwise the yarns will twist and snarl, and weaving will be impossible. The cloth, therefore, coming direct from the loom, is moist and damp, and it takes a long time for this moisture to dry out and the cloth to harden properly. Buffing wheels will show much longer wear, all other conditions being equal, if the sheetings or buffs can be kept in stock by the manufacturer or user, in a cool dry place, several months before being used. This period will allow the cloth to harden and the cutting power of the buff will be increased.

In the last analysis, the user of the buffs is safer if he buys his buffs far enough in advance to permit thorough drying and aging in his own storehouse. The manufacturer endeavors to dry and age the cloth thoroughly before cutting it into buffs, but should a shipment be made to the consumer during rainy weather the cloth may absorb enough moisture to soften it and return it to its original "green" condition. Then if the consumer is low on his buff stock and has to use the new shipment before giving it a chance to dry and age again, the buffs will show a decided depreciation in efficiency. The reason for this is very often not understood by the consumer, with the result that the blame is wrongly placed on the buff.

Converting the Cloth into Buffs

The common method of converting cloth into buffs is to cut and assemble eighteen or twenty disks together, then put a row of sewing around the center hole, forming what is known basically in the industry as a "section." Twenty-ply is the standard for a section, although a great many sections are made eighteen-ply. This eighteen-ply standard came into being some years ago through unscrupulous competition. Twenty-ply was the original standard, but several concerns, thinking to gain an advantage, sold goods at less than the twenty-ply price, using eighteen layers, and finally it became a secondary standard, but it should not be allowed to continue to exist.

Buffing wheels are made up from the unit of sections assembled together in any desired number, or to form any required width of face. There are three distinct types of buffing wheels: First, loose buffs, made up of full disks of cotton or wool cloth, sewed together into sections only around the center hole, for convenience in handling; second, full-disk sewed buffs, which are spirally or concentrically sewed over the entire surface between the center hole and the periphery; third, pieced-sewed buffs made of pieces too small to be cut into full disks. These pieces are assembled together, as will be described later, and held in position by spiral or concentric sewing, the same as the full-disk sewed buffs.

Loose or Open Buffs

A loose or open buff, as the name implies, is one that is loose or open at the cutting or buffing surface. Consequently it has to be made of full disks of cloth, which are sewed together in standard sections of eighteen- or twenty-ply, with only a single sewing around the arbor hole at the center. They are made in the different grades of cloth referred to previously.

In the actual conversion of the cotton cloth into loose or full-disk buffing wheels, the following processes are used. The cloth is received either in bales or in rolls. Some manufacturers using the rolls place eighteen to twenty rolls in a rack and pull the cloth from all the rolls at one time on a laying-out table, where the edges are squared up. From this table the cloth passes through the cutting presses, where the disks are cut out.

Other manufacturers take the folded piece goods from the bale and lay them out on a "booking" or laying-out table, by means of a laying-out machine, which travels back and forth lengthwise on the table and lays the cloth, layer upon layer, until ninety or one hundred layers have been put into what is called a "book." The function of this machine is to square up the edges of the cloth of one layer with the corresponding edges of the preceding layers, so that the die-cutting can be carried to the edges of the book, making all the disks full circles. These books, when completed, have the edges clamped into position, so they may not be disturbed by moving the book, and are passed through the cutting press, where the disks are cut out, as shown in Fig. 3. The dies used for cutting the disks are usually compound; that is, they cut the center hole and the outside edge at the same time. The dies for the center hole are made interchangeable, and any sized center hole can be produced in combination with any outside diameter.

From the cutting press the disks are moved to a sorting and disk turning table. Here damaged disks are sorted out, and the perfect ones are assembled into buffing sections, which are eighteen or twenty layers thick, as may be desired. (See Fig. 1.) In assembling, the disks are placed on a center pin of suitable size, and each disk or pair of disks is turned in relation to the preceding disk or pair so that the threads in each lie in a different relative position from those in the neighboring disks. This insures uniform wear on the face of the buff. As soon as the proper number of layers are assembled, the buff section is moved to a sewing machine, which sews usually one row of sewing around the center hole. The buff is now finished, except for the trimming of any irregularities on the outside edge, and upon being branded is ready for shipment.

Full-disk Sewed Buffs

A full-disk sewed buff is one that is made of full disks of cotton or woolen cloth in standard sections of eighteen- or twenty-ply, sewed spirally or concentrically between the center hole and circumference of the buff. This sewing gives the buff section greater stiffness and resistance to bending, when in contact with the work. The stiffness or body of the buff depends largely upon the distance between the rows of sewing, the length of the stitch and the tension of the stitches. In standard sewing, the rows are 1/4 or 3/8 inch apart. The length of the stitch varies with different manufacturers from 3/16 to 1/2 inch, but the common form of stitch is about 3/16 to 1/4 inch long.

The sewing is accomplished with special sewing machines, developed for this purpose (see Fig. 4). Usually two needle machines are used, and the sewing is done automatically. The movement of the sewing machine foot turns the buff around, operates a worm screw, rack and pinion, or other device, which moves the buff under the needles of the machine so that the sewing is guided automatically spirally or concentrically over the entire surface of the buff.

Practically all pieced-sewed buffs manufactured by large makers are sewed in the same type of machine and with what is known as a lock stitch, that is, a stitch that will not ravel or pull out. The chain stitch was formerly used in sewing buffs, but it has the objection of unraveling very easily. The sewing of buff wheels is an interesting operation. Let the reader take a wire nail and try to drive it through a buff wheel section; and then imagine two slender sewing machine needles being driven down through 1/4 to 3/8 inch thickness of cloth at a speed of about one thousand stitches a minute—and some idea of the difficulty of this operation may be obtained.

A pieced-sewed buff is one in which all the plies or layers, except the outside layers, are in the form of pieces

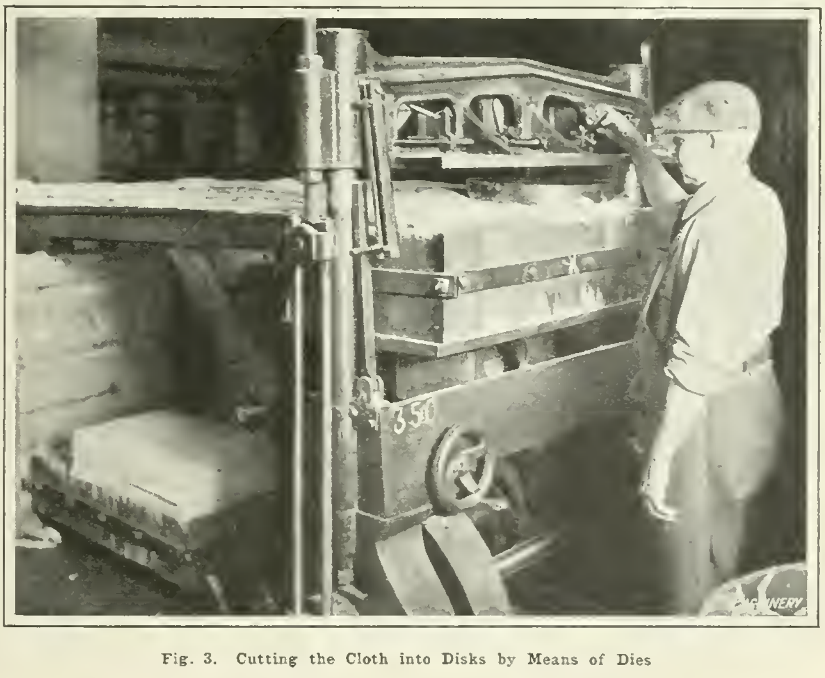


Fig. 3. Cutting the Cloth into Disks by Means of Dies

too small to cut into full disks, and the whole assembly is sewed together with concentric or spiral rows of sewing. The standard materials used in these buffs are bleached and unbleached cotton cloths, while special forms are made of so-called "fancy" or printed goods, khaki, and a variety of textures.

Weight is the common basis for the unit standard per section in buffs of this type, rather than ply, for the reason that the form and size of the pieces of cloth vary greatly, and it is commercially impossible to manufacture the sections with the same number of ply in each. They are sold on the basis of bulk weight, as the sections are likely to vary somewhat in weight.

Strip and Wedge Styles of Pieced-sewed Buffs

Pieced buffs are of two types of construction, known as the strip and the wedge styles. The wedge type was the original construction, but later the strip style was introduced. This style was patented, and has to a large extent superseded other forms. In the strip construction two methods of assembling are employed: For a buff to be 14 inches in diameter when finished, the strip may be cut, by one method, to a length of 29 inches. A laying-out board, with raised edges, is provided, and in this is placed one piece of cloth 29 inches square for one of the covers or outside layers. On this cover will be laid a layer of strips, arranged edge to edge, and with the edges as evenly matched as is possible. Then another layer of strips crosswise and so on until the proper thickness for a buff section is built up. The top cover is then laid in place. This 29-inch square will be cut into four buff sections, each 14½ inches in diameter, with a very small hole in the center. The sections are sewed spirally or concentrically, after which the outside diameter and the center hole are cut in a cutting press with a compound die, finishing the manufacturing operations.

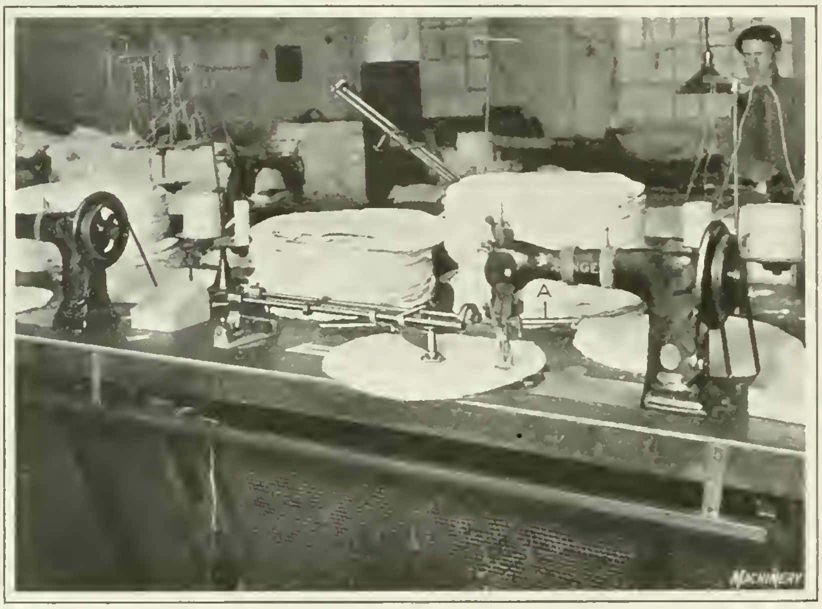


Fig. 4. Automatic Sewing Machine for sewing Buffs

The other form of strip construction is known as the "booking" form. This consists of assembling the strips on a table arranged with raised sides and ends, forming a box, of a suitable length and width to produce a certain definite number of sections. (See Fig. 2.) In this process, a full sheet of cloth is laid on the table, a layer of strips lengthwise, with the edges matched, on top of it, next a layer of strips crosswise and so on until the proper thickness is built up. The top sheet, or the cover, is then put in place and the edges of the entire mass fastened together to hold the strips in place during the moving of the "book" to the cutting press. From this point on, the process is exactly the same as for the buff made in the 29-inch square form.

In the segment or wedge buff, the pieces of material are cut out by means of a die into wedge-shaped segments, with two, four, six, or eight segments to a circle. A form is provided, usually a wooden block or a pan with raised edges. A full disk is deposited in the form for one cover of the buff, then a layer of the wedges is laid on this cover, carefully matched, and succeeding layers are built up until the requisite thickness is obtained. In the arrangement of the layers, the joints are "broken," as one would say in bricklaying, to avoid several joints coming in the same place. After the top cover is in position, the buff is ready for cutting and then for the sewing machine, subsequent operations being the same as for the 29-inch square. During the process described, great care must be taken by the operator to arrange the goods so that the buff will be as well balanced as possible. In some makes of the strip form of buff, the goods are so closely graded and matched for uniformity that a practical working balance is secured. Buffs made from graded cloth, of course, give more satisfactory performance than those not graded, chiefly on account of the uniformity permitting better standards in the cost of the goods being buffed.

Pieced-sewed buffs were originated in an endeavor to utilize the small corners left over after cutting full-disk buffs from cotton sheeting. It will be realized that when three circles intersect, or meet, there is a triangular area surrounded by the circles. These triangles were cut into wedge-shaped segments, which were arranged edge to edge in layers with the edges of each layer "breaking joints" with those of the next layer. Then with a full disk at the bottom and another on top, the whole was sewed together. For some kinds of work, this proved to be a very acceptable form.

As time passed and the business grew in volume, the supply of these triangles could not keep up with the demand, and it became necessary to resort to the use of small pieces of cotton cloth from cotton mills. The principal source of supply of such small pieces occurs in the waste cloth produced by tearing out oil-spotted or otherwise damaged parts from the cloth produced. These "rags" are usually in the form of strips. These were laid out smoothly and cut into wedge-shaped segments, but later on, a patent was secured by one concern for assembling the strips themselves into squares with each layer at right angles to the next one and with a full piece top and bottom, and a better form of construction was secured. However, both wedge-shaped segments and the strip construction are in existence today in a large way.

There are certain inherent difficulties involved in the manufacture of pieced-sewed buffs, the principal one being to secure a permanent supply of uniform goods of a quality satisfactory for buffing wheel purposes. During periods of excessive business activity, such as we had in the years 1919 and 1920, it is usually impossible for any manufacturer of buffing wheels to supply pieced-sewed buffs of a uniform quality in sufficient quantities to the trade, with the result that standards are somewhat destroyed. This condition happens in every business cycle where the demand for pieced-sewed buffs exceeds the producing capacity of cotton mills, so far as remnants are concerned. In other words, the pieced-sewed buff business is not established on a proper basis. It does not control its own supply of raw materials, and it is to be hoped that a form of buffing wheel may be developed that will correct this difficulty.

The question has often been asked why full-disk buffs are usually made of unbleached goods, while the pieced-sewed buffs are made of bleached goods. The answer is that unbleached goods are used in full-disk buffs because that is the way the goods are received from the mills, and bleaching does not produce an article sufficiently superior to warrant the cost of doing this. The reason that pieced-sewed buffs are usually made of bleached goods is because the small pieces are the remnants detached from the large bolt or cuts of cotton cloth or by-products of mills fabricating bleached cotton cloth into merchandise, and there is only a limited supply of unbleached material suitable for buffs. In other words, there are practically no unbleached remnants on the market. In the pieced-buff production, about 2 per cent of the buffs are unbleached and 98 per cent bleached.

It will be appreciated that the question of balance is very important, in the manufacture of pieced-sewed buffs, when it is remembered that buffing wheels are operated at the high speed of ten to twelve thousand peripheral feet per minute. Therefore, it is essential to obtain the most perfect balance possible. This is very difficult, in view of the shape of the pieces, their irregularity, and the varying weights of the cloth used. Another important point is to make the section as even in thickness throughout the area as possible, and here again the varying character of the goods makes this difficult.

Special Forms of Buffing Wheels

While the preceding facts cover the more common and standard types of buffing wheels, there are many special forms of buffing wheels used. Woolen cloth, which has previously been referred to, is used in what is known as hand-sewed buffs; these buffs are employed almost entirely on precious metals. The woolen cloth has to be absolutely pure—free from cotton—as the buffing operation of pure woolen cloth at slow speeds on precious metals must lay down the metal and produce the luster, without tearing any of the precious metal away. In that sense the action is quite different from high-speed, faster cutting cotton buffs used on the coarser metals. Canton flannel is another material used in various weights and constructions having no particular standard, which is employed almost exclusively in the form of hand-sewed buffs on sterling silver. Sheepskin buffs are also used, the skins being soft and flexible.

All of these three materials are made up in the so-called "hand-sewed" wheel, in which instead of sewing eighteen or twenty layers of the material together into sections, the entire thickness of the wheel, from ¾ inch up to 3 inches, is sewed through and through by drilling holes and sewing by hand with baling needles, using a special heavy tough twine. This form of sewing is always done in concentric circles, each circle being complete in itself and not connected with the other circles. The reason for this is that the buff operates at slow speed, and the sewing is required to hold the layers of material together into the unit form of a wheel, so that as the wheel wears down to the first row of sewing, that row, being independent of the next row, can be cut out without opening up or destroying the buff.

The center of this jewelers' form of buff is hardened with shellac or glue to permit the wheel to be used on the small taper screw arbor usually employed in jewelers' work. The sheepskin buffs sometimes are left open, having only one row of sewing around the center like a loose buff, but are never made up in the form of sections. They are always made in complete units.

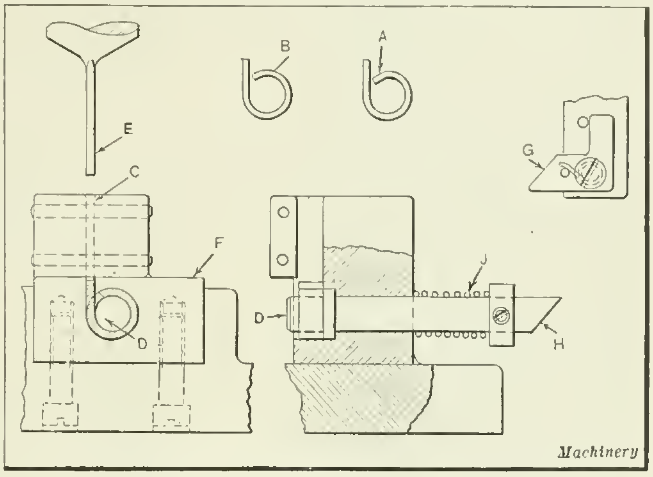
Another form of buffing wheel is the solid felt wheel, which has a peculiar advantage in the solidity of its face, when used on relief work, such as nameplates or ornamental plates on stoves, where it is desired to buff the top of the work and leave the recessed surface in the original frosted silver color of the unbuffed nickel.

CURLING DIE WITH ARBOR

By D. A. NEVIN

The usual design of curling die for forming hinges, rings, and a variety of curled parts leaves the work with a flattened portion in the loop, as shown at *A* in the accompanying illustration. This inaccuracy is permissible in some cases, but it is frequently desired that the ring be nearly perfect, as shown at *B*. To accomplish this, the work should be curled around an arbor. The die shown in the illustration is provided with such an arbor. A positive means of ejecting the work is also embodied in this die.

The straight blank is placed in the slot at *C*, which encloses it, and it is curled around the arbor *D* when the punch *E* descends. On the up stroke of the press, the trigger *G* moves upward with the punch, and comes in contact with the cam end *H* of arbor *D*, thus ejecting the work from the die-block *F*. The ring opens sufficiently to allow it to be stripped from the arbor when the latter is returned to the position shown, by the action of the spring *J*. The ring only needs to open a few thousandths inch in order to be stripped from arbor *D*, provided a sharp corner is left on the edge of the hole which encloses the work. On the down stroke of the press, the trigger *G* snaps over the cam end *H* of arbor *D*. A variety of work can be accurately curled in a punch and die of this design, including tubes of short lengths. Some parts, however, may require a second operation for closing the seam.



Curling Die provided with Arbor and Stripping Device

* * *

PREVENTION OF CAR SHORTAGE

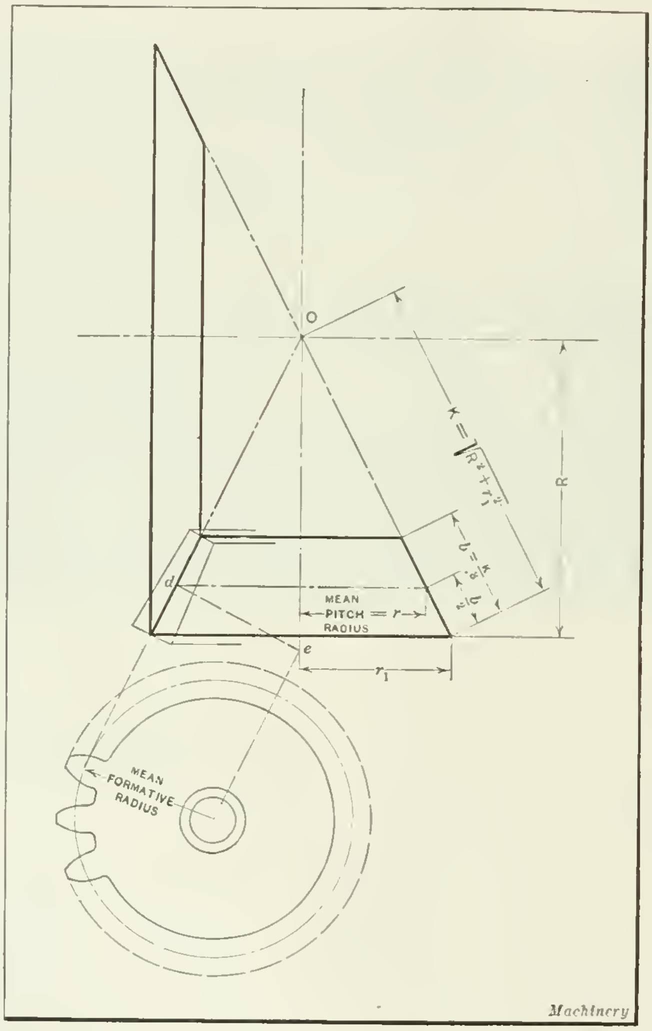
Secretary Hoover is asking the cooperation of all executives in the industries in preventing car shortage and freight embargoes during the coming fall and winter. The principal methods by which the industries can assist in preventing an overloading of the railroad facilities next winter are by ordering and storing their winter coal between now and September 1; by loading all cars to full capacity; by promptly loading and unloading cars; by reducing reconsignment shipments; and by never demanding more cars than can be promptly used. It is estimated that if all the industries would observe this request the railroads would be able to increase the effectiveness of the present equipment to an extent that would be equivalent to 3000 new locomotives, 300,000 cars, and a 10 per cent addition in track mileage and terminal facilities.

The most serious check to our present industrial activity may come from a shortage of railroad facilities. It is therefore to the interest of every manufacturer to do his share in preventing this shortage from becoming more serious than it otherwise would be.

Computing Pitch of Bevel Gears

By GEORGE F. NORDENHOLT, Assistant Professor in Mechanical Engineering, Lehigh University, Bethlehem, Pa.

BEVEL gears, in order to be kept in accurate alignment must be properly proportioned in respect to pitch, width of face, and slant height of pitch cone. The methods used in determining the ratio of face width b (see accompanying illustration) to the circular pitch, are practically the same as in the case of spur gears. However, in designing bevel gears there is the added restriction that the face width should not exceed a certain proportion of the slant height K of the pitch cone. The reason for this is readily understood when we consider the fact that the teeth become thinner as they approach the apex of the pitch cone. Should the tooth become too thin at the inner end in proportion to its mean thickness, it would break if the load were momentarily concentrated at the thin end. The ratio of face width to mean circular pitch is usually 2½ or 3, and the face width should not exceed one-third of the slant height of the pitch cone.



Method of calculating "Formative Tooth" of Bevel Gear

The pitch of bevel gears may readily be calculated by applying Tredgold's approximation and then computing the pitch of the "formative spur gear." The method of applying Tredgold's approximation is shown in the illustration. The line ed is drawn perpendicular to the line Od of the pitch cone, and produced until it intersects the axis of the pinion at e. The profile of a spur gear tooth based on a pitch radius equal to ed will be very nearly the same as the actual profile of the bevel gear tooth at point d, assuming that the pitch is the same in both cases. If the load on the tooth and its strength are both assumed to be proportional to the distance from the apex of the pitch cone, then we may consider the whole load as acting at the mid-point of the tooth face, which will be at the mean radius of the pinion. The required pitch of the corresponding formative tooth will then be the pitch of the bevel pinion at the mid-point of the tooth, that is, the mean pitch. Formulas (1), (2), and (3) of the present article appeared also in April, 1922, MACHINERY in an article entitled "Methods of Computing Pitch of Spur Gears." However, for convenience these formulas are given here also.

$$\frac{cz^2}{4\pi^2} = \frac{r^2 f \times (b \div p)}{P} \qquad (1)$$

$$p^3 = \frac{2\pi c P r}{z f \times (b \div p)} \qquad (2)$$

$$p^5 = \left(\frac{(2\pi c \div \sqrt[3]{720}) \times Pr}{(b \div p) \times S}\right)^3 \times \frac{n}{z^2} \qquad (3)$$

In the foregoing formulas,

c = a constant, the value of which depends on the number of teeth;
r = radius of pitch circle of pinion;
b = width of tooth;
p = circular pitch;
f = allowable tooth stress;
S = allowable initial tooth stress for peripheral velocities up to 1 foot per second;
P = load on tooth;
z = number of teeth in pinion; and
n = revolutions per minute of pinion.

Formula (1) is applicable when the diameters of the gears are known. Formula (2) applies when the diameters are unknown, and the peripheral velocity of the gear is not more than 1 foot per second, while Formula (3) applies when the diameters are unknown, and the peripheral velocity is greater than 1 foot per second. These formulas may be used to find the pitch of the "mean formative spur gear" of the bevel gear pinion. The method may best be explained by working out examples. Only bevel gears having shafts meeting at right angles will be considered, but by substituting the proper trigonometrical functions the method can be used for any shaft angle. In finding the pitch of the "mean formative spur gear" of bevel gears having their shafts at right angles, two cases must be considered. In the first, the diameter of one of the gears is specified, and in the second, no diameter is given.

Solution when Diameters are Specified

Example—Four horsepower is to be transmitted by a pair of bevel gears. The shafts meet at right angles and the outer pitch diameter of the pinion is to be 8 inches. The pinion is to run at a speed of 100 revolutions per minute, while the other shaft is to have a speed of 50 revolutions per minute. The problem is to find the circular pitch.

In this problem all computations will be based on the pinion, as it has the weaker tooth. Assuming $b = K \div 3$, it is evident from an inspection of the similar triangles involved that the mean pitch radius will be 5/6 that of the outer radius or 5/6 × 4 = 3.33 inches. Assuming that the full load is acting at the mean radius, we have

$$P = \frac{63{,}025H}{rn} = \frac{63{,}025 \times 4}{3.33 \times 100} = 760 \text{ (approximately)}$$

where H = horsepower transmitted;
r = mean radius of pinion; and
n = number of revolutions per minute.

The mean peripheral velocity will then be found by the formula,

$$\frac{2\pi rn}{720} = \frac{2\pi \times 3.33 \times 100}{720} = 2.9 \text{ feet per second}$$

Assuming an allowable initial unit stress of 6000 for velocities up to 1 foot per second, and using Reuleaux's formula, we have

$$f = \frac{6000}{\sqrt[3]{V}} = \frac{6000}{\sqrt[3]{2.9}} = 4200$$

Taking $b \div p$ as 3 and, for the formative gear, applying Formula (1), we have,

$$\frac{cz^2}{4\pi^2} = \frac{rf \times (b \div p)}{P}$$

where r should really be considered as the radius of the formative gear.

However, it will be noticed that the mean formative radius is only slightly larger than the mean radius of the bevel pinion. If the mean radius of the pinion is used for r in the foregoing formula, it will result in a smaller number of teeth. But these teeth will be on a smaller radius; hence the difference in pitch will be very slight when we assume that the formative radius and mean radius are equal. In any case, the error is on the side of safety, so in order to simplify matters, we will carry through the assumption, and let $r = 3.33$ inches.

Hence

$$\frac{cz^2}{4\pi^2} = \frac{(3.33)^2 \times 3 \times 4200}{760} = 184 \qquad (4)$$

From the table accompanying the article previously referred to, we see that this value corresponds to 26 teeth; hence the diametral pitch of the formative gear would be

$$\frac{26}{2r} = \frac{26}{6.66} = 3.90$$

This gives a circular pitch of

$$p = \frac{\pi}{3.90} = 0.8$$

which will be the mean circular pitch of the bevel gear.

The slant height of the pitch cones will be:

$$\sqrt{R^2 + r_1^2} = \sqrt{16 + 64} = 9 \text{ inches, approximately.}$$

As $b \div p$ was assumed as 3, b will equal $3p = 2.4$ inches.

This is less than $K \div 3 = \frac{9}{3} = 3$. Hence the tooth width is within the assigned limits as regards its proportion to pitch and slant height of the pitch cone.

The question now arises as to what would be the procedure had b come out greater than $K \div 3$. To illustrate this, we will work out the same example, assuming that it is required to transmit 7 horsepower instead of 4. Then the load P would be 7/4 as great, and as all other quantities remain the same,

$$\frac{cz^2}{4\pi^2} = \frac{184 \times 4}{7} = 105$$

According to the table previously referred to, z would equal 19, and the diametral pitch would be $19 \div 6.66 = 2.85$, the corresponding circular pitch being $\pi \div 2.88 = 1.10$, which would be the mean circular pitch of the bevel gears.

As $b \div p$ was taken to be equal to 3, b would equal $3 \times 1.10 = 3.3$ inches. This is somewhat greater than $K \div 3 = 3$ If this is not desirable, we may recalculate, using a smaller value of $b \div p$, say 2.5. Then as this would be the only quantity changing its value

$$\frac{cz^2}{4\pi^2} = 105 \times \frac{2.5}{3} = 87.5$$

According to the table, the corresponding value of z is 17. The diametral pitch of the formative gear then equals

$$\frac{17}{6.66} = 2.55, \text{ and } p = \frac{\pi}{2.55} = 1.23$$

As $b \div p = 2.5$, $b = 2.5 \times 1.23 = 3.08$, which, though slightly larger than $K \div 3$, would probably be permissible.

The foregoing method ignores the fact that should the calculations for b result in a value less than $K \div 3$, the mean radius would be greater than 5/6 the outer radius. The resulting error, however, is so small as to be practically negligible.

Solution when No Diameters are Specified

Before proceeding with an example in which no diameters are specified, we will develop a formula to determine the proper value of $b \div p$ so that b will not be more than $K \div 3$. We have

$$K = \sqrt{R^2 + r_1^2}$$

But

$$R = \frac{tZ}{2\pi} \text{ and } r_1 = \frac{tz}{2\pi}$$

where t equals circular pitch at the outer diameter, and Z, number of teeth in the larger gear.

Hence

$$K = \frac{t}{2\pi} \times \sqrt{Z^2 + z^2}$$

Dividing and multiplying the terms under the radical by z^2,

$$K = \frac{t}{2\pi} \times \sqrt{z^2\left(\frac{Z^2 + z^2}{z^2}\right)} = \frac{tz}{2\pi} \times \sqrt{a^2 + 1}$$

where a is the velocity ratio $Z \div z$.

Dividing both sides by 3,

$$\frac{K}{3} = \frac{tz}{6\pi} \times \sqrt{a^2 + 1}$$

But $K \div 3$ is the maximum value for b; hence

$$b = \frac{tz}{6\pi} \times \sqrt{a^2 + 1} \text{ or } \frac{b}{t} = \frac{z}{6\pi} \times \sqrt{a^2 + 1}$$

which will be the ratio of the width to the pitch at the outer diameter. The mean pitch is 5/6 the outer pitch when $b = K \div 3$; hence by dividing both sides by 5/6 and substituting for $5/6 \times t$ its value p,

$$\frac{b}{p} = \frac{z}{5\pi} \times \sqrt{a^2 + 1}$$

which is the ratio of b to the mean circular pitch, when $b = K \div 3$. With a and z known, this value of $K \div 3$ can readily be figured. If it comes out equal to, or less than, the desired ratio of $b \div p$, the computed value of $b \div p$ should be used in further computations, and b will then equal $K \div 3$. If it comes out greater than the desired ratio, the latter ratio should be used, and b will be less than $K \div 3$.

Example—Two horsepower is to be transmitted by a pair of bevel gears, the shafts meeting at right angles. The gear shaft is to make 10 revolutions per minute and the pinion shaft 20.

Assume 15 teeth for the pinion and 30 teeth for the gear, which will give a velocity ratio of 2 as desired.

Then

$$\frac{b}{p} = \frac{z}{5\pi} \times \sqrt{a^2 + 1} = \frac{15}{5\pi} \times \sqrt{4 + 1} = 2.12$$

and b will equal $K \div 3$.

As the velocity will probably be less than 1 foot per second, Formula (2) should be applied. From the table of constants the value of $2\pi c$ for 15 teeth = 80.4. We will assume that the gears are steel and that the allowable unit stress is 16,000 pounds per square inch.

$$Pr = \frac{63{,}025 \times H}{n} = \frac{63{,}025 \times 2}{20} = 6300 \text{ (approximately)}$$

Then

$$p^3 = \frac{2\pi c\, Pr}{(b \div p) f} = \frac{80.4 \times 6300}{2.12 \times 16{,}000} = 14.9$$

and

$$p = 2.46 \text{ inches}$$

The mean circumference = 15 × 2.46 = 35.4 inches = 3 feet, approximately. The peripheral velocity will equal $\frac{3n}{60} = \frac{3 \times 10}{60} = 0.5$ feet per second, which, being less than 1, shows that it was correct to use Formula (2). Had the peripheral velocity been found to be greater than 1 it would have been necessary to recalculate, using Formula (3). A typical problem in which the mean peripheral velocity is found to be greater than 1 is as follows:

Example—Ten horsepower is to be transmitted between two shafts meeting at right angles, one shaft making 200 revolutions per minute and the other 50 revolutions per minute. In this problem we will assume 18 teeth for the pinion. Then for the limiting value of $b = K \div 3$, we would have

$$\frac{b}{p} = \frac{z}{5\pi} \times \sqrt{a^2 + 1} = \frac{18}{5\pi} \times \sqrt{16 + 1} = 5.06$$

Hence a maximum value of $b \div p = 3$, will make b less than $K \div 3$. As the velocity will probably be greater than 1 foot per second, we will apply Formula (3).

From the table of constants $\frac{2\pi c}{\sqrt[3]{720}}$ for 18 teeth = 8.13.

In this case we will assume that the gears are cast iron and that the allowable unit stress in 6000 pounds per square inch.

$$Pr = \frac{63.025\ H}{n} = \frac{63{,}025 \times 10}{200} = 3150$$

$$p^8 = \left[\frac{(2\pi c \div \sqrt[3]{720}) \times Pr}{(b \div p) \times S}\right]^3 \times \frac{n}{z^2}$$

$$= \left(\frac{8.13 \times 3150}{3 \times 6000}\right)^3 \times \frac{200}{324} = 1.788$$

$$p = \sqrt[8]{1.788} = \sqrt[4]{1.33} = \sqrt{1.15} = 1.07$$

Therefore 1.07 is the mean circular pitch.

The mean circumference will be 1.07 × 18=19 inches=1.5 feet, approximately. The peripheral velocity will equal $\frac{1.5 \times n}{60} = \frac{1.5 \times 200}{60} = 5$ feet per second, which being greater than 1 shows that it was correct to use Formula (3). Had the peripheral velocity been found to be less than 1 it would have been necessary to recalculate, using Formula (2).

It will be noticed that in these last two solutions where no diameters are specified, the numbers of teeth and the radii of the bevel gear and formative gear were assumed to be equal. However, as in the case where diameters were given, the error is very slight and is on the side of safety. The greatest error from this cause will be in figuring miter gears, in which case the pitch calculated will be about 4 per cent greater than if the calculations were based on the formative radius and number of teeth. However, for all practical purposes, the methods outlined above are sufficiently accurate.

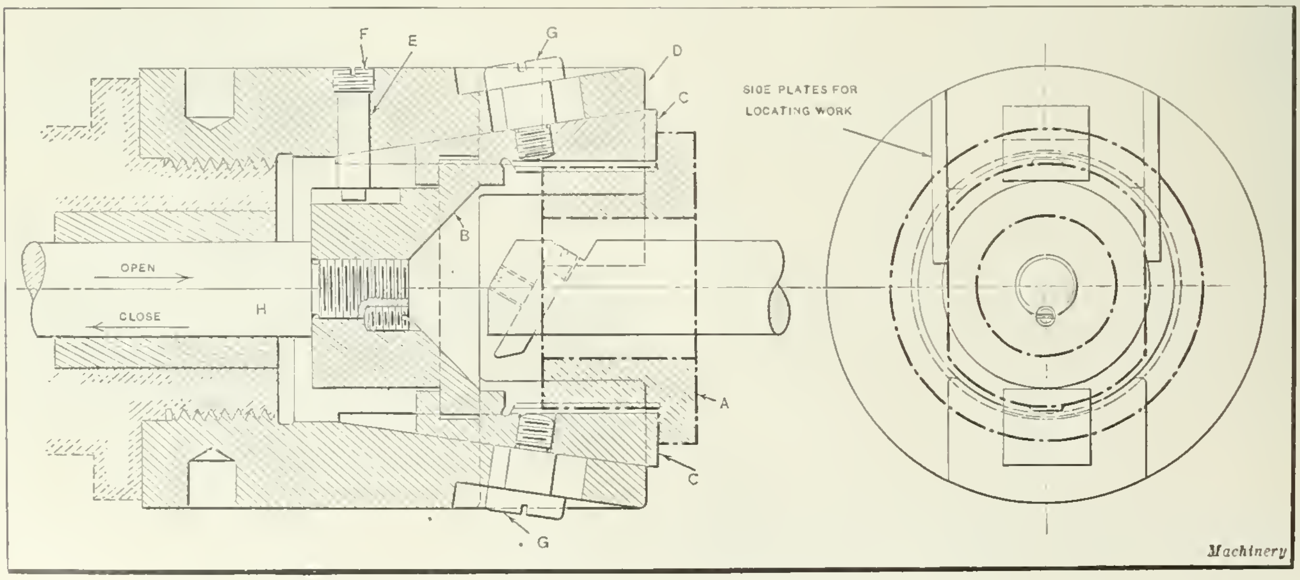
* * *

CHUCK FOR HOLDING ROUND WORK WHILE BORING

By VICTOR HUGO

The chuck shown in the illustration is of the two-jaw type, and is used to hold work of the kind shown at *A* while the central hole is being bored. A chuck of the same general construction but having three jaws may be more desirable for a different class of work. This chuck was designed with a view to eliminating, as far as possible, the trouble caused by chips getting behind the moving parts.

The flange *B*, which is screwed to the end of rod *H* and operates jaws *C*, is caused to turn with the body *D* by pin *E*. The pin *E* is held in position by screw *F*. The flange *B* is beveled on its front face, so that any chips which may fall into the chuck behind the work are thrown forward and out through the opening at the side of the chuck body by centrifugal force. The rod *H*, which serves to actuate the chuck jaws, may be made to operate pneumatically or by a handwheel or a forked lever. The jaws *C* are a sliding fit in slots cut in the chuck body, and are held in place by screws *G*.



Two-jaw Chuck for holding Round Work while the Central Hole is being bored

Scraping and Frosting Flat Surfaces

By O. S. MARSHALL

THE art of scraping flat metal surfaces came up for discussion recently among some shop students who were under the writer's direction. As first there appeared to be a difference of opinion regarding the correct methods of sharpening and using a scraper. A carefully outlined course of instruction and experimental work in the shop, supplemented by reference to photographs showing a skilled workman in the exact positions assumed under actual working conditions, served to clear up all disputed points and fix the fundamental principles of scraping firmly in the minds of the students. The photographs and the information gathered and prepared by the writer for this course of instruction form the basis of the present article. The methods described and illustrated in the following are regularly employed in the plant of a well-known machine tool building company.

Fundamental Principles Involved

At the outset the difference between "cutting" and "scraping" was thoroughly discussed and demonstrated. Emphasis was placed on the fact that the desired surface obtained by scraping was achieved by reducing the high spots or "mountains" on the machined surface to a general level with the low places. It was also pointed out that the smaller crevices in the metal receive the very small chips or metal scrapings in the form of a powdered paste, which serves as filling, thereby helping to produce a surface that is more or less glassy or mirror-like in appearance. The same glassy surface, carried to an even greater degree of refinement, is produced by performing a polishing operation on the work.

Shape of Scraper

The shape or form of the end of the scraper, as well as the working angle of the scraper in the workman's hands, must be correct in order to obtain satisfactory results. In Fig. 3 is shown an enlarged outline of the end of a correctly sharpened scraper, the enlargement being approximately twenty times. This outline is a reproduction of one obtained from a shadow photograph.

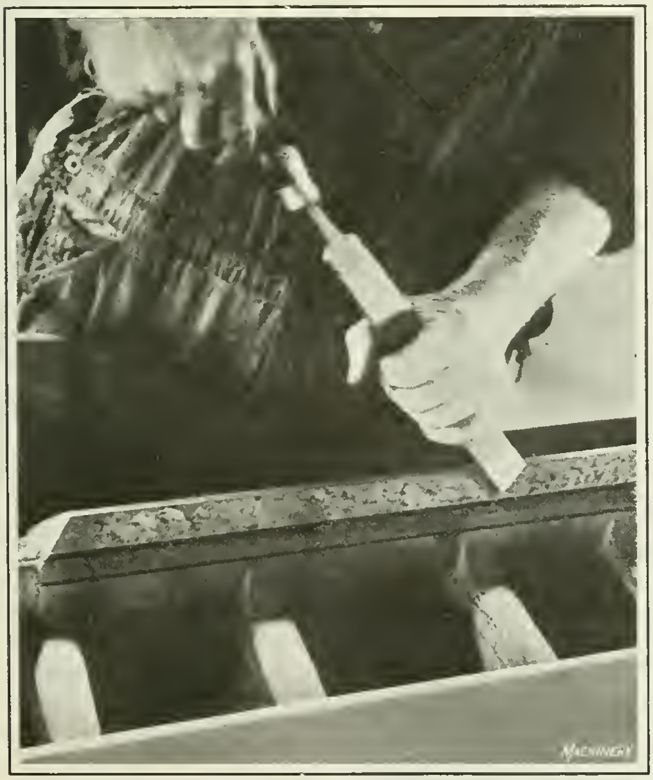


Fig. 1. Scraping the Ways of a Lathe

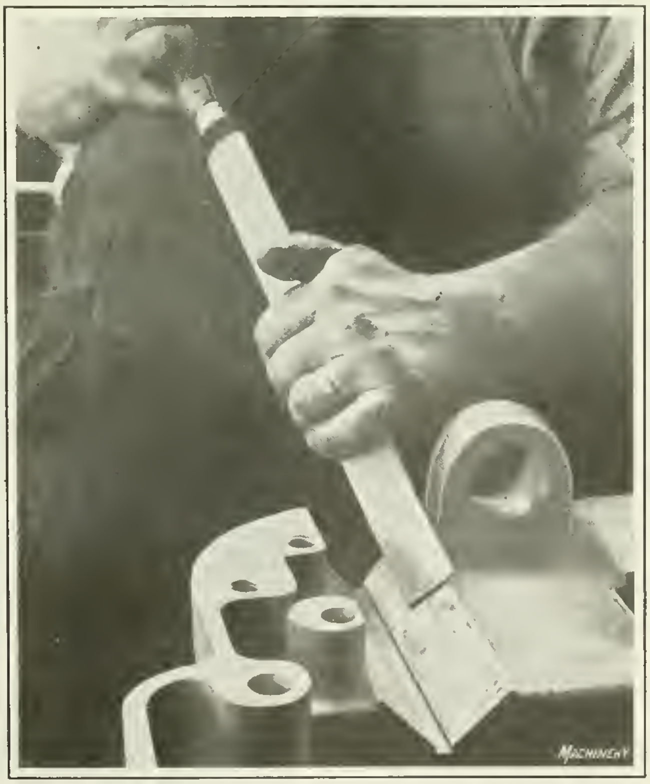


Fig. 2. Scraping the V-bearing of a Lathe Saddle

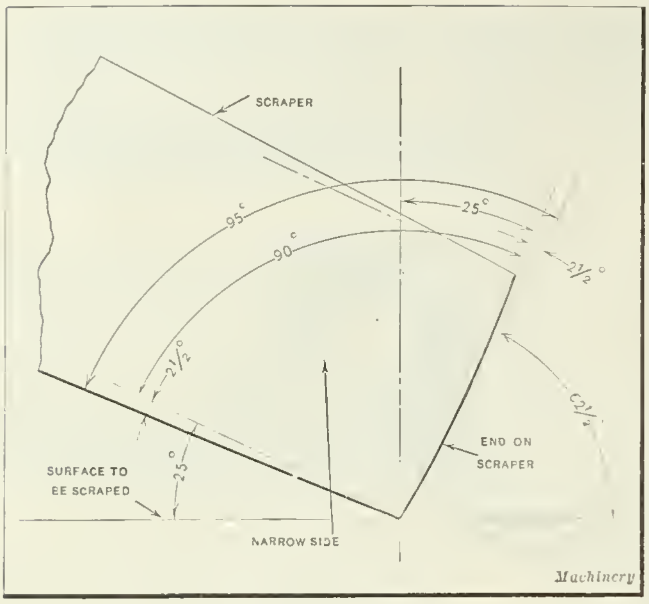


Fig. 3. Diagram showing Thin Edge of Correctly Sharpened Scraper (Twenty Times Actual Size)

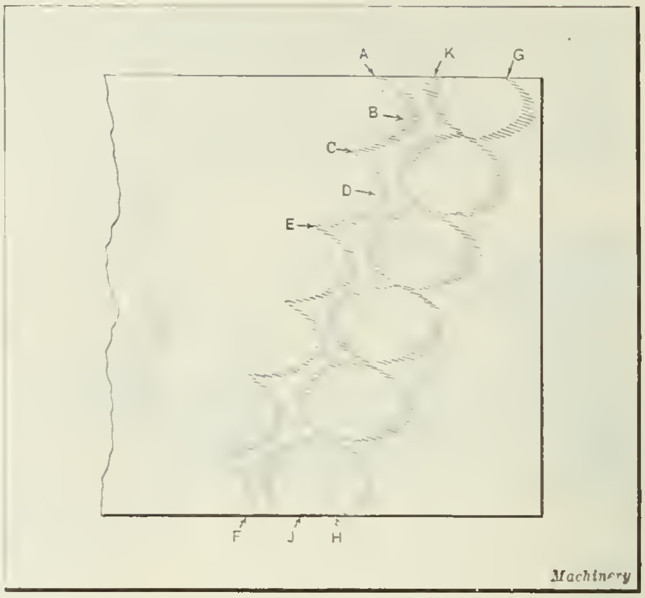


Fig. 4. Diagram illustrating Method of producing Crescent Frosting such as is used for Decorative Purposes

It will be noted that the end surface forms an obtuse angle with each of the flat sides of the scraper at the cutting edges. The crest of the end surface is approximately in the center of the thin end. The scraping edges formed by the sides and end surface have an included angle of 95 degrees as indicated. The end of the scraper (looking at the flat side) is also slightly curved, as shown in the lower right-hand corner of the central view in the heading illustration.

A well-known text-book used by one of the students recommended the use of a flat scraper sharpened in an entirely different manner. The tool illustrated in this book had a concave end for the scraping edge, produced by contact with the cylindrical face of an emery wheel during the sharpening or grinding operation. According to the text-book referred to, the ground scraper was to be held in a vertical position relative to the hone for fine edging, in order to obtain a square cutting edge. The disadvantages of a square cutting edge, as thus produced, for use on work of the kind under consideration were readily demonstrated by comparing the results obtained by its use with those obtained by a scraper sharpened in the manner described in this article.

Fortunately it was easy to find some poorly scraped surfaces which showed scraper chatter marks, as well as some well finished surfaces that were free from these defects. Surfaces duplicating the good and the faulty examples were next produced in a series of trials. These tests proved conclusively that the best results could be obtained with a scraper having a rounded end, ground and honed to the shape indicated in Fig. 3 and in the heading illustration.

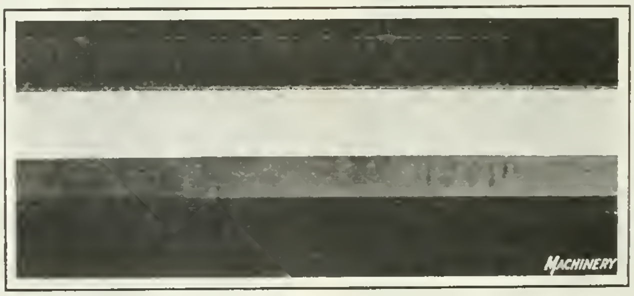


Fig. 5. Unscraped Machined Surface

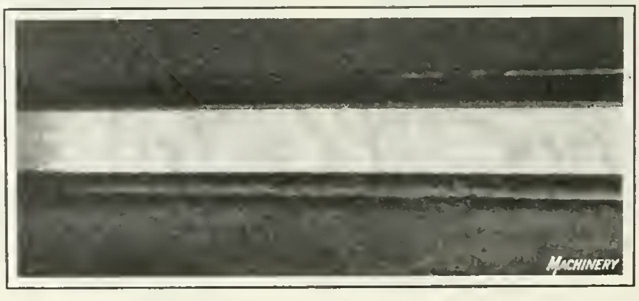


Fig. 6. Surface shown in Fig. 5 after being scraped

Method of Sharpening Scraper

The illustration at the extreme left of the heading illustration shows how the scraper is held when the end is being ground to a slight curve. A fine-grain grindstone, about 3 feet in diameter is used for this operation. After being sharpened on the grindstone, the scraper is honed on an India oilstone in the manner indicated in the central view of the heading illustration. The scraper is inclined at an angle of from 5 to 8 degrees with the vertical when it is being honed, in order to form the end to the shape indicated in Fig. 3 and in the lower right-hand corner of the central view of the heading illustration.

Before the scraper is used, it may be given a stroke or two with the oilstone on its flat side, in order to obtain a keen edge. The several angles concerned in sharpening and in using the scraper are shown diagrammatically in Fig. 3. It will be noted that the 2½-degree angle plus the 25-degree angle of inclination gives the end of the scraper a reverse rake angle of about 27½ degrees.

Producing a Flat Surface

The position of the operator's hands in holding the scraper, and the angular position of the scraper in relation to the work when a flat surface is being scraped, are clearly shown in Figs. 1 and 2, and also in the view at the extreme right in the heading illustration. The "leaded" or high places (the dark spots) which are to be scraped down are shown quite clearly in Figs. 1 and 2. Fig. 6 is a close-up view showing the scraper marks, the work being ready to receive the testing jig or master plate, which, when rubbed on its surface, will show the extent of the contact surface between the plate and the work. After the master plate is removed, the high places, as indicated by the dark leaded spots, are all scraped down. By repeating this process of applying the master plate and then scraping down the high spots, it is possible to obtain a true flat surface. In scraping down the high spots on a flat surface, the scraper is made to remove metal only on the forward or pushing stroke. Before being scraped, a machined surface generally has a porous appearance, as shown in Fig. 5.

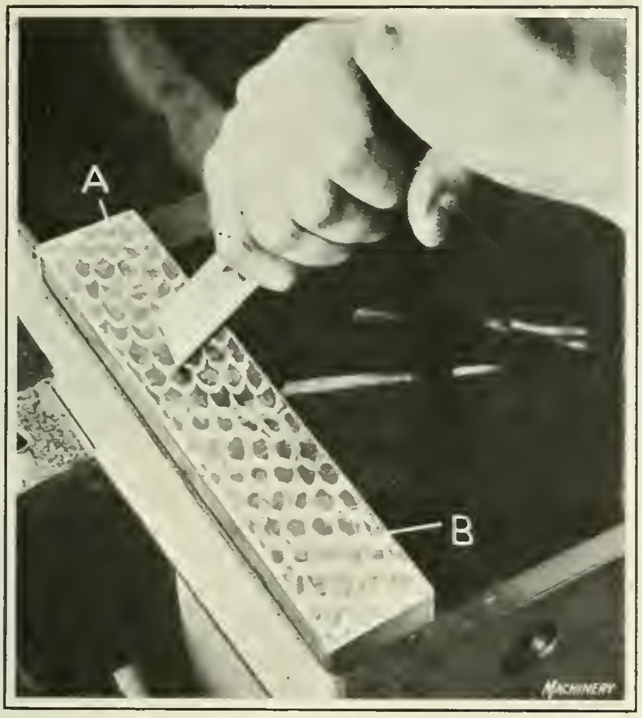


Fig. 7. Example of Crescent Frosting, showing Position of Scraper at Beginning of Crescent-forming Stroke

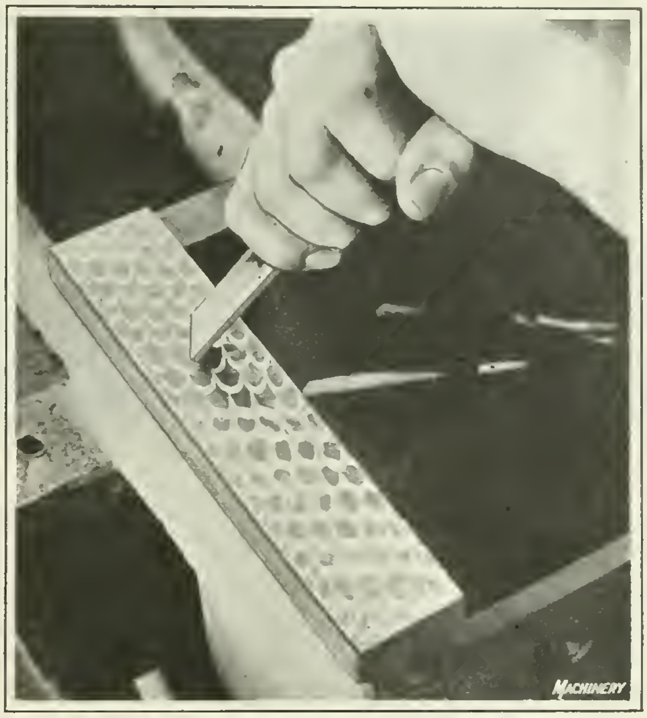


Fig. 8. View showing the Scraper in the Mid-stroke Position of the Crescent-forming Movement

Figs. 4, 7, and 8 will convey to the reader, if studied in connection with the text, a working knowledge of the method employed to produce the crescent form of frosting used by some machine tool builders. The frosting is done primarily for decorative purposes after the other work is finished. First the position of the workman relative to the surface to be frosted (see Figs. 7 and 8) should be carefully noted. The workman begins the frosting operation at the left-hand end or side of the surface to be frosted and works toward his right. Each stroke of the scraper is started at the edge opposite the workman. By drawing the scraper toward him with a peculiar oscillating movement, the workman forms a series of crescents which are tied together at their points. For decorative effect this series of crescents is usually laid diagonally across the surface, as shown in Fig. 7. If the full circle effect is to be obtained, as at *B*, the workman first frosts the work as shown at *A*, working from left to right (standing on the opposite side from that shown). After this has been done, he completes the second series.

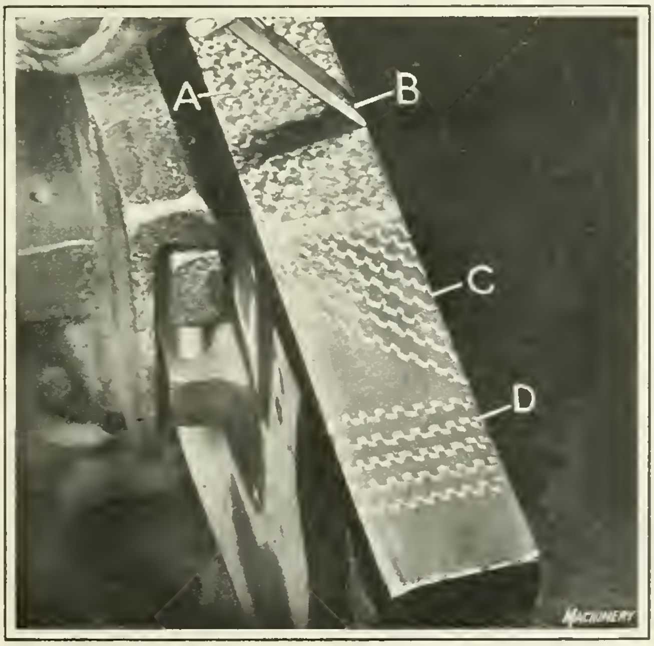


Fig. 9. Example of Diamond Style of Frosting often applied to Scraped Surfaces

In making the second series of crescents which give the complete circle effect as shown at *B*, the workman stands on the right-hand side of the work, as shown in the illustration. This illustration merely shows the position of the operator's hands and wrists at the beginning of the crescent-forming movement. The position of the scraper at the beginning and end of the crescent-forming movement is the same. It will be noted that the broad side of the scraper is nearly in full view in Fig. 7, whereas little more than the edge of the scraper is shown in Fig. 8. In the latter illustration, the mid-stroke position of the wrists and scraper are shown, the upper half of a crescent having already been formed.

The workman oscillates the scraper—he does not slide it—by a series of rapid and slight wrist twists, first from left to right, then from right to left, imparting a side rocking motion to the tool back and forth and continuously working it toward himself as each crescent is formed, until a string of crescents is formed completely across the surface. The workman then begins another series of crescents by placing the scraper at the edge opposite him, as previously described, and again rapidly oscillates or "waltzes" the scraper across the surface. This operation is repeated until the surface has been completely covered.

Briefly, the left-to-right movement, or half oscillation, forms the upper half of the crescent, as for instance, from *A* to *B*, Fig. 4, and the right-to-left or reverse motion forms the lower half of the crescent from *B* to *C*. These movements are repeated in forming the crescent *CDE* and each successive crescent, until a complete string extending from *A* to *F* is finished. After completing the crescents from *A* to *F*, the next string extending from *G* to *H* is produced in a similar manner. The addition of the series of crescents formed by strings such as the one extending from *J* to *K* gives the complete circle effect. The second series of crescents is produced in exactly the same manner as the first, the workman standing on the opposite side of the work, as previously explained. Sometimes when an especially clear frosting is desired, the surface is slightly polished with fine emery cloth. Needless to say, a little practice is required before it is possible to become expert in the art of frosting.

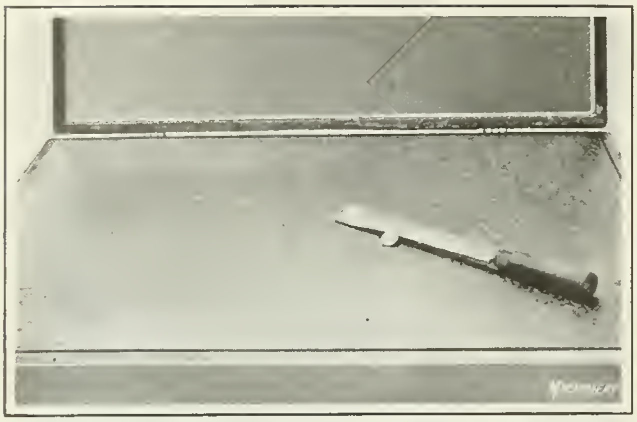


Fig. 10. Master Surface Plate used to test Accuracy of Surface Plates used in the Shop

In Fig. 9 is shown another type of frosting which, when fully worked in as shown at *A*, gives a genuine frost-like appearance to the surface. A surface frosted in this manner will scintillate light in all directions when observed under good lighting conditions. At *B* will be seen the scraper, which is preferably made long enough to enable the workman to support the handle end by pressing firmly against his shoulder. This illustration also gives a good idea of the correct amount of inclination to give the scraper. The strokes are all begun at the farther side of the work, the scraper being drawn toward the workman instead of being pushed from him, as in the case of scraping.

The end of the scraper that does the frosting is ground and honed to practically the same form as for scraping. In producing this style of frosting, which is sometimes called "diamond" frosting, either the diagonal series of spots, as shown at *C* or the straight-across series, as shown at *D*, may be made first. When both series have been laid on, the surface will appear as at *A*. The procedure in forming the series of spots is to bring the scraper a slight distance toward the workman, giving it sufficient pressure to mark but not to scrape the surface, and then slip it lightly to the right; next bring it forward again slightly and then slip it to the left, and again bring it forward. These movements are repeated until the complete surface has been treated. As the workman develops skill the "forward right, forward left" movements can be repeated rapidly, so that a surface of considerable size, such as the master plate shown in Fig. 10, may be quickly frosted.

The scraper is moved forward the same amount each time before it is moved sidewise. The length of the forward movement may be ⅛ inch or more, depending on the size of the surface to be frosted and the appearance desired. That the plate shown in Fig. 10 represents a really fine piece of scraping and finishing by frosting may be seen by noting the reflection of the cover at each of the corners where it is hinged to the protecting box. A scraper of ordinary size and a quarter dollar are laid on the plate in order to give some idea of the size of the plate. A master surface plate of this type is valued at several hundred dollars and is employed only in testing the surface plates used by the workmen in the shop.

* * *

SINGLE-RIB PATTERN THAT FACILITATES PRODUCTION

By M. E. DUGGAN

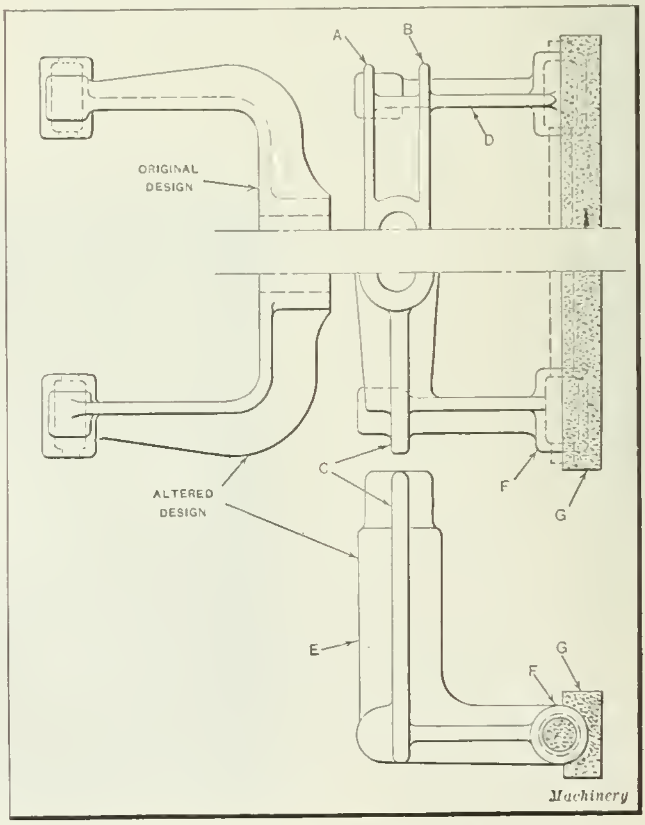
The two upper views in the accompanying illustration show the design of a machine casting which was required to be replaced on short notice. It will be noted that only a half-section of the casting is shown in these views. In order to facilitate making the patterns and molding, the ribs *A* and *B* were eliminated in making the repair part. A single rib *C*, as shown in the lower views of the redesigned casting, was substituted for ribs *A* and *B*. The single-rib casting gave the necessary strength and served every purpose required of the two ribs in the original design. The pattern for the original double-ribbed casting was made with a core-print between the ribs. This pattern was intended to be molded in the position shown in the view at the upper left-hand corner of the illustration. The whole pattern, in this case, was to be molded in the drag flask with the right-angle arms *D* down.

In the case of the redesigned pattern, the right and left cores required in molding the original two-ribbed pattern were eliminated. The section *E* was made loose where it joined rib *C* so that it could be lifted away with the cope. The two journal bearings were made loose at the point where they joined the right-angle arms. The core-print was, of course, made the same size and shape as the core *G*. This core-print was attached to the loose pieces *F* and extended completely across from one bearing to the other.

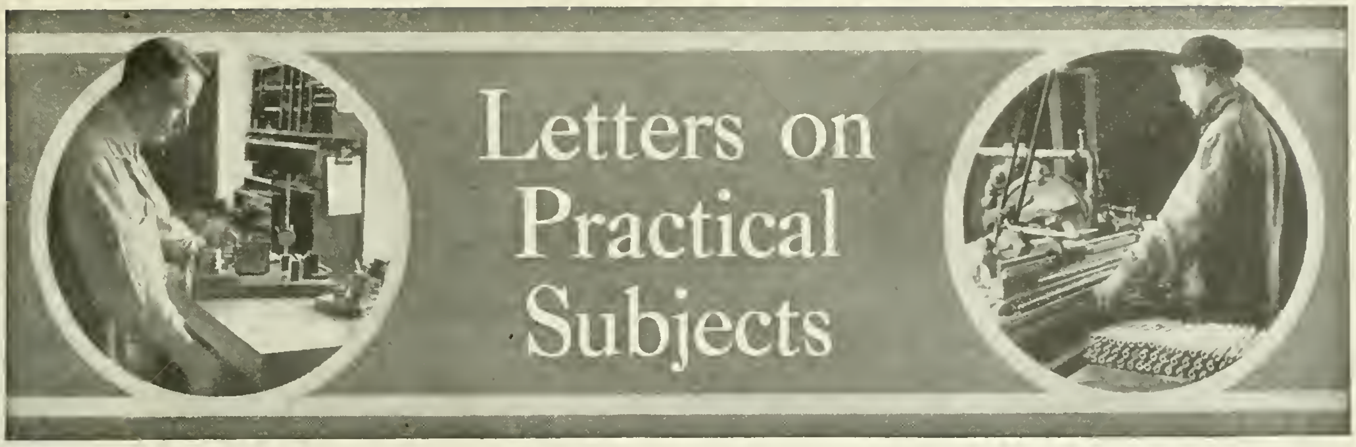
In molding the pattern, the loose section *E* was removed, and the bottom of the flat rib *C* laid on the bottom board. Sand was then shoveled into the flask, and the mold made up in the usual manner until the center of the bearing *F* was reached. The loose bearings were next lifted from the flask and the journal cores set in place in the mold. The ram-up cores *G*, which were made to match the hubs of the journal cores, were then put in place in the mold, after which the filing in of the sand was continued up to the top of the drag flask.

The drag was next rolled over and the loose section of the pattern *E* placed in position on the drag. The cope flask was placed on the drag, and sand filled in, thus completing the cope part of the mold in the usual manner. The cope was then lifted and the loose section *E* removed. The section of the pattern in the drag was also lifted, after which the cope was put back in place on the drag and the mold clamped together ready to be poured.

Patterns for repair parts are usually required on short notice, and for this reason the patternmaker who has this class of work to do should be quick to note any change in design that will enable the work to be done more quickly.



Changes made in Casting to facilitate Molding Operation



TACHOMETER FOR INDICATING HIGH SPEEDS

The measurement of high rotational speeds in the shop is receiving more attention at the present time than it has in the past. This is due no doubt to the increase in the use of high-speed abrasive wheels for finishing operations. Difficulty is often experienced, however, in obtaining correct indications at high speeds. An unusual method of solving this problem is described in the following: The method was developed and used at the plant of the Pratt & Whitney Co., Hartford, Conn. A simple device known as a flicker tachometer is employed. The particular device described was designed for general shop use where rotational speeds of from 300 to 500,000 revolutions per minute were to be indicated or measured.

A laboratory set-up of the flicker tachometer is shown diagrammatically in the accompanying illustration. This particular set-up is intended for indicating the rotational speed of the jack-shaft *B*, which has a speed of approximately 16,000 revolutions per minute. The device consists of a variable-speed electric motor *A*, a revolution counter *C*, a notched or serrated black disk *D*, and a rheostat *R* for varying the speed of the motor. Additional equipment consists of a target *T* attached to the shaft to be indicated, and a stop-watch. The motor is a simple direct-current type, is series-wound, and is capable of making 10,000 revolutions per minute when connected directly across the 110-volt alternating-current circuit. The power employed is about 10 watts.

The rheostat is used as a voltage divider. It has a resistance of 500 ohms and will carry a current of 1/2 ampere. The two end terminals are connected across the 110-volt line so that the current flows through the resistance wire continuously. The motor is connected across one end terminal and the slider, as indicated in the diagram. By moving the slider, any voltage from 0 to 110 volts can be impressed on the motor, and a wide range of speed thus obtained. On the motor shaft is mounted the flicker disk *D* which is made of heavy black paper. The periphery of this disk is cut or notched with five equidistant slots, each slot being about one-tenth the width of the adjacent uncut portions.

The purpose of this disk is to reduce the apparent rotation of the shaft under observation to zero when the end of the shaft is viewed through the rapidly revolving slots on the edge of the flicker disk *D*. When this is accomplished by varying the motor speed, the number of revolutions per minute of the motor is obtained by means of the revolution counter *C* and a stop-watch. The speed of the motor thus obtained is multiplied by the number of slots in the flicker

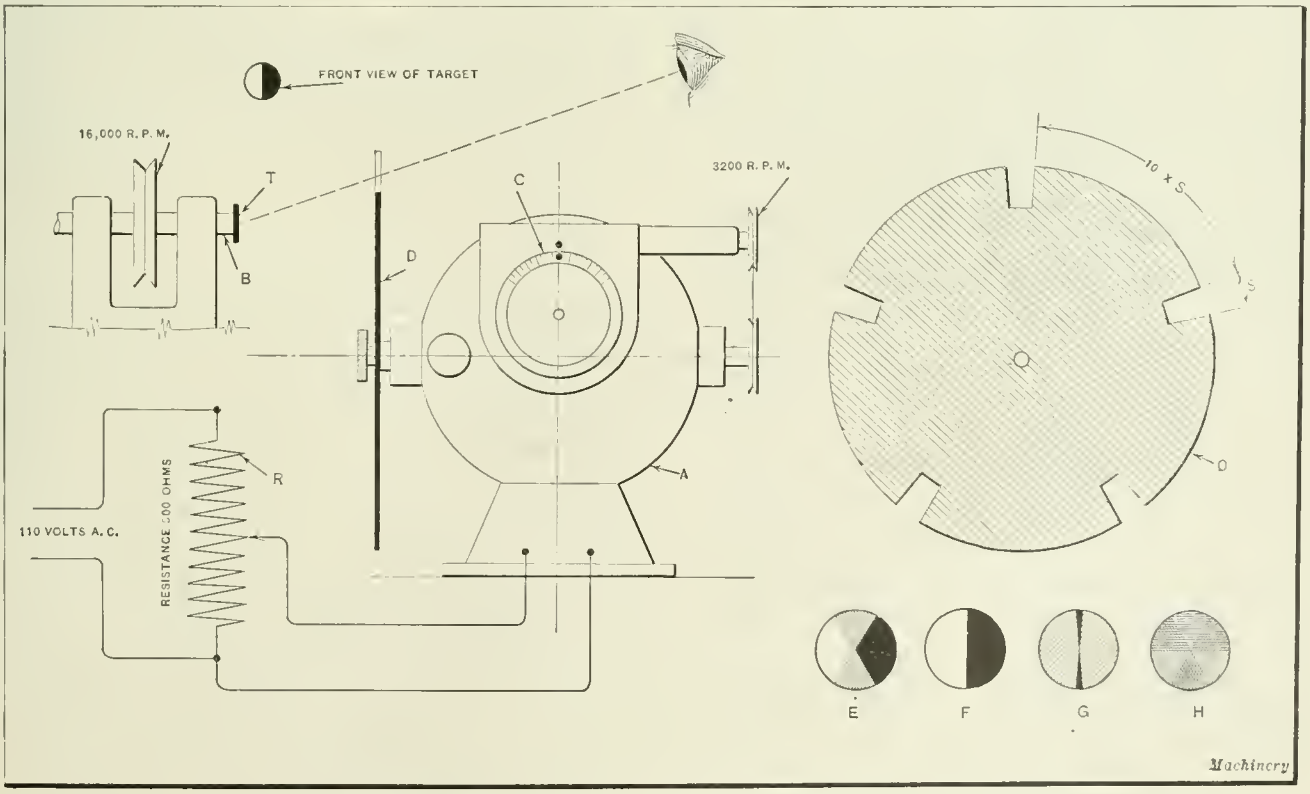


Diagram illustrating Use of Flicker Tachometer in determining Speed of a Shaft disk to obtain the speed of the shaft under observation. In explanation, the stroboscopic action of the flicker disk might be compared to that of a moving picture camera, since it takes instantaneous pictures of the end of the shaft. If the shaft makes one revolution in the interval that successive slots in the flicker disk pass the eye, the shaft will appear to be always in the same position, and it will apparently stand still. When this condition obtains, the flicker disk may be said to have reached its synchronous speed. If the speed of the shaft being tested falls below this synchronous speed, the shaft will appear to rotate backward, and if its speed is increased so that it revolves faster than the synchronous speed it will appear to be turning forward.

If the shaft is running at one-half or twice the synchronous speed, it again apparently stands still, and errors in determining the speed may thus occur. In order to eliminate the chance of making errors of this kind, a target *T* with one-half its surface blackened as indicated in the illustration, is used as an observation point. A simple circular piece of paper that has half its surface black and the other half white, attached to the end of the shaft with gum or shellac so that it will revolve with the shaft, makes a suitable target.

At twice the synchronous speed, or in other words, when the flicker disk is not running fast enough, the target does not show a full 180-degree black sector, as it does when the synchronous speed has been reached by the flicker disk, but instead it appears to have a sector of about 120 degrees of dense black with grayed sections at each side, as indicated diagrammatically in the view at *E*. At one-half the synchronous speed when the flicker disk is revolving too fast, the target becomes gray with a single dark line through the center as indicated at *G*.

In the first case, the shaft has an opportunity of making one revolution while completely hidden behind the opaque portions of the flicker disk *D;* that is, the shaft is seen only in the position it occupies at every other revolution. Thus the period of time that the target is visible through any one slot is twice as long as when the flicker disk is running at the synchronous speed. This accounts for the attenuation of the dark area and the graying of its edges.

At one half the synchronous speed, when the flicker disk is running too fast, the shaft makes only one-half a revolution between the passages of the slots, so that the dark part of the target is seen first on one side of the center and then on the other side. Under this condition the target would appear to be of a uniform gray, if the slot or aperture in the periphery of the flicker disk were of negligible width, but since it has an appreciable width, the two positions overlap somewhat, giving the strong dark line through the center of the gray patch.

At other speeds, where the ratio can be expressed by a small fraction, crosses and spoked patterns appear. The appearance of the target when the flicker disk is running at the synchronous speed is shown by the view at *F*, while at *H* the target is shown as it appears when the jack-shaft has reached a speed of only one-third the correct synchronous speed.

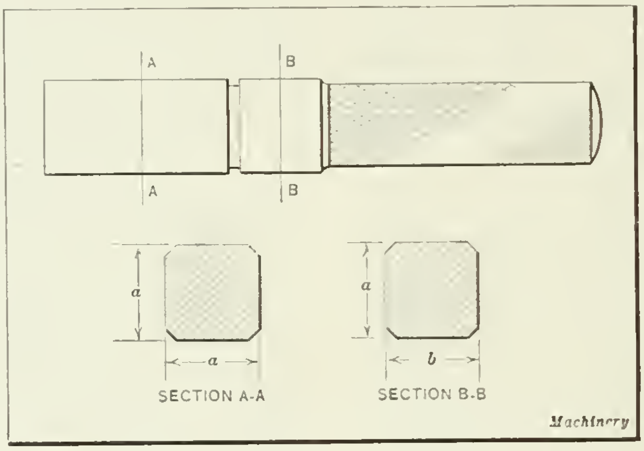
This method of determining the speed of a shaft cannot be used satisfactorily in a room illuminated by arc lamps operating on alternating current, or where incandescent lamps are used that operate on a 25-cycle current, because the flicker of the lighting system is superimposed on the target, thus giving results that are difficult to interpret.

When correctly employed the method of speed determination described has a number of advantages. In the first place, it can be used for a wide range of speeds, from 300 to 500,000 revolutions per minute. Second, it does not absorb power from the observed shaft. This is a particularly desirable feature in indicating the speed of spindles driven at extremely high speeds. Third, it can be used to obtain the speeds of shafts in inaccessible places by using set-screws, patches of grease, etc., as targets. The arms of pulleys, however, should not be used as observation points. Fourth, it will show rapid variations in the average speed which the ordinary tachometer will not show because of its more sluggish action.

Hartford, Conn. PAUL M. MUELLER

SQUARE-HOLE LIMIT GAGE

An improved type of square-hole limit gage has recently come to the writer's attention. The "Go" portion indicated by section *A–A* in the accompanying illustration is ground in the usual way, while the "Not Go" portion indicated by section *B–B* is ground on two opposite sides to the same dimensions as the "Go" portion. The remaining two sides are ground to the "Not Go" or high limit. Referring to the illustration, dimension *a* represents the "Go" limit and *b* represents the "Not Go" limit.



Limit Gage for testing Accuracy of Square Holes

The writer has used square-hole gages provided by some of the finest automotive and specialty shops of the country. Among all those used, only one shop employed the type of gage here shown. In view of the fact that a strong demand exists for accuracy in the dimensions across flats, this type of gage should become very popular.

In testing or gaging a hole, the "Not Go" portion of the gage should not, of course, enter the hole if the hole is machined to the correct size, but, regardless of whether it does or not, the gage should be removed and given one-quarter turn, and again inserted in the hole. In this way, the distance across either of the opposite flatted sides is gaged independently of the other two sides. As very few holes are machined absolutely square, the advantage of testing the accuracy of the hole with a gage of this type is obvious.

New London, Conn. GEORGE E. HODGES

TESTING FUEL OIL BEFORE ACCEPTANCE

Specifications for ordering fuel oil at a certain plant had been carefully drawn up to prevent the possibility of receiving a Mexican or high-sulphur oil for which the burner system of the plant was not designed. Through an error in shipping instructions, however, a car of Mexican oil was shipped to this plant and, as was customary, the oil was tested by a member of the works laboratory before being put into the storage tanks. The error was discovered, of course, and another car of the proper kind of oil ordered to take the place of the Mexican oil. A great deal of trouble was thus avoided, for had this heavy oil gotten into the system (which held about 30,000 gallons), it would have clogged up the needle valve burners, and the whole plant would have been tied up. It is the policy in this plant to have all raw materials tested by a member of the works laboratory before accepted for use.

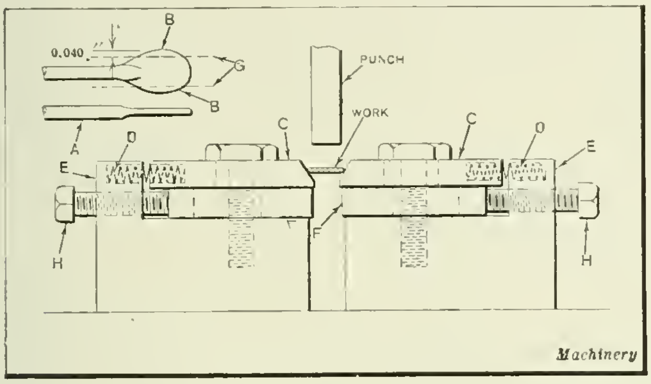
Philadelphia, Pa. ARTHUR L. COLLINS

TRIMMING DIE WITH UNIQUE LOCATING DEVICE

The die here illustrated is used to trim the sides *B* from parts such as shown at *A*. The flattened end of the work is placed in the vee formed by the guide plates *C*. As the punch descends, it forces the work downward, thus causing plates *C* to be pushed back against the tension of springs *D*, until further movement is stopped by the upward projecting ends of blocks *E*. When this position is reached, the work has been pushed down until it rests on the upper faces of the trimming dies *F*.

The inner ends of slides *C* are in contact with the work at this time, and serve to centralize it over the trimming dies *F*, so that the same amount of metal will be removed from each side. The continued downward movement of the punch forces the work past the trimming dies, thus trimming the flattened part of the work along the lines indicated at *G*. As the ends of the die-plates *F* overhang the die-blocks *E*, the work is left free to be removed when the punch has carried it past the ends of the die-plates.

The metal removed from the sides of the work remains on the die-plates *F* until the punch ascends. When the punch clears the die on the upward stroke, the springs *D* cause plates *C* to move forward and push the chips or trimmings into the opening, so that they fall through a hole in the die-bolster. The ends of dies *F* are not given any clearance, and so the work is burnished in passing through the die. The ends of the dies, as well as the end of the punch, can be easily sharpened by grinding. The screws *H* provide a means of adjusting the die-plates *B* to a good cutting fit on the punch.



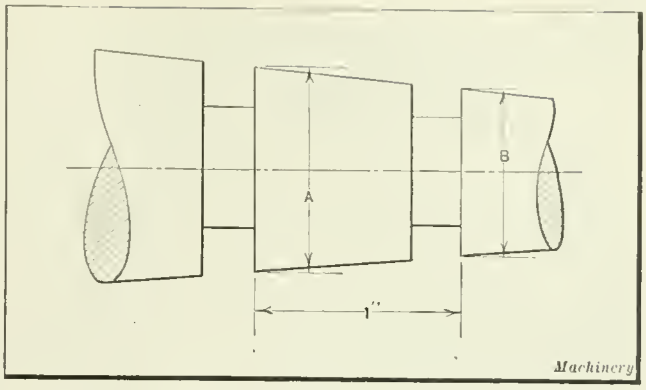
Trimming Die for Part shown in Detail View

Philadelphia, Pa. R. H. KASPER

METHOD OF SETTING LATHE TAPER ATTACHMENT

A method of setting the taper attachment of a lathe which has been found satisfactory by the writer is described in the following: A piece of round scrap stock is first placed in the chuck or collet and the compound rest is then set at an angle of 90 degrees or parallel with the axis of the lathe spindle. A cutting-off or parting tool is next placed in the toolpost and the dial on the compound rest set at zero. Then, using the cross-feed, a groove or neck is cut in the stock to a depth of 1/4 inch, and the tool withdrawn. The feed-screw of the compound rest is then turned until the dial indicates a movement of 1 inch to the left, after which the tool is again fed into the work and withdrawn. This produces two grooves or necks having faces exactly 1 inch apart as will be seen by reference to the accompanying illustration.

The taper attachment is next set approximately to the taper desired and a trial cut taken across the work, which will leave two high points that can be easily measured with a micrometer. The taper attachment is then adjusted until the difference between the diameters at the high points of dimensions *A* and *B* is equal to the taper per inch, or one-twelfth the taper per foot.



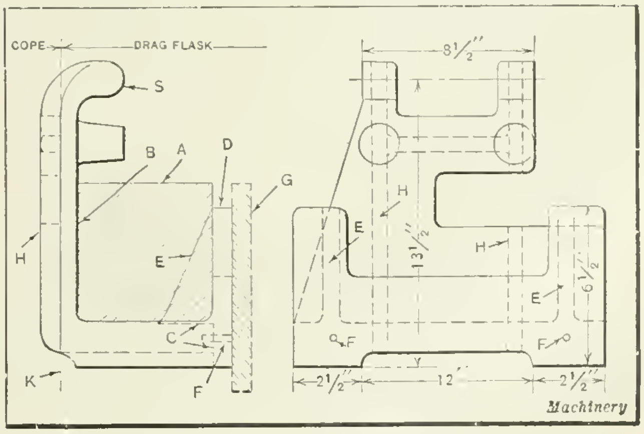
Method of turning Piece of Scrap Stock to facilitate testing Accuracy of Taper Attachment Setting

Erie, Pa. LEO R. LYNCH

PATTERN FOR CAST-IRON BRACKET

Many draftsmen unnecessarily complicate the work of the patternmaker and molder by their attempts to reduce to as few as possible, the number of castings required for repair jobs or for constructing special machines or tools. When too many details or elements are combined in one casting, the resulting designs often present such difficult problems in patternmaking and molding that any advantage gained by a reduction in the number of castings is more than overbalanced by the difficulties encountered in making the patterns and in molding. However, the patternmaker can, and often does, simplify designs originated by the draftsman that involve needlessly complicated patternmaking and molding problems. In case the patternmaker fails to provide patterns that can be conveniently employed by the molder, the latter may make further changes in order to facilitate his work. For instance, in the production of the pattern shown in the accompanying illustration, changes in the original design which were suggested by the molder saved considerable time and resulted in a better casting.

The pattern was made for use in molding a bracket casting to replace one that had been broken. The original bracket was made in two pieces, which were machined and bolted together. Instead of making separate patterns for the two pieces as was originally done, the patternmaker made a pattern designed to produce a complete bracket in one piece. The one-piece pattern was made to be molded in a two-part flask. The space between the hinge bracket *S* and the foot was intended to be molded in a dry sand core, such as is shown by the dotted section at *A*. The hinge



Two-part Pattern for a Cast-iron Bracket section of the pattern was intended to be molded in green sand. The reason given by the patternmaker for making the pattern in this way was that a stronger pattern would be obtained. A casting can be produced by the use of a pattern made in this way, but it is difficult to produce a dry sand core of correct size that will present a flat surface along the face of the casting at *B* when set in the mold.

The changes in the pattern suggested by the molder were as follows: The pattern was made in two pieces to be parted on the dotted line *C;* the foot *D* and ribs *E* were made loose, and held in place with dowel-pins *F*. The whole pattern was to be molded in green sand in the drag flask with the parting on the line *K*. As the cover core *G* entered into the molding operation, it was possible to use a two-part flask, but this core has nothing to do with the making of the pattern.

To one who is not experienced in molding practice, the making of a mold by the use of this pattern appears to be a complicated job. Actually the method is simple and one that can be used in making patterns for a great variety of parts. The whole pattern up to the line *K* was molded in the drag flask, and the ribs *H* were molded in the cope. According to the generally accepted rules for good patternmaking practice, all parts above the parting face should be made loose whenever possible. As there was but one casting to be made in this case, this rule was disregarded, and the rib pieces were nailed fast to the pattern. The ribs were given extra taper to facilitate lifting the cope.

The drag flask was placed on a bed of molding sand, and the pattern placed within the drag on the bed of sand with the ribs *H* imbedded in the sand up to the parting line *K*. Sand was shoveled in and rammed up to the top of the pattern. Next the loose piece *D*, with the ribs *E* fastened to it, was lifted out of the mold, being parted from the main pattern on the dotted line *C*. This section of the mold was then mended and finished in the usual way. The cover core *G*, more commonly called a slab core by foundry workers, was next placed over the opening left in the mold by the removal of the loose piece *D*. After setting the cover core in place, the drag flask was completely filled in with molding sand. It was then rolled over and the cope flask put in place. The cope part of the mold was then completed in the usual way. After lifting the cope and removing the remaining section of the pattern, the cope and the drag were locked together, thus completing the mold.

Kenosha, Wis. M. E. Duggan

A NON-SPLITTING WOOD SCREW

An improvement in the ordinary wood screw can be made by grinding a flat down one side of the threaded part of the screw, thus enabling the screw threads to tap out a hole for themselves. This expedient has been used successfully on pattern work. It eliminates the necessity for first drilling out the screw hole, in order to prevent splitting the wood, and does not appreciably weaken the joint. P. R. H.

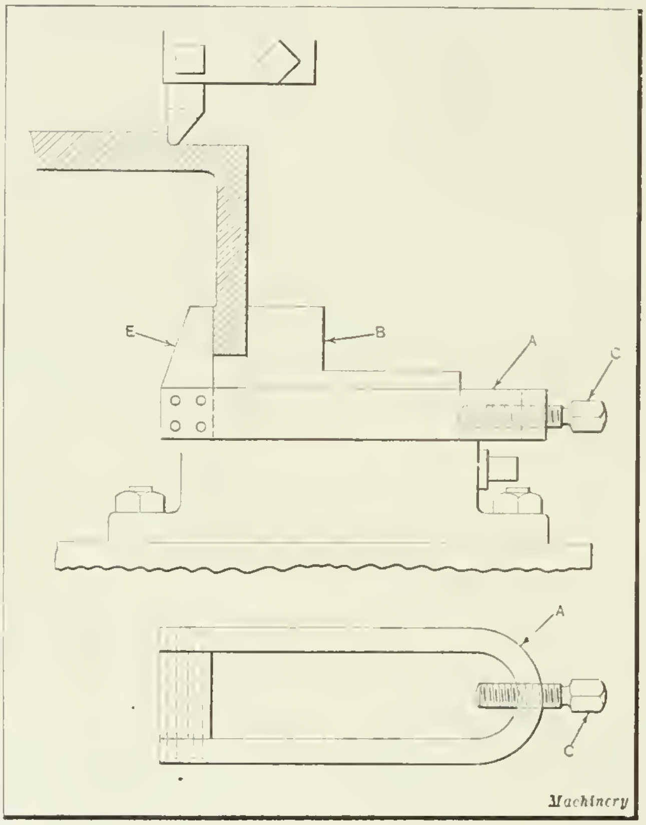
SUPPLEMENTARY JAWS FOR BORING MILL CHUCK

Difficulty is often experienced in holding thin rings, cylinders, or drums in the regular chuck of a boring mill. If the jaws are adjusted to clamp the work tight enough to permit taking a heavy cut, the work is likely to be distorted or sprung out of round. On the other hand, if the jaws are clamped lightly on the work, there is danger of the work slipping. In order to overcome these difficulties and make it possible to take heavy cuts, supplementary jaws like the one shown at *A* in the accompanying illustration were designed for use in one shop. These jaws were slipped over or around the regular jaws *B* as shown. The regular jaws are first tightened, after which the supplementary jaws are brought against the inside of the work.

The supplementary jaws are tightened by means of the screw *C* located at the rear of the clamping strap. The clamping straps, in this particular instance, were made of ½- by 1½-inch steel stock, and the jaws *E* were made up of steel to suit the width of the regular jaws. The straps were fastened to the jaws by means of rivets and by welding. By properly proportioning the length of the straps, work of any thickness can be held in place.

Joe V. Romig

Allentown, Pa.



Supplementary Jaw for Boring Mill Chuck

* * *

The spontaneous breaking of main springs in watches has been investigated by S. R. Williams of Oberlin College. An examination of the records of several years of two firms doing a large repair business in watches indicated that there is a peak in this business in the summer, fairly coincident with the occurrence of the greatest number of thunderstorms. Further experiments indicated that the breakage is not due to heat, however, but to moisture. It is believed that the moisture acts by starting rusting points which weaken the spring. In an experiment in which fifty-six samples were tried, equally divided between two well-sealed jars, one containing dry and the other moist air, seventeen springs out of twenty-eight broke in the moist air, while none broke in the dry jar. Oiling the springs was found to markedly decrease the liability of breakage.

* * *

The primary safeguard to continued prosperity will be continued willingness of our people to save their enlarged earnings, to resist extravagance and waste, to give full individual exertion. Our second safeguard rests upon the individual business man in today's well developed sense of caution and resistance to the will-o'-wisp of higher prices and over-expansion and speculation. Our third line of defense is our credit men and our bankers who can check the dangers of speculative credits. The danger point arises when there is an over-ordering of goods. Our bankers in daily contact with the commercial fabric of the country are fully alive to their responsibilities.—*Herbert Hoover*

The British Metal-working Industries

From Machinery's Special Correspondent

London, June 12

THE engineering industry continues to show periodic pulsations, each succeeding cycle leaving conditions generally a little better than before. The disappointing feature in the machine tool branch is that the rate of trade acceleration in the second quarter of the year has not kept pace with the first three months. Inquiries appear to be plentiful in all departments, but the period required for maturing into orders is very lengthy.

Conditions in the Machine Tool Industry

Machine tool firms having a fairly wide range of products are doing better than those that make but a single type. The wide variation in the experience of different concerns is shown by the fact that some report conditions to be considerably improved over six months ago, while others have found the depression at a lower level during the last few months than at any time for two years.

Makers of lathe and drill chucks, centers and sockets, state that business is very difficult to negotiate in the face of German competition. Conditions, however, show an improvement, compared with a few months ago, and France is stated to be a fairly good customer for some of these goods. The independent type of chuck is said to be in much better demand than the self-centering type, indicating a return to the manufacture of a variety of goods rather than a single specialized product.

Except in the heavier types, lathe makers are not very busy, but in plate and bar working machines substantial progress is being made. India is a good customer, and there is a fair amount of work on hand on account of British shipyards and steel works generally. Inquiry also is exceptionally good; in fact, one large firm that specializes in heavy hydraulic machinery finds it necessary to run night and day in the estimating and drawing office departments. Rolling stock makers and locomotive builders are becoming increasingly interested in machine tools, and there are excellent prospects of some good orders maturing from these sources in the near future. Meanwhile, financial considerations hamper the placing of business; that is to say, firms want new tools and could make good use of them, but for the moment they are prevented from buying by lack of capital.

Inquiries, however, in addition to being scattered broadcast throughout all machine tool manufacturing countries, mostly arise from reconstruction schemes, either in government or railway work-shops, and such orders usually take a long time to mature. The number of inquiries and orders received by machine tool makers for repair parts for second-hand machines bought at sales shows clearly how badly the trade has been hit by the accumulation and disposal of surplus equipment, and it will doubtless be some years before this effect is eliminated. Recent inquiries from Russia for saws and tools are causing manufacturers to hope for a repetition of the good business that was done last year in these lines and on a cash basis.

General Engineering Field

Textile machinery makers and those engaged in the manufacture of details for these trades are fairly well employed. The builders of electrical machinery also have little cause for complaint, and the brass trades are receiving a fair volume of inquiries which, it is hoped, will shortly turn into business.

Among railway engineers a brighter tone is noted. Locomotive builders have recently obtained a number of domestic and overseas orders, and it is understood that large additional orders will be placed in the near future on behalf of the Dominions and countries in the Near East. Rolling stock makers are also much more active, several orders for railway cars having recently been placed by the London & North Eastern Railway Co. Works engaged in the production of railway tires, wheels and axles, and buffers and springs are busy on domestic, Indian, and Canadian orders.

Iron and Steel Industries

Iron works in Lanarkshire are gradually opening up, and since the first of the year several thousand men have found employment. Scottish foundries are busier than they have been for several years. In Sheffield, the iron and steel industries appear to be marking time, the recent rapid price advances, ranging from 40 to 50 per cent, in the common brands of steel, having effectively applied the brake so far as the placing of new orders is concerned. In the heavy steel departments, which are booked well ahead, contracts generally were entered into before the recent series of advances. The output is now stated to be on a pre-war scale, while for basic and acid steel it is even greater, as the present greatly increased capacity is now working at about four-fifths of its maximum capacity. In some districts, more than twice the number of iron and steel furnaces are in operation, as compared with twelve months ago, and the rolling mills are in full swing.

With the general engineering trades recovering but slowly and the shipyards with room for many more orders, the demand for tool steel continues to be low. The trade in edge tools is very disappointing, although makers of saws are doing a little more business. With restricted Continental production and high American costs, it is considered possible to increase the trade with the colonies and South America, as stocks in the lighter steel trades are low and requirements great.

Overseas Trade in Machine Tools

The returns for April show a recovery in the volume and a fall in the average value of exports of machine tools. Thus during April the total exports reached 1183 tons, as against 911 tons in March, the corresponding values being £125,390 and £119,441. Imports continue to oscillate, as they have for the last two years. In April imports reached 300 tons with a value of £42,368. The value per ton of exports fell to £106 and that of imports rose to £141.

New Machine Tools

A new departure has been made in machine tool design by Wilkins & Mitchell, of Darlaston. Briefly, the machine may be said to consist of a number of standard drill heads, each carrying a set of adjustable drill spindles, which may be arranged in any order within the scope of adjustment to suit the work in hand. The heads are self-contained electrically driven units, and may themselves be mounted in any desired series on a frame which is built up of standard sections that may be added to indefinitely to accommodate the drill heads in any required horizontal, vertical, or angular positions. The machine can be arranged for simultaneously carrying on different operations; for example, milling may be done at one point while drilling or some other operation is in progress at another part of the machine.

MAKING LEATHER BELTS ENDLESS

By LOUIS W. ARNY

Almost any kind of belt can be made endless by the belting manufacturer, and when an endless belt can be placed around the pulleys without an expenditure of too much time and effort, and there is provision for taking up the stretch, new belts should be ordered to be made endless. If it is necessary to take down shafting and pulleys to install such a belt, or if there is no provision for taking up the stretch, a belt made endless at the factory is impracticable. Some belts can be made endless on the pulleys satisfactorily, and some cannot. This article applies only to leather belts or to those that can be made endless on the pulleys satisfactorily. Making a belt endless on the pulleys is like many another job in that it appears difficult and complicated, but when the trick has once been learned, it will be found to be remarkably simple.

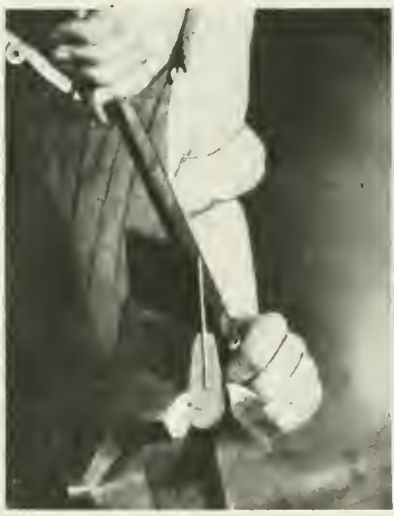


Fig. 1. Starting to turn over the Edge of the Turned-edge Scraper

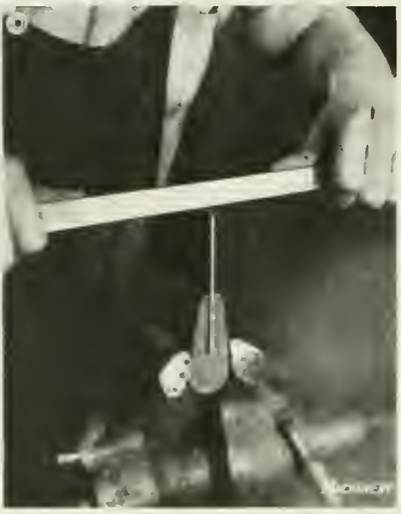


Fig. 2. Completing the turning over of the Edge of the Turned-edge Scraper

The tools required are as follows: (1) Clamps and rods; (2) belt scraper; (3) slicker; (4) belt hoe; (5) belt shave; (6) spoke-shave; (7) long skiver; (8) heel chop; (9) knife sharpener; (10) steel sharpener; (11) awl; (12) drive punch; (13) blind punch; (14) staple puller; (15) glue kettle; (16) ripping hammer; (17) screwdriver; (18) pegging hammer; (19) hand punch; (20) 3½-inch best glue brush; and (21) safety copper glue kettle.

Any of these tools not already on hand may be obtained from leather belting manufacturers. There is only one of them that is unusual to the ordinary mechanic—the turned-edge scraper (see Fig. 1). The blade of this tool is formed of a flat piece of good steel, about the thickness and quality of good saw steel. This blade is fitted in a handle, as shown. The unusual feature about this tool is that it has an edge that is turned at right angles to the blade. This is accomplished by first grinding a long edge and then rubbing this down to a fine edge on a "clearingstone." A smooth, hard, steel tool is next used, as shown in Fig. 1, for turning this edge so that it is at right angles to the blade. With the scraper firmly held in a vise, pressure is applied on one side, about at the angle shown. When the edge is smoothly and uniformly turned to this angle, the angle of the steel tool is changed to about half way between the positions shown in Figs. 1 and 2, and the process repeated. The steel tool is then held at right angles to the blade (see Fig. 2) in order to turn over the edge to the right-angle position.

There is a small steel tool known as a "steel sharpener" which is round, slightly tapered, and has a smooth, hard point; this is used to keep the turned edge of the scraper in good cutting condition, by rubbing the hard point on the under side of the turned edge, and the surface of the tool on the upper side. These turned edges are fairly durable, when working in leather, but when they are gone it is necessary to grind the tool again and repeat the process of forming the edge. The scraper is one of the most important tools in the beltmaker's kit, because it saves much time in cutting laps, and because by its use it is possible to scrape down a lap to an even bevel, and to make sharp points on the laps.

Making Laps

In making the laps on the belt, the first step is to decide on the length of the lap desired. Generally speaking, it is wise to make a new lap of the same length as the others in the belt, although in the case of double belts, this may be varied to suit the conditions. One lap should not be made over another one, and it may be necessary to make a lap longer or shorter to avoid this. The things to be remembered are that the line of the point and the line of the heel must be exactly square with the edge of the belt, that the bevel from heel to point must be uniform and regular, and that there must be no "humps," especially back of the point, to prevent the proper adhesion of the cement at every point of contact.

Next, clamp the belt to a table, so that both hands are

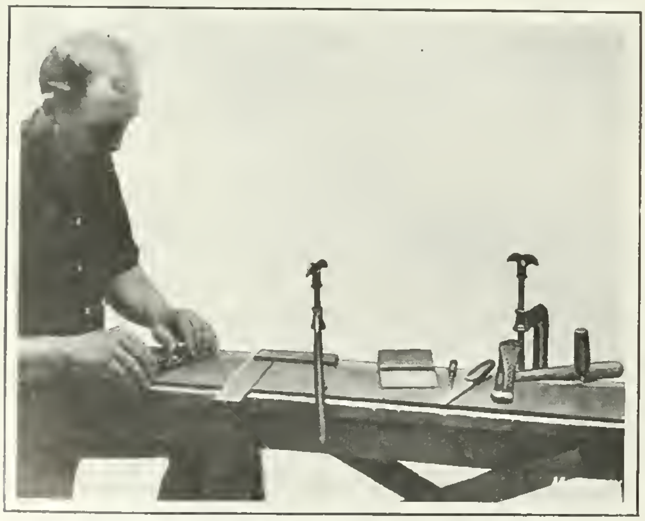


Fig. 3. Cutting away the Material for the Lap Joint with the Spoke-shave

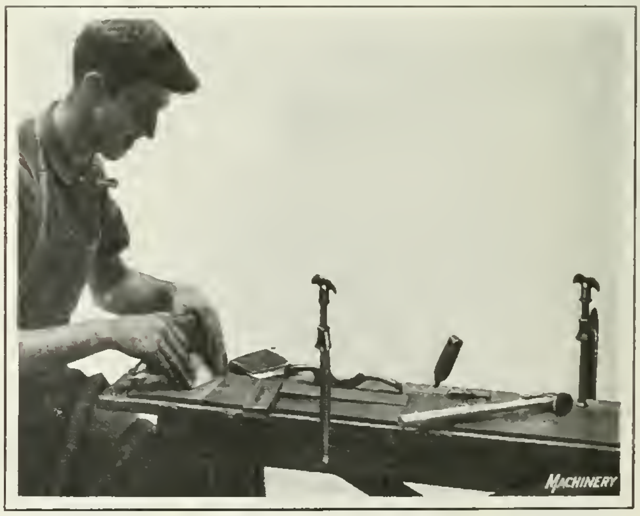


Fig. 4. Scraping down the Joint to a Fine Point with the Turned-edge Scraper

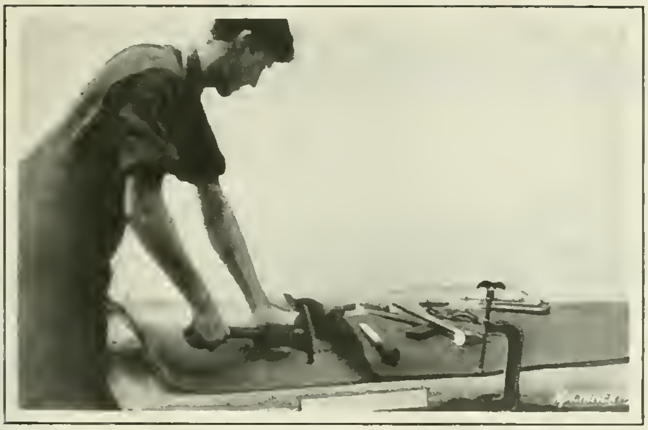


Fig. 5. Scraping off the Old Glue at the Joint

free for the use of tools. Measure the lap desired, and mark across the belt a line, drawn by the use of the square, representing the end or heel of the lap; then proceed, with the spoke-shave, to cut away the material from this line down to the end of the belt, the latter becoming the point of the lap (see Fig. 3). The lap should be "roughed off" with the spoke-shave, and then scraped down to the point with the scraper (Fig. 4), and trimmed up with the knife. A small steel plane can also be used to advantage in connection with the spoke-shave.

Care should be taken to remove all the old glue, the scraper being used as shown in Fig. 5, in order to present a clean fresh surface to the cement. The glue should be hot, and not too heavy; it should be spread thin and worked carefully into the fibers of the leather, as shown in Fig. 6.

Next bring the two glued surfaces together, taking care that they do not slip on each other. Rub the joint with a scraper handle to supply a little pressure, or place the joint between two small boards and apply pressure with the bench clamps. Permit the glue to "set" for an hour before putting the belt on the pulley.

* * *

ANNUAL MEETING OF SOCIETY FOR TESTING MATERIALS

The twenty-sixth annual meeting of the American Society for Testing Materials was held June 25 to 29 at the Chalfonte-Haddon Hall, Atlantic City, N. J. Among the many subjects dealt with at this meeting were the following: Non-ferrous metals and alloys; copper wire; methods of casting test specimens of gunmetal; influence of the ratio of length to diameter in compression testing of babbitt metals; corrosion of iron and steel; corrosion of non-ferrous metals and alloys; endurance properties of steel; resistance of manganese bronze, duralumin, and electron metal to alternating stresses; magnetic analysis; a new method of magnetic inspection; the significance of tool temperatures as a function of the cutting resistance of metals; and heat-treatment of iron and steel. Copies of the papers presented before the meeting may be obtained by addressing the society at its headquarters, 1315 Spruce St., Philadelphia, Pa.

* * *

At a recent meeting of the Association of Gas and Internal Combustion Engine Builders and of Builders of Gas Producers in France, attention was called, says *Le Genie Civil*, to the use made in France of the abbreviation H. P. for horsepower, this expression designates the British and American unit of power, which is equal to 33,000 foot-pounds per minute, or approximately 76 kilogram-meters per second, whereas the French horsepower, and the horsepower as used in all countries employing the metric system, is only 75 kilogram-meters per second. It was suggested that in the future the metric horsepower be designated C. V., an abbreviation of *cheval-vapeur*.

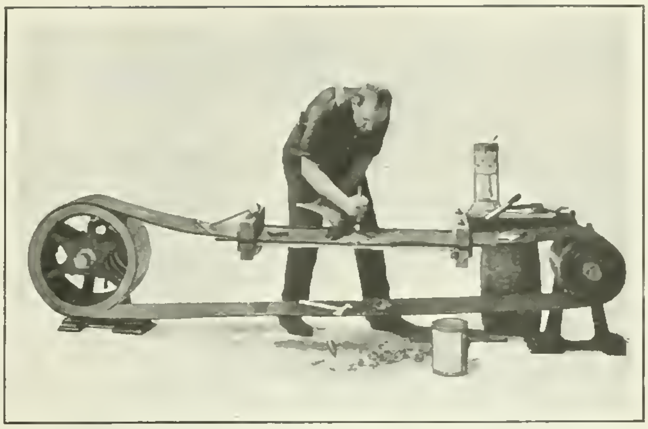


Fig. 6. Spreading the Cement and working it into the Fibers

TOLERANCES IN MACHINE BUILDING

It would be of great value to the shops engaged in building machinery of various kinds if more data were available on the subject of tolerances used by leading machine builders in their work. It does not seem possible to determine definitely the tolerances that should be used for different classes of fits under all conditions, and any attempt to lay down specific rules is likely to prove useless, but a great service could be rendered the industries by the Bureau of Standards or by the American Society of Mechanical Engineers if tolerances now actually employed in the building of a number of different machines and mechanisms were placed on record.

For example, suppose that through the Bureau of Standards a number of high-grade steam engine builders would agree to place on record the tolerances used in their shops on cylinder diameters, pistons, piston-rings, piston-rods, and bushings, crankshaft bearings, and other important parts where fits of different kinds are required. This would prove of considerable help and guidance to other manufacturers building similar types of machines, and would enable them to establish a system of tolerances and limits for their work. Gradually, such tolerances could be collected from every important field in the machine industries—machine tools, steam engines, steam turbines, pumps, gas engines, hydraulic turbines, automobiles, trucks, tractors, sewing machines, cranes and hoists, to mention only a few of the larger industrial divisions. A work of this kind is of such magnitude and importance that it can be successfully undertaken only by a public agency, such as the Bureau of Standards, or a professional society with a large membership, such as the American Society of Mechanical Engineers. There is no doubt as to the value of the work. Its cost should not be prohibitive, because it is a work that can be carried on gradually.

* * *

CHROMIZING

In a paper presented before the annual meeting of the American Electro-chemical Society, F. C. Kelley described in detail the process of chromizing and its effect on the physical and chemical properties of iron and steel. This process is somewhat similar to the well-known process of calorizing. It consists of packing the material to be treated in a powdered mixture of alumina and chromium—45 per cent of alumina and 55 per cent of chromium, by weight. The material is usually packed into a tube of iron, which is then heated to from 1300 to 1400 degrees C. in hydrogen, vacuum, or some neutral atmosphere. Chromizing has been used on turbine buckets in order to protect them against corrosion. As regards resistance to corrosion, chromized iron samples have been tested in comparison with sherardized samples and found to be equal to the latter. By casehardening and heat-treatment chromized iron may be made very hard.

The Machine-building Industries

THE great expansion that took place in the machine tool industry during and immediately after the war is well illustrated by a comparison between the pre-war business in this industry, the business done today, and the present capacity of the machine tool building shops. As nearly as can be determined, the number of machines sold today in the entire industry is approximately 50 per cent in excess of the average number of machines sold previous to the war; but notwithstanding this increase in demand, the machine tool industry, as a whole, is now occupied at only from 50 to 60 per cent of its capacity. Some shops, of course, have a greater volume of business than this, and in many instances the output is limited not by lack of orders, but by a scarcity of skilled labor. Several plants are operating to the fullest extent possible with the men available, and would increase operations if skilled help were to be had.

The demand is especially good for automatic machinery, some lines of drilling machines, and lathes. There is not quite so active a demand for planers, shapers, and milling machines. Some makers have found the difficulty of getting gray iron castings a limiting factor in their output. All gray iron foundries are occupied to capacity, with deliveries quite far in the future. The demand for forging machinery is good, and the shops in this field have all the business they can handle with the available labor supply. The demand for punching and shearing machinery is also good.

The Small Tool Industry

In the small tool field, the demand is fully normal; some of the drill manufacturers are unable to operate their plants to capacity because of lack of help. One manufacturer of drill chucks states that his present business is larger than ever before, and the special tool and equipment shops in the larger manufacturing centers in the middle western states are reporting unusually good business; only in the milling cutter field is there less than a normal demand.

One of the commercial agencies states that at the end of the high-pressure period in 1920 there were not less than 4700 tool shops making jigs, fixtures, gages, and special equipment in the United States—shops that had no regular line of manufacture and that employed anywhere from two to twenty-five men, only a very few being larger than this. Of these more than one-half are no longer in existence, owing to lack of business, but there are still about 2000 of these shops, and the better among them are now enjoying a good business.

Conditions in Special Fields

The demand for vises is good, and one concern states that April was the best month in volume of business in the history of the company. Good business is looked forward to in this field for the rest of the year. In the gear-cutting field, both the jobbing shops and those cutting automotive gears are fully occupied in most parts of the country. Some of the shops cutting automobile gears have orders for six months ahead and are working night shifts. The die-casting shops are active; most of them are taxed to capacity, and some are working over-time. The metal stamping and pressed steel shops have all the work they can handle; the gray iron foundries, as mentioned, are working to capacity and yet are unable to cope with the present demand on their facilities; and the forging shops are enjoying a normal business. In the ball and roller bearing field, the plants are running to capacity, and as a whole the machine-building industries are occupied to the fullest extent, limited in many cases only by the available labor supply.

The second-hand machinery market has returned to what must be considered a normal state. The excess second-hand machinery has been sold off, and dealers state that there is now only a regular supply to meet the normal demand for this class of machinery. Good second-hand machines are scarce.

Conditions in the Railroad Field

The railroads are in a better position financially than they have been for many years, and have placed unusually large orders for new rolling stock. There has also been a fair amount of buying of shop equipment, although proportionately less attention has been given to such equipment than to locomotives and cars. During the first four months of the year the railroads ordered over 1500 locomotives and 57,000 freight cars. Altogether there are about 2000 locomotives on order, still to be delivered, and over 100,000 freight cars. The railroads report record freight loadings during the past month. There are fewer freight cars in need of repairs than at any time in the last three years.

The Automobile Truck and Tractor Industries

Automobile production again broke all records in May with a total of over 400,000 cars and trucks, a rate of production equal to nearly 5,000,000 cars a year. The schedules for June are large, but after that a somewhat reduced output is generally expected. During the twelve months ended April 30, 3,208,000 new automobiles were sold in the United States. In spite of this great production, the demand is still said to be ahead of the output, and the manufacturers of the leading makes of cars complain about the shortage of labor and materials. The well-known automobile companies are in a stronger financial position than ever before, while some of the smaller ones have gone into receiverships.

The Iron and Steel Industry

The basic industry in the machine-building field—the iron and steel industry—is unusually active. The great demand of two months ago has fallen off somewhat, but this is favorable to continued prosperity in the machine-building field rather than otherwise; a lessening demand for raw materials will prevent further increases in prices. Deliveries are so far in the future that even with a decrease in new orders, production continues practically unchanged. The pig iron output during the month of May broke all previous records, as did also steel ingot production.

Summary of the Business Situation

In reviewing the business situation, the Federal Reserve Bank points out that the business pulse is steadier—not weaker—as a result of the discriminating attitude adopted in buying. A spirit of conservatism is evident, which is reassuring. This is an indication that the continuation of sound prosperity is preferred to a business boom. Most business men do not want industry to travel so fast that it will become travel-worn. At present there is little evidence of unwieldy inventories; and there is an indication of a desire to keep bills paid up. Generally speaking, business is now on a more substantial basis—more normal—than it has ever been since the beginning of the world war. There is neither abnormal demand, caused by artificial conditions, nor lack of demand, caused by business depression. "Normaley" has at last arrived.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Fellows Thread Generator

FOR generating threads on taps, worms, hobs, and similar parts at high rates of cutting speeds, the Fellows Gear Shaper Co., Springfield, Vt., has recently placed on the market a machine that operates on the molding-generating principle, using a helical gear-shaper cutter. The principle of operation can best be understood by considering the threads as rack teeth wrapped around a cylinder in a helical path. The work rotates on an axis at right angles to that of the cutter, and the cutter rotates in harmony with the work; that is, the work and cutter are geared together in relation to the number of teeth in the cutter and the number of threads on the worm. The cutter is carried in a head mounted on a slide that is traversed longitudinally along the work, and as the cutter is rolled in mesh with the work, it produces threads by the molding-generating process. Some idea of the production possibilities of this new thread generating machine can be obtained by studying the action of the helical gear-shaper cutter that is employed. The following description will make clear the nature of the cutting action:

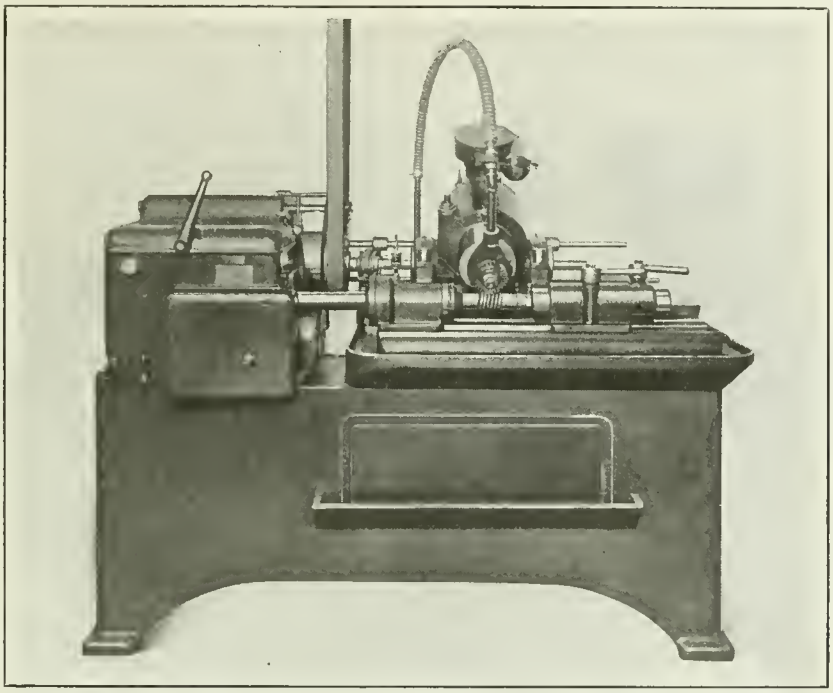


Fig. 1. Fellows Thread Generator for Worms, Hobs, Taps and Similar Work

The principle of generation, as applied on this particular machine, enables the cutter to be operated at a high rate of speed, which results in several advantages over other forms of thread-cutting tools. First, as the cutter is rolled in mesh with the work, any particular part of the cutting edge on the tool remains in contact with the work for only a very short period of time. Second, this rolling action enables the cutting tool to take a "shaving" cut, so that a comparatively coarse feed can be employed. Third, one tooth is not depended upon to do all the cutting, as there are many teeth which are brought successively and at a rapid rate into contact with the work. In this process, the cut is a combination turning and milling one, having the good features of both and the disadvantages of neither.

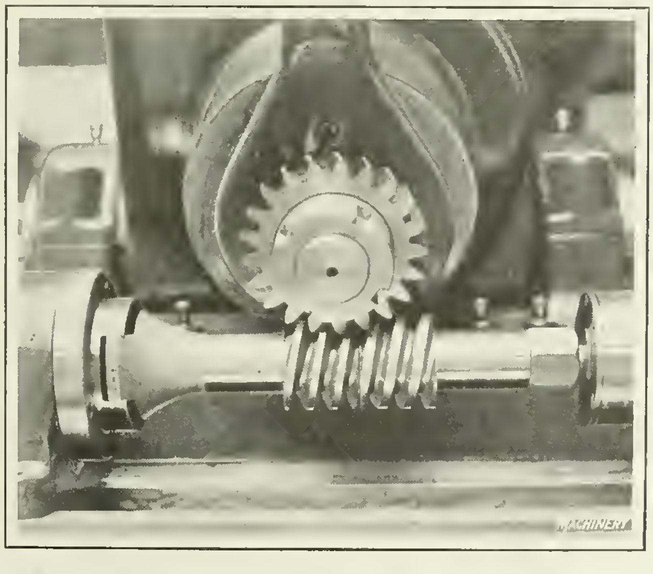


Fig. 2. Close-up View of a Thread-generating Cutter producing Two Double-thread Forms

As an illustration of the work that may be performed, it will be assumed that a triple-threaded worm, 2.100 inches in outside diameter, is to be generated, and that the worm can be rotated at a speed of 600 revolutions per minute. If the cutter used has a pitch diameter of 3½ inches and a circular pitch of 0.525 inch, it would have 21 teeth and should rotate at a speed of 57.14 revolutions per minute. At a work speed of 600 revolutions per minute, the cutting speed at the periphery of the work would be 330 feet per minute. Each tooth of the cutter would remain in contact with the work for approximately 1/20 of a second, as 1200 teeth would be presented to the work every minute. If a comparison is made between these speeds and those used in milling and turning with tools made from high-speed steel, it will be seen that speeds ranging from three to five times as great can be employed in this generating process, thus permitting high production rates to be obtained.

The principle of thread generation, as briefly outlined in the foregoing, demands three main conditions in a machine intended for generating threads. First, the cutter must be rotated in the proper relation to the work; second, there must be an arrangement for traversing the cutter longitudinally past the work; and third, provision must be made to compensate for the rolling motion of the cutter. As an illustration, if a generating cutter were geared up with a worm thread, the cutter would run satisfactorily with the thread, provided the cutter were not moved longitudinally. As soon as the cutter was moved longitudinally, it would cut off the threads on the work unless there was some provision to compensate for the rolling motion of the cutter.

Features of the Design

Change-gears are provided for obtaining the proper ratio of rotation between the cutter and the work, and also for traversing the cutter along the work at the desired feed per revolution of the latter. Change-gears and a differential mechanism compensate for the rolling motion of the cutter.

In order to permit the cutter-slide, which is operated by means of a lead-screw, to be traversed in both directions, a reversing clutch is furnished on the main feed shaft. In cases where it is possible to finish the work at one pass of the cutter, the cutter may be traversed from right to left on the first part, and the next piece machined after shifting the reversing clutch so as to traverse the cutter from left to right. Thus the mechanism obviates the necessity of returning the cutter-slide to the starting position at the completion of each cut. As the cutter passes out of contact with the work, a tripping mechanism is operated to stop the machine.

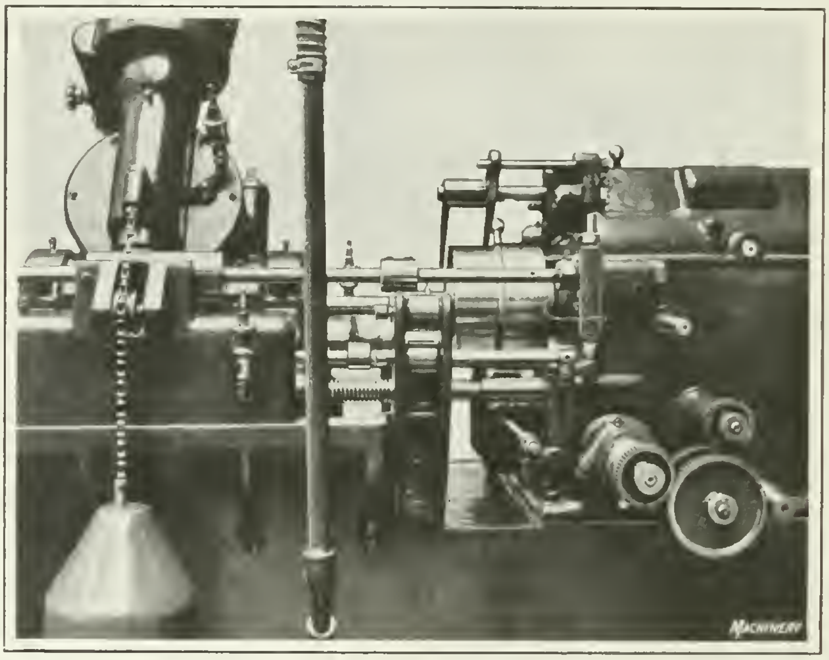


Fig. 3. Rear View of Thread Generator, showing the Driving and Tripping Mechanisms

The cutter-head is provided with trunnions which are retained in bearings in the cutter-slide, and so the head can be swiveled on the trunnions to elevate or lower the cutter relative to the work. The control of the head is through a depth bar, which is supported in a seat in a projection on the cutter-slide. Resting on this bar is a shoe or roll, as the requirements may demand, which is held in a rod that passes up through the head and is screwed into a worm-wheel, the latter being operated through a worm and hand-wheel for setting the cutter to the proper depth. The depth control bar can be made in various shapes so that roughing and finishing cuts can be taken on a part, or the bar can be made plain for taking only one cut.

Capacity of the Machine

This thread generator has been designed to handle a large range of work. On the No. 1 machine the maximum length of thread that can be cut is 12 inches; the maximum center distance, 18 inches; the maximum outside diameter, 4 inches; the maximum pitch, ⅝ inch linear or 5 diametral pitch; the maximum helix angle, 23 degrees; and the maximum pressure angle, 14½ degrees. When provided with standard equipment, this machine will cut single, double, triple, and quadruple threads from ¼ to ⅝ inch, or 6 to 16 millimeters, inclusive, linear pitch. By the use of a special worm and worm-wheel in the cutter-head, which may be substituted for the standard type, single threads from 0.050 up to and including ¼ inch, or from 2 to 6 millimeters, inclusive, linear pitch, may be cut.

The application of the molding-generating principle to cutting threads on worms, hobs, taps, etc., by employing a Fellows helical gear-shaper cutter, has resulted in the development of a machine running at unusually high speeds.

LAPOINTE HYDRAULIC BROACHING MACHINE

A hydraulically driven pull-broaching machine known as the No. 3H has been recently brought out by the J. N. Lapointe Co., New London, Conn. The principal feature claimed for the new machine is the high production rates obtainable. For example, in using a six-spline broach, 1⅝ inches in diameter and 48 inches in length, 175 pieces have been broached per hour. An efficiency of 93 per cent is claimed for the driving method. The cutting and return speeds of the draw-head are instantly adjustable to any rate from 0 to 25 feet per minute by manipulating the upright lever at the broaching end of the bed. This lever is pulled to the left to make the ram pull the broach through the work and to the right to cause the return of the draw-head.

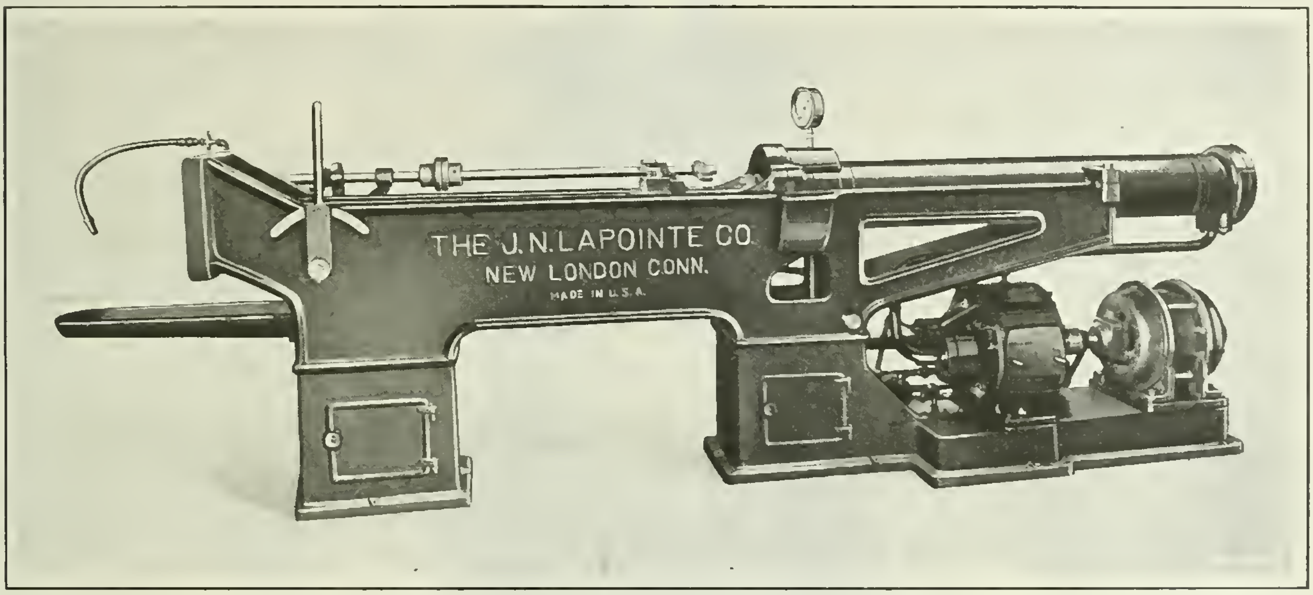
The movements of the control lever are imparted through links and rods at the back of the machine to a rack and pinion mechanism which operates the valve of a Hele-Shaw high-speed rotary pump driven by a constant-speed 7½-horsepower motor running at 860 revolutions per minute. The armature shaft of the motor is connected directly to the driving shaft of the pump through a tooth clutch. When the control lever is operated to the left, the pump valve is opened to deliver oil under pressure into the forward end of the machine cylinder and force back a piston attached directly to the draw-head ram. Conversely, when the control lever is pushed to the right, the pump valve is opened to admit oil into the cylinder in back of the piston and give the return stroke to the draw-head.

The pressure developed depends upon the extent that the pump valve is opened to admit oil into the cylinder. A maximum pressure of 1500 pounds per square inch can be produced, and the machine has a rated capacity of 32,000 pounds pulling force. The central shaft of the pump is hollow and functions as a valve for discharging oil into the cylinder, having both inlet and exhaust ports. The pump may also be driven by belt instead of a motor.

Supported by upright brackets at the rear of the machine is a longitudinal rod that is connected to the pump control mechanism in such a way that it is moved with the control lever and in the same direction. At each end of this rod there is a projecting dog which the draw-head trips at the end of its stroke to throw the control mechanism and the pump valve into the neutral or inoperative position. This insures that the machine will stop at the desired point without any effort on the part of the operator, and provides a convenient means of limiting the length of stroke.

A special device consisting of a fixed and an adjustable collar on this control rod may be set to guard against the use of too fast a cutting speed. The adjustable collar can be made to contact with the left-hand bracket supporting the rod when the lever has been moved the proper distance to the left to open the pump valve the desired amount, the collar then preventing any further movement of the lever. This device may be locked by a production foreman after he has set the adjustable collar for a predetermined maximum speed, so that the machine operator cannot change it, as he would be likely to do if he were paid on a piece-work basis. The setting of this collar does not interfere with a full-speed return of the draw-head. Automatic valves also guard against too great a broach pull, and a direct reading gage indicates when a broach has become dull and should be resharpened. These two features considerably lessen tool breakage.

Oil for the pump is contained in a reservoir in the pump base, to which it is returned from the cylinder. Any small leakage that may occur in the pump serves to lubricate its revolving and sliding members. Cutting lubricant is supplied to the work from a small geared pump driven by the motor. The lubricant is drawn from a reservoir in the front leg of the bed, and drains back into the reservoir after it is used. The drip pan at the front of the machine may be swung aside when it interferes with the broaching of large work. The draw-head is equipped with the regular Lapointe pull-bushing holder, and slides on square ways. Brass shoes, which are readily replaced when worn, take all wear resulting from the sliding of the head.



Lapointe Single-unit Type Hydraulically Operated Broaching Machine

This machine has been made considerably stronger than the previous No. 3 machines, so as to insure against any vibration or chatter due to broaching parts at high speeds. The standard equipment of the machine consists of 1½-, 2-, and 2½-inch reducing bushings, and ⅜-, ⅝-, ¾-, and 1-inch pull-bushings. Some of the principal specifications are as follows: Maximum stroke of draw-head, 56 inches; diameter of hole in faceplate, 5 inches; vertical adjustment of draw-head, 1⅝ inches above and below the center; floor space occupied, 13½ feet by 27 inches; and approximate weight, 3500 pounds.

FOOTE-BURT TWO-SPINDLE HIGH-DUTY DRILLING MACHINE

For the production drilling of hubs, gears, connecting-rods, links, and similar parts, the Foote-Burt Co., Cleveland, Ohio, has developed a two-spindle high-duty drilling machine of unusual construction. From the illustration it will be seen that the frame consists of a base unit and a head unit, between which pedestals of different heights may be inserted to bring the spindle noses as close as possible to the lower face of the head unit for the particular job on which the machine is to be used. Rigidity of construction is obtained by using heavy trussed iron castings, and by employing four 2-inch bolts which extend from the top to the bottom of the machine, to tie the different units together.

This machine is built in two sizes, which handle practically the full range of a miscellaneous line of products such as mentioned. In addition to using this machine simply for drilling, it may be employed for the performance of such successive operations as drilling and spot-facing, or drilling and reaming, and by the use of auxiliary multiple-spindle heads on the spindles, it may also be adapted to the multiple drilling of bolt-holes in flanges and work of a like nature.

When two similar operations are performed simultaneously, like drilling holes in two pieces, a two-station fixture is mounted on the work-table to increase the rate of production. Thus, while two pieces of work in one station are being drilled under the two spindles of the machines, finished pieces may be removed from the other station and new pieces set in place. In such a case, the work-table is indexed 180 degrees between each drilling.

When successive operations like drilling and spot-facing, or drilling and reaming, are being performed, a three-station fixture is used. This fixture is indexed 120 degrees between each operation, the work being set up at one station during the time that the first operation is progressing at the second station and the final operation at the third. The large hand-lever seen at the front of the base is employed to engage or disengage a lock-bolt which secures the table in the various indexed positions. In work on which two successive operations are performed on the same piece, it is important that the two spindles operate independently of each other, because the proper speeds and feeds for drilling and counterboring, for instance, are different. On this machine the speed and feed mechanisms for the two spindles are entirely independent of each other.

Driving Mechanism

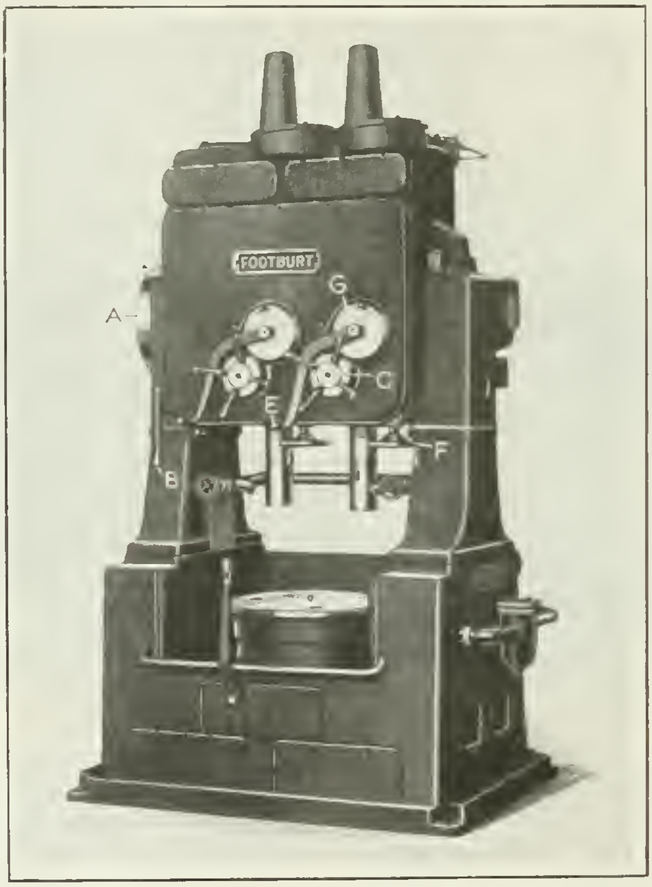
Power is delivered to the machine by means of a single pulley *A*, which is provided with a friction clutch operated by manipulating lever *B*. From the pulley shaft, motion is transmitted through two sets of forged-steel bevel gears to two auxiliary vertical shafts, each of which serves one of the two spindles on the machines. As the mechanisms for the two spindles are exactly the same it will be sufficient to describe one of them. From the auxiliary shaft, take-off gears transmit power to a pair of forged-steel helical gears, the second of which drives the spindle. Different speeds are obtained by changing the ratio of the take-off gears, these being provided in sets to furnish spindle speeds from

43 to 304 revolutions per minute. Through the use of special ratios, however, speeds up to 500 revolutions per minute may be obtained. As this machine is intended for long runs of production work, it will be apparent that this provision for changing the rate of spindle rotation is adequate. On the other hand, the machine possesses ample flexibility to adapt it for a wide range of work, and it is intended for such use rather than for one particular line only.

Arrangement of the Feed Mechanism

Power is taken from the spindle through a pair of take-off gears to drive the feed mechanism, and as in the case of speed changes, different rates of feed are obtained by changing the ratio of the feed take-off gears. This arrangement affords a range of feeds from 0.006 to 0.168 inch per spindle revolution, practically any desired rate being available for any particular job. However, other feeds can also be obtained. The feed take-off gears transmit power to a vertical shaft, at the lower end of which there is a worm meshing with a worm-wheel mounted on a horizontal shaft, and at the forward end of the horizontal shaft, capstan wheel *C* is attached.

On this worm-wheel shaft there is a helical pinion that meshes with helical rack teeth cut in the side of the spindle sleeve. Similar rack teeth are cut on the opposite side of the spindle sleeve, and with these is meshed a pinion on an auxiliary shaft that is driven through gearing by the worm-wheel shaft. The helix angle of the rack and pinion on one side of the spindle is opposite to that of the rack and pinion on the other side, so that the thrust of one pinion compensates for that of the other. The use of helical pinions and racks for feeding the spindle insures a smooth feeding movement.



Foote-Burt High-duty Machine designed for Production Drilling

Hand Feeds for the Spindle

In addition to the power spindle feed, a hand feed may be obtained in either of two ways. On the worm-shaft that drives the feed mechanism, there is a positive jaw clutch, which can be engaged or disengaged by operating lever *E*. One method of obtaining a hand feed is by disengaging the clutch and turning handwheel *F*. If it is desired to obtain a quick traverse movement of the spindle, this is accomplished by pulling forward any handle of the capstan wheel *C* to release the clutch on the worm-wheel, thus enabling a hand movement of the spindle to be obtained directly through the pinions that mesh with the rack teeth on the spindle. Disk *G* is geared to the feed mechanism, so that it revolves at the same rate as the pinion. On this disk there is a knock-out plug, which can be set to contact with lever *E* and trip the clutch at any predetermined point.

As the machine is intended for operation under severe conditions, provision has been made for delivering a copious flow of coolant to the work. A centrifugal pump having a capacity for delivering forty-five gallons of fluid per minute to the work through a 1¼-inch pipe is furnished. The reservoir is in the base of the machine and holds over two barrels of coolant, so that with the coolant in continuous circulation, there is no danger of its temperature rising to a point where cooling of the tools and work will not be efficient. A strainer is provided in the pipe line, as seen at the right in the base unit, and the coolant passes through another strainer at the point where it returns into the reservoir. These strainers insure the removal of all chips and other foreign matter from the fluid. A guard similar to that at the back of the work-table is placed at the front of the machine when it is in operation, to prevent the coolant from splashing on the operator and floor. This guard was removed at the time the photograph was taken in order that an unobstructed view of the table would be obtained.

BARDONS & OLIVER TURRET LATHES

A line of turret lathes intended for machining brass, iron, and aluminum parts, is being placed on the market by Bardons & Oliver, Cleveland, Ohio. These lathes are made with either a plain or a friction-geared head, and with or without an automatic chuck. The clutch mechanism of the friction-geared head is easily operated by means of a conveniently located lever. Cone-type frictions are used, and these are as large in diameter as the cone pulley and head gear permit. The frictions are adjustable for wear by means of ring nuts on the spindle, which are located outside of the cone, so as to be readily accessible. A quick release of the gripping surfaces is insured by springs, thus avoiding excessive end friction and overcoming the tendency of the spindle to revolve when the clutch is disengaged.

Special attention has been given to insure adequate lubrication of the headstock members. The spindles of machines not equipped with an automatic chuck are threaded at the rear end to permit air chucks to be attached. The spindle nose regularly has two straight bearings, one at the outer and one at the inner end, in addition to the thread. This construction is said to insure true-running chucks, faceplates, and fixtures. However, the spindle nose can also be made to suit the customer.

The cut-off rest, as regularly furnished, is provided with a lever feed for the cross movement on the 13- and 15-inch machines, and with a screw feed on the 18-inch size. A screw feed can also be furnished on the 15-inch machine. Side wear of the cut-off slide may be compensated for by means of a gib locked to the saddle. The cross motion of the slide is accurately regulated by two stop-screws, one at the front and the other at the rear of the machine. The screw-feed rest is provided with a micrometer dial in addition to the stop-screws. Means have been provided for taking up wear of the rack and pinion on the lever-feed rest. A hand longitudinal adjustment with a micrometer dial is regularly furnished for both types of rests. The rest is guided along the bed entirely by the front way to which

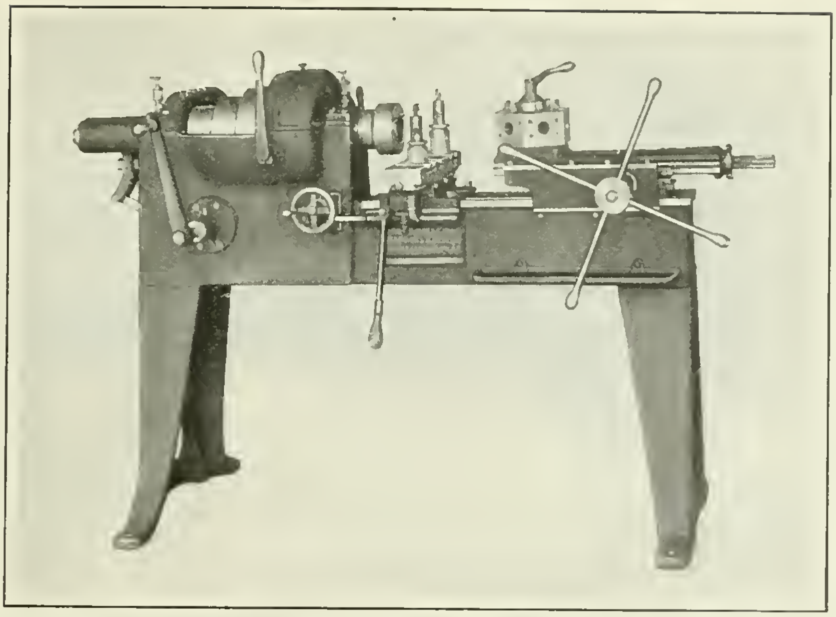


Fig. 1. Bardons & Oliver Turret Lathe intended for machining Brass, Iron, and Aluminum

the saddle is gibbed. Cut-off toolposts can be furnished in any one of four types. There is a plain round toolpost which has an adjustment for height, and swivels in a horizontal plane; a round toolpost with a base similar to that mentioned, except that the base has an extension to provide for an auxiliary clamping bolt; a square toolpost, which does not swivel and is adjustable for height by means of toothed wedges; and an open-side toolpost, convenient for working close to the chuck, which has a vertical adjustment and does not swivel. A vertical or under-cut forming tool slide can be furnished in place of the cut-off rest for turning irregular castings of circular cross-section by the use of forming tools. Means are provided for making all necessary adjustments. The forming of such parts is done by imparting one motion of the lever or screw, the tool taking a tangential cut on the work.

The turret is indexed automatically at the backward movement of the turret slide. It will be noticed that the bearing for the slide is extended beyond the front end of the saddle, so as to furnish a support for the slide through practically all of the usual working travel. This construction also permits of bringing the bearing close to the cut-off slide. The vertical turret locking bolt is placed at the front of the turret slide, as shown in Fig. 2, and enters hardened and ground taper bushings located in the turret as near the periphery as possible. Alignment of the turret holes with the spindle is maintained horizontally by means of two taper gibs, and vertically by means of a taper frame.

The turret stud has a hole through it in line with the hole through the spindle, to allow long stock to pass clear through the turret. This stud is used only for clamping the turret and does not take the thrust of the cut, a taper projection on the bottom of the turret, which fits an adjustable split ring in the slide, being provided for this purpose. The turret is tightened in this taper thrust bearing when clamped by the binder handle. The nut and spool in the center of the turret hold the turret to its seat on the slide. The nut is readily accessible for adjustment. An independent stop is provided for each turret face, the revolving type of stop-screw carrier being used. The stop-block may be quickly moved to one side when it is desired to feed a tool further than the block allows.

The automatic chuck is easily operated by means of the long vertical lever near the front of the bed, which actuates a patented mechanism of levers and links to give ample power for gripping the work in the collet. The three-step wedge, seen in Fig. 3, allows for a slight variation in the diameter of the work. When the collet is gripping the nominal size of stock, or, in the case of castings or forgings, when it is gripping the size corresponding to the majority of pieces, the fingers usually rest on the middle step of the wedge. Then, if the stock or piece is under-size, the fingers should rest on the largest step; and if over-size they should rest on the smallest. The gripping power of the collet is regulated by turning the threaded ring or adjusting nut which receives the thrust of the finger-holder, the latter

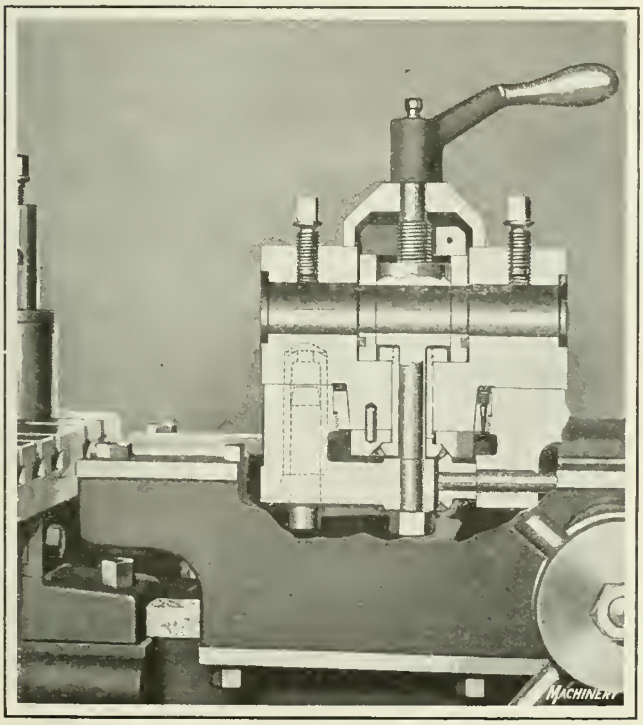


Fig. 2. Sectional View of the Turret, showing the Indexing and Locking Means and Hole through the Turret

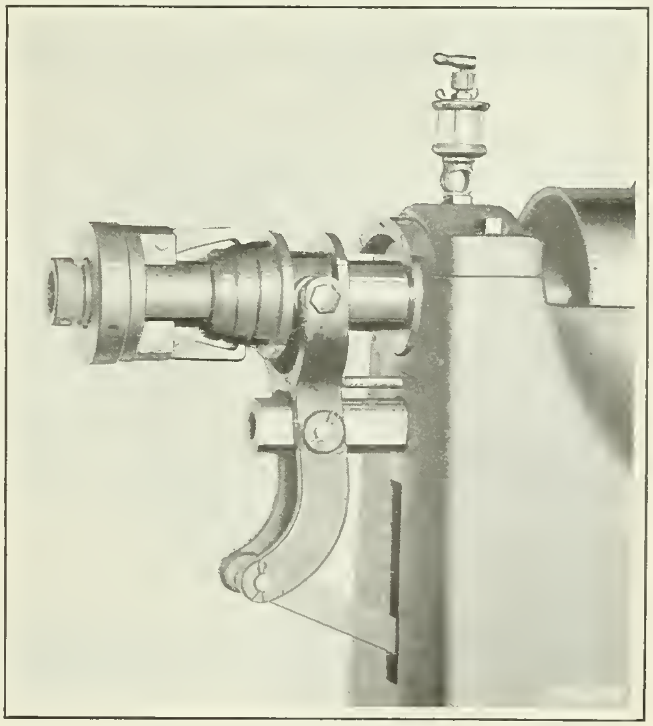


Fig. 3. Three-step Wedge which compensates for Variations in the Diameter of Work

being free to move the spindle. The adjusting nut is locked by means of a taper bushing or binder screw at the rear of the spindle.

For holding castings, forgings, or stampings, which are larger than the capacity of the bar stock collets, a hinged-type extra-capacity collet can be supplied. This collet can be furnished with either a push-out or a draw-back mechanism. For second-operation work, it is often desirable to have machines equipped with a draw-back automatic chuck, instead of the push-out type. On these machines, the additional parts necessary to change from the push-out to the draw-back chuck can be easily applied to the standard automatic chuck spindle. This line of lathes may also be equipped with a wire feed, power feed for the turret slide, power cross-feed for the cut-off slide, and a set-over turret slide and saddle.

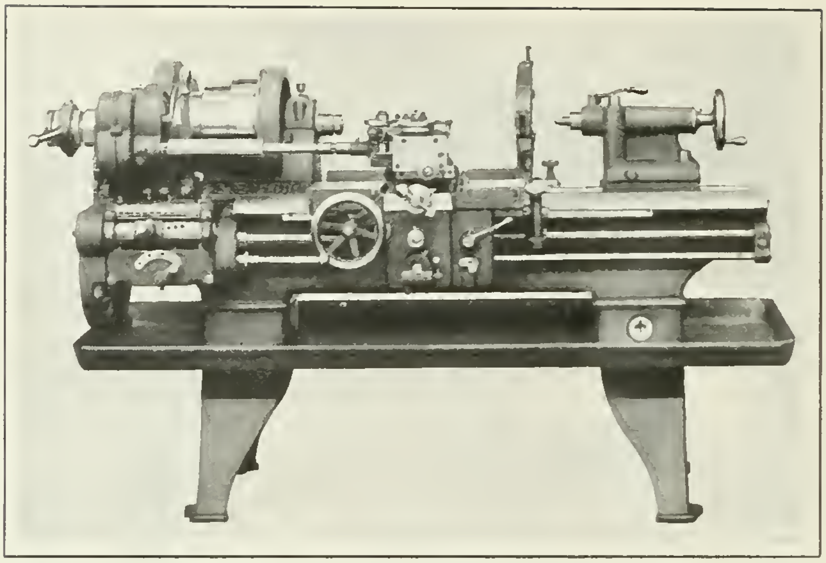


Fig. 1. LeBlond Fifteen-inch Heavy-duty Tool-room Lathe

LE BLOND HEAVY-DUTY TOOL-ROOM LATHE

A 15-inch heavy-duty tool-room lathe is now being introduced to the trade by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. This machine is similar to the lathes described in April MACHINERY except that it may be equipped with a cone-type headstock having either a hand- or a lever-operated draw-in attachment and chuck, a new universal relieving attachment, and a pan bed. This lathe may also be supplied with either a geared head, or a belted constant-speed or geared variable-speed motor drive. The lever-operated draw-in attachment and chuck is quicker and stronger in action than the handwheel type, and is preferable when a quantity of pieces is to be run; but the handwheel type is satisfactory for average tool-room service.

The spindle nose is furnished with a hardened closer in which is fitted a standard draw-in collet or spring chuck which is closed on the work by means of the handwheel at the rear end of the spindle on the hand-operated type, or by means of the lever on the lever-operated type. Either attachment can be supplied with any size collet from 1/4 inch to 1 inch, the sizes increasing in increments of 1/16 inch.

The universal relieving attachment can be applied to both cone- and geared-head lathes. By means of two cams any relief from 0 to 1/4 inch can be obtained, and practically all work within the range of the attachment can be handled without angularity of the knuckle joints. External, cylindrical, internal, end, side, and angular relief may be easily accomplished, and spiral relief can also be obtained by employing a special driving shaft and sleeve. The taper attachment may be used in connection with relieving operations.

The attachment is driven from the headstock through interchangeable spur gears which are arranged on a quadrant, the attachment in no way interfering with the use of the lathe for ordinary work. The drive is transmitted to the actuating mechanism on the tool-slide through a telescopic shaft. The tool-slide is substituted for the regular compound rest and incorporates the same swivel feature, thus enabling the operator to swivel the slide to the proper angle for obtaining angular, side, and end relief. Graduations facilitate setting the slide to the desired angular positions. The drive to the actuating mechanism is through a pair of hardened miter gears, one of which is keyed to the shaft of the left cam seen in Figs. 2 and 3. The driving gear can be swiveled about the center of the driven gear due to its being mounted in a swivel bracket which can be conveniently clamped. Because of this construction the driving shaft

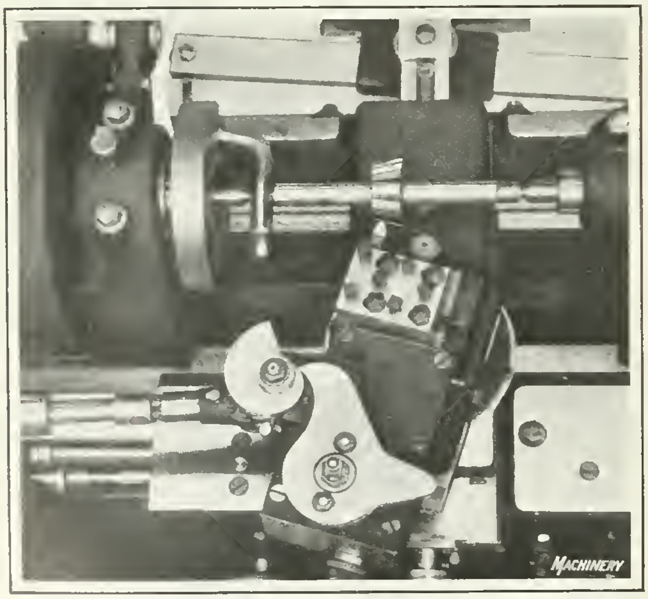


Fig. 2. Using the Relieving Attachment for machining an Angular Cutter

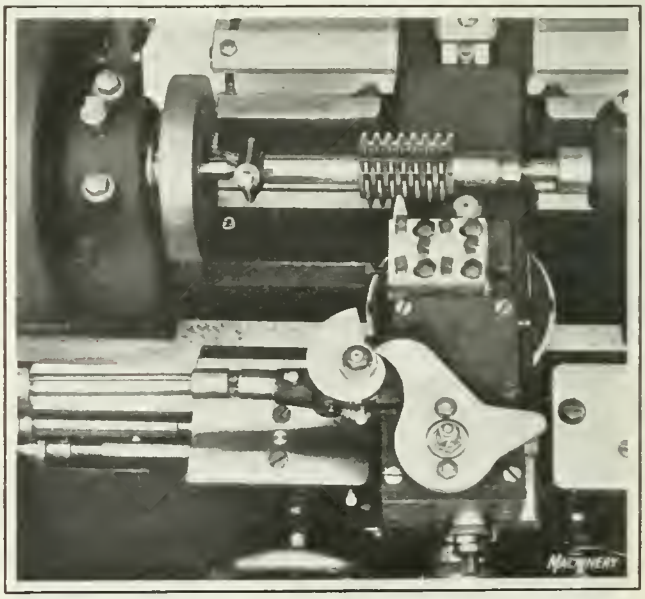


Fig. 3. Set-up of the Attachment for relieving a Hob with Straight Flutes

usually remains straight, regardless of the angular setting of the tool-slide, and so angularity of the knuckle joints is obviated.

The driving cam revolves constantly and imparts an oscillating motion to the larger follower cam at the right, the latter being mounted on a vertical eccentric shaft which may be adjusted relative to the follower cam by means of the square milled on the upper extension of the shaft. This eccentric shaft is oscillated under the influence of the master and follower cams and imparts a reciprocating motion to the tool-slide by means of the eccentric that is formed on the shaft and a rod that connects it to the tool-slide. The motion imparted to the eccentric shaft is constant, and so the variation in the stroke of the tool-slide is accomplished by adjusting the eccentricity of the vertical shaft in relation to the follower cam. It is evident that as the line of eccentricity approaches parallelism with the ways of the tool-slide, the stroke of the slide is decreased, and that when adjusted to the maximum throw of the eccentric, the stroke of the slide is lengthened to give the greatest amount of relief.

The regular range of adjustment permits relief from 0 to ¼ inch, as already mentioned, and requirements beyond this range can be taken care of by using special cams. Adjustment for relief is easily made, as the follower cam is graduated to facilitate setting it. A heavy coil spring maintains contact of the follower cam with the driving cam when the low portion of the latter is reached, thus returning the slide forward at that time. The tool-slide is furnished with a three-position tool-block which is adjustable laterally by fine-thread screws. An operation which consists of relieving an angular cutter is illustrated in Fig. 2, the attachment being swiveled to the proper angle and the taper attachment connected to the cross-slide. The attachment could also be swung around to relieve the side of this cutter. In Fig. 3 the attachment is being employed for relieving a hob with straight flutes.

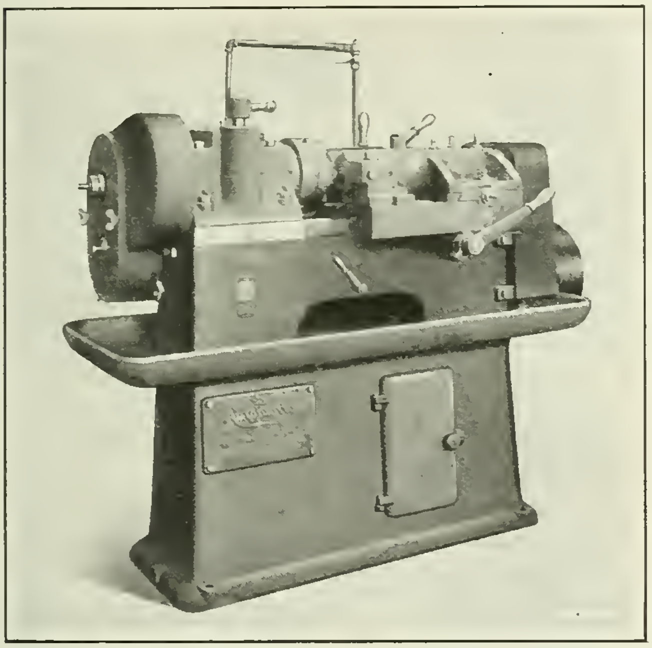


Fig. 1. Coulter Duplex-hob Thread-milling Machine for Wrench Jaws

COULTER THREAD-MILLING MACHINE

A machine in which two hobs are employed for milling threads on pipe-wrench jaws has recently been developed by the Automatic Machine Co., Bridgeport, Conn. The threading of wrench jaws is usually peculiarly difficult, and hard on the machines and component parts used, because the surfaces to be threaded are interrupted, the section is rectangular in form, and the threaded surfaces are curved to a diameter equal to the width of the section. In designing this machine, special consideration was given to ample rigidity, sufficient weight, adequate bearing surfaces, large milling spindles, and sturdy milling arbor supports. An important feature enabling high production to be attained is the use of two hobs which are mounted parallel to each other and directly opposite, as illustrated in Fig. 2, so that only one-half a revolution of the work is required to complete the threading of a rough-trimmed forging.

Power is delivered to the machine through a single pulley, and is transmitted to the work and milling spindles through spiral gears. Variations in feed are obtained by change-gearing, and lead is given to the thread of the wrench by means of a cam which has a wide face working against a bronze shoe which is fastened adjustably to the milling-spindle carriage and held in contact with it by weight. The parallel milling spindles are independently and collectively adjustable, so that each cutter may be located exactly the same distance from the center of the work and accurately set for sizing it. A tail-center is located between the milling-spindle housings and operated by means of the hand-lever on the front of the machine at the right and the clamping handle on top.

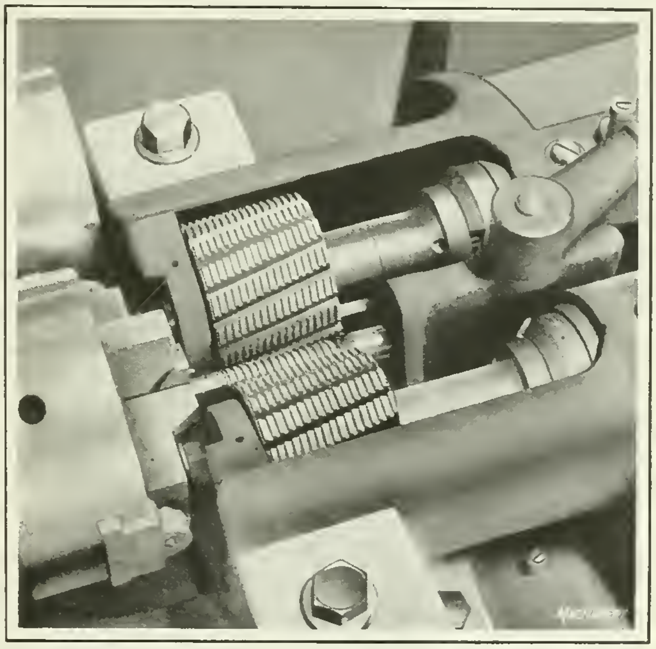


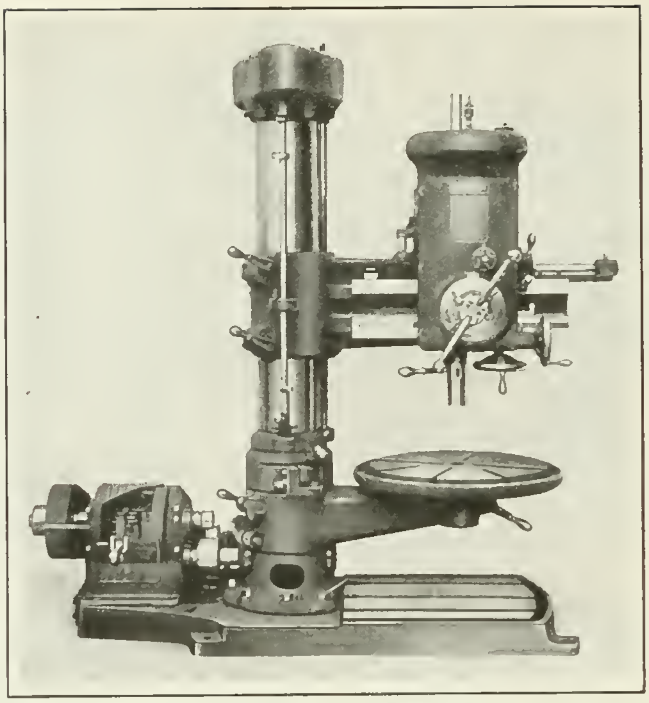
Fig. 2. Close-up View, showing the Arrangement of the Two Hobs

The small handle at the front directly under the chuck is used for starting the machine, and the handle on top of the work-spindle is employed for operating the chuck through a plunger in the center of the spindle. By this arrangement two tool-steel levers fulcrumed in the steel chuck body are made to act on master jaws of the chuck into which are fitted adjustable work-holding jaws. Between the jaws and at right angles to them is fitted a jig for supporting and aligning the head end of the wrench jaw without requiring it to be centered. The base has a liberal oil-pan beneath which is an oil reservoir and a cabinet for storage purposes. An oil-pump and piping are regularly supplied. As an example of the production possible, eighty-five 14-inch wrench jaws were completely threaded during a trial, in one hour floor-to-floor time.

AMERICAN RADIAL DRILLING MACHINE

A high-speed radial drilling machine similar to one described in May, 1919, Machinery, except that it is built in 2- and 2½-foot sizes, has been added to the line of the American Tool Works Co., Cincinnati, Ohio. The head of this machine is of the double-drive, back-geared type, which provides two rates of spindle speed for each speed obtained through the cone pulley or six-speed gear-box with which the machine may be equipped. There are twelve speeds, in geometrical progression, ranging from 50 to 900 revolutions per minute, which adapt the machine to a wide range of drilling, tapping, and facing operations. The head is enclosed by an oil-tight housing.

One of the improvements of this machine is in the tapping attachment, the entire mechanism of which is fully enclosed and runs in oil. The gears are made from steel forgings and are bronze-bushed, and the entire unit is mounted on a steel sleeve which runs on ball bearings. The speed box is of the cone-and-tumbler type, and has an automatic silent-clutch auxiliary drive which keeps the shafts and gears running while changes are being made, so that much of the shock caused by the engagement of gears is eliminated. This forms a positive drive which is used only during speed-changing and never for a working speed. The gears of the tumbler mechanism are cut with B. & S. 20-degree cutters, and are carburized and hardened. A spring device located between the speed box and the column driving gears prevents shocks from being transmitted to the speed box parts.



American Radial Drilling Machine

Four feeds are provided in geometrical progression, ranging from 0.004 to 0.016 inch per revolution of the spindle. The feed mechanism is protected against shocks and excessive stresses by a friction clutch which forms the connection between the mechanism and the spindle. This clutch is an expanding band type, quickly adjustable to the desired tension.

DUPLEX ROTARY SURFACE GRINDER

An improved Osterholm duplex rotary grinding machine has been brought out by Williams, White & Co., Moline, Ill. This machine was developed to automatically surface-grind thrust washers, clutch disks, bearing races, and many other parts that can be individually or collectively chucked within a diameter of 12 inches. It is primarily a production machine, and so it has been heavily designed to permit a large amount of metal to be removed in a short time. The machine automatically completes one cycle after the work is chucked and the machine started.

In Fig. 1 the machine is shown in the loading position with the rotary chucks at rest. When it is started, the rotary chucks are raised to the position shown in Fig. 2, and locked by the first fractional rotation of the cam on the left-hand side of the machine. Further rotation of the cam advances the abrasive wheel toward the work, the rate at which the wheel moves forward being determined by the shape of the cam. Heavy cutting is accomplished in the first part of the cycle, allowing ample time during the remainder of the cycle for the wheel to cut itself free, true the surface being ground, and produce a finish of the desired quality. On the completion of the cycle the chucks automatically drop to the loading position and the machine stops.

The automatic features of this duplex grinder make it possible to operate the machine with comparatively unskilled labor, and where the combined chucking and unloading time is considerably less than the operating time, it is recommended that one operator run two or more machines. Ample provision has been made for supplying coolant, a large stream of liquid being pumped through the wheel-spindle and an additional stream through each of the work-spindles. The water introduced in the rapidly revolving wheel-spindle cascades over the brim of the wheel and prevents loading of the wheel. The water coming from the work-spindles at the rear of the work has a tendency to keep down the temperature of the work and thus prevents burning and warping. When the machine is in the operating

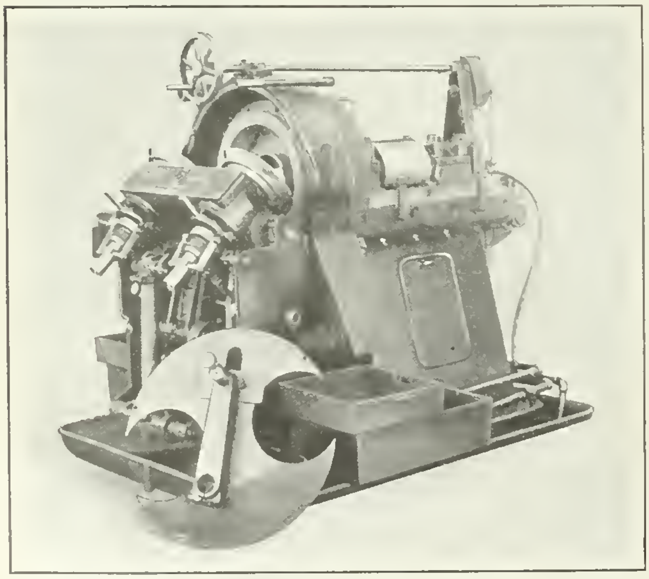


Fig. 1. Osterholm Duplex Rotary Surface Grinding Machine

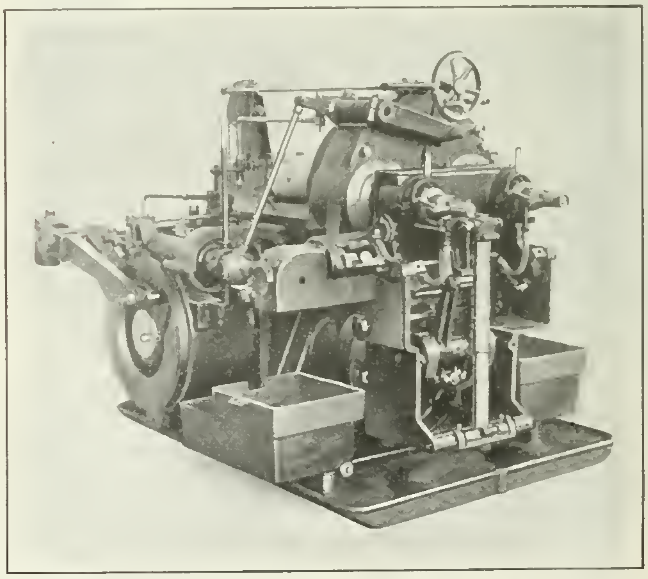


Fig. 2. View of the Machine with the Chucks in the Operating Position

position, the wheel chamber is practically sealed and hence the operator, the machine parts, and the floor remain as dry as if no water were used.

Mechanical chucks, either pneumatic or hand-operated, are recommended for use on the machine, because such parts as thrust washers can be ground with accurate parallel sides in two operations. Expanding or contracting collets are operated through toggle links by means of the handles seen in the illustrations, and these form a convenient means of chucking. Magnetic chucks may also be used.

Ring grinding wheels 20 inches in diameter are employed, the depth and rim thickness being varied to suit the work. The wheel is advanced by means of the hand-wheel on top of the water guard, to compensate for loss in grinding and dressing. This adjustment is calibrated in thousandths of an inch. The wheel dresser is mechanically driven and always in place. The cycle of the machine is varied by means of the change-gears on the left-hand side, and a three-step change-gear provides for rotating the wheel-spindle at from 900 to 1000 revolutions per minute. There are three chuck speeds ranging from 8 to 12 revolutions per minute. A cycle of the machine is completed in from twenty seconds to two minutes. The machine is lubricated by means of ring and chain oilers.

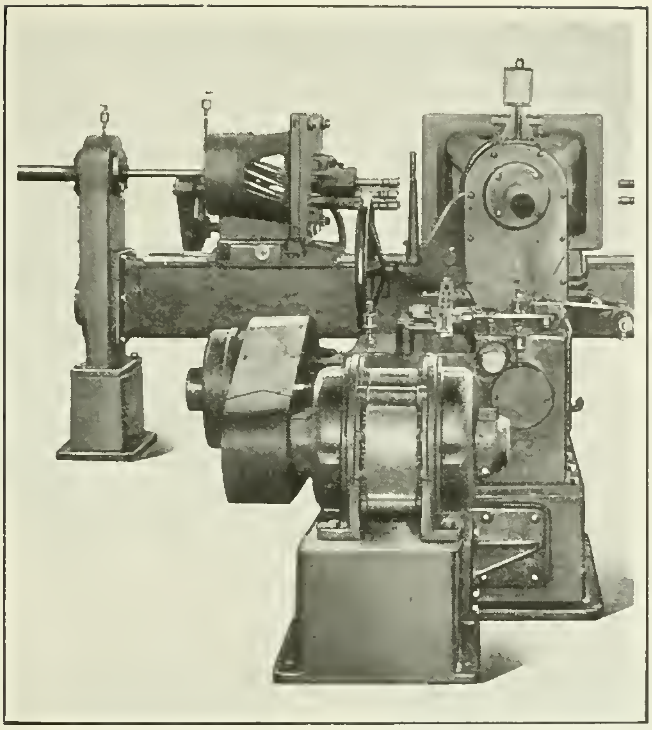


Fig. 2. Rear View of the Fox Tapping Machine

FOX THREE-WAY SEMI-AUTOMATIC TAPPING MACHINE

Holes can be simultaneously tapped in both ends and one side of automobile cylinder blocks in a three-way semi-automatic tapping machine recently developed by the Fox Machine Co., Jackson, Mich. From the front view of the machine, shown in Fig. 1, it will be seen that there are two side-heads which tap the holes in the ends of the block, and a rear head for tapping the holes in the side. The left-hand head has four spindles, and the right-hand and rear heads have six each. All spindles are mounted on patented cluster plates which are held rigid by arms doweled to the plates. The gearing and spindles in the heads are standard.

Power for driving all three heads is obtained from a 10-horsepower motor running at 1200 revolutions per minute, which is located at the back of the machine, as illustrated in Fig. 2. The power transmission from the motor to the driving clutch is through a silent chain. Reversing clutches are mounted on a shaft which extends to the front of the machine, and on this shaft is also mounted a sprocket which drives, through a chain, the spindles of the rear head. At the front end of the same shaft there are bevel gears which drive horizontal shafts; these shafts carry the motion to a chain sprocket at each end of the front column, from which the power is transmitted to shafts that drive the spindle gearing in the right- and left-hand heads. The rear view also shows the automatic reversing mechanism which is typical of Fox vertical tapping machines.

Change-gears are carried by each head to advance and return the heads along the bed in unison, at a speed corresponding to the pitch of the taps in the head. These gears can be changed to accommodate taps of different leads. The motion of the heads can be started, stopped, or reversed by means of the lever at the left of the table on the front side of the machine. A forward movement of this lever starts the taps revolving in the right-hand direction, the

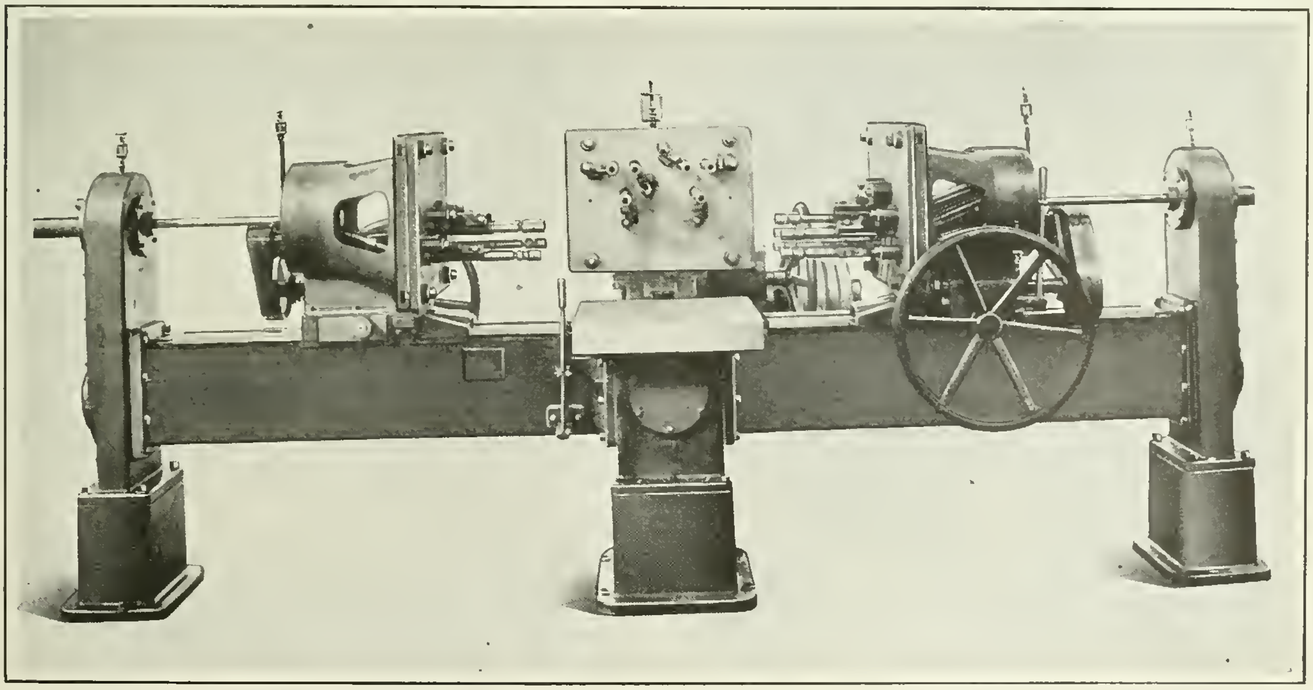


Fig. 1. Three-way Semi-automatic Tapping Machine made by the Fox Machine Co.

heads advancing at a feed corresponding to the lead of the taps, and thus insuring accurate threads. Reversing is automatic, the heads being returned at a feed that is in the same ratio to the tap lead as that in which they are advanced, without any assistance from the operator. They are automatically stopped when they have returned to the starting positions. The tapping speeds are about 20 feet per minute. This machine weighs about 6350 pounds.

REED-PRENTICE CUTTER GRINDER

A small universal cutter grinder capable of handling a large variety of small drills, milling cutters, and engravers' tools, has been lately developed by the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass. With this machine, tools can be ground to a predetermined angle even by an inexperienced man. From the accompanying illustration, it will be seen that the machine is equipped with two wheels, mounted directly on the armature shaft of an enclosed motor. The motor regularly furnished is of 1/8 horsepower capacity, runs at 3400 revolutions per minute, and is intended for connection to any 110-volt, alternating-current, lighting circuit. One of the wheels is used in connection with a universal head, and the other is intended for free-hand grinding. The machine may also be furnished without the latter wheel. Both wheels are 4 inches in diameter.

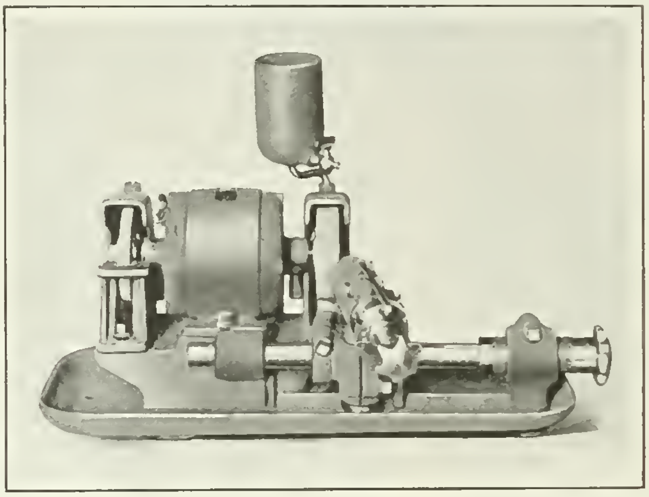


Fig. 1. Reed-Prentice Grinder for Small Drills, Milling Cutters, and Engraver's Tools

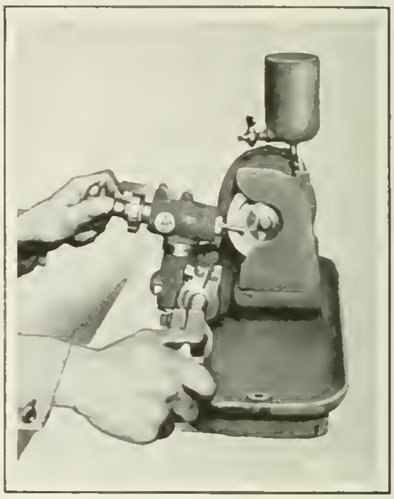


Fig. 2. Positions of the Operator's Hands in grinding a Cutter

The universal head provides for grinding tools at any desired angle. A swivel bracket which forms the lower part of the head is clamped on a bar mounted parallel to the armature shaft. One end of the bar is supported in a stationary bearing, while the other end is held in a bearing that provides for longitudinal adjustment. The head may be swiveled to any desired position, accuracy of a setting being facilitated by graduations on the circular flange. The position of the head relative to the swivel bracket is fixed by means of the clamping screw at the front of the bracket. The cutter-spindle in the head is arranged with a draw-bar collet and an index-plate. The handle of the draw-bar is extended for the convenience of the operator. After a cutter has been clamped in the collet, this handle is used for rotating the spindle.

Mounted on the bar at each side of the swivel head is a dog that extends downward, and directly under the bar, projecting upward from the oil-pan, there is a rib that serves to trip the dogs. The extension of the left-hand dog is on the rear side of this stop, while the extension of the right-hand dog is on the front side. The dogs are set to control the amount of rotation of the swivel bar in grinding a cutter. A knurled-head plunger located on the side of the head engages a series of curves in the cutter-spindle and provides a means of varying the distance between the end of the collet and the wheel. This often eliminates resetting the dogs.

On the inside of the index-plate there is a spring cam that contacts with a projecting pin on the front of the head. The cam is adjustable to give a longitudinal movement of the cutter-spindle ranging from 0 to 1/8 inch during a 180-degree rotation of the spindle. With this combination of horizontal movements and the rotating spindle, practically any amount of relief can be obtained on a cutter. The cam is so arranged, however, that the spindle can be rotated 270 degrees, which eliminates the necessity of setting a cutter in the collet in exact relation to its cutting edge. Practically any type of eccentric-relief cutter may be ground, and it is possible to experiment with the amount of relief best adapted to a particular class of work.

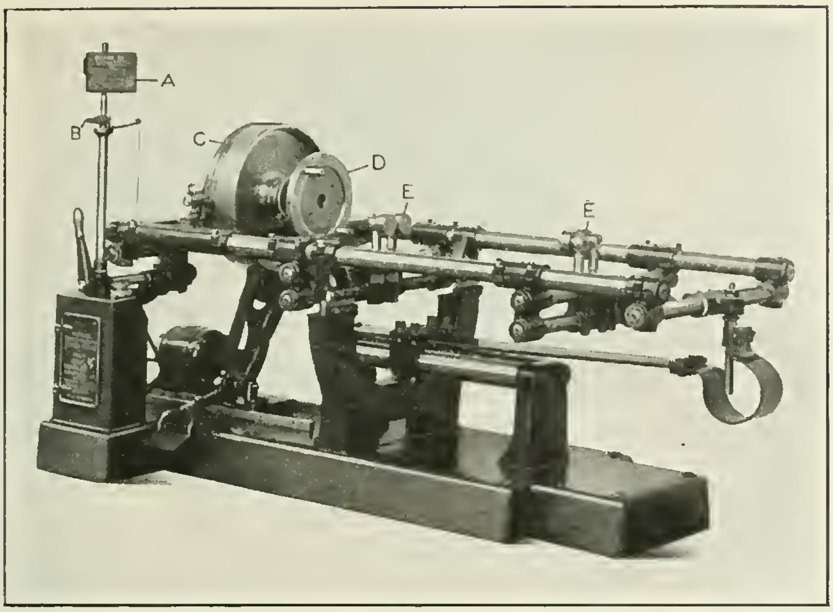
An index-plate having twenty-four divisions is regularly furnished to provide for grinding fluted cutters. In indexing a cutter, the lever on top of the head is lifted from the slot of the index-plate in which it happens to be, the spindle is rotated, and the lever is dropped into the desired slot. This lever is also used to hold the cutter-spindle from rotating as the collet is tightened, when a cutter is being clamped in place.

A fluted cutter is held in the collet with the flutes extending and with the index-lever in a slot in the index-plate. The cutter is set so as to give the tooth clearance desired, and the universal head is set at 90 degrees with the bar, so that the flutes are parallel with the side of the wheel. The dogs are then clamped on the bar to permit a rotation of the head about equal to the length of the flutes. Then with the operator's hands as illustrated in Fig. 2, the cutter is fed into the wheel by adjusting the swivel bar longitudinally with the right hand, and passed back and forth across the face of the wheel by employing the left hand. When one flute has been ground, the cutter is drawn away from the wheel, the index-lever lifted with the right hand, and the cutter indexed to the next flute. Fish-tail, eccentric-relief, twist drills, and other tools may also be quickly and accurately ground.

GISHOLT BALANCING MACHINE

A patented machine has been recently placed on the market by the Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis., for dynamic and static balancing, by making two corrections which are individually measured and located near the ends of the part. This machine applies the principles of dynamic and static balancing discovered by Dr. B. L. Newkirk. Duplicate parts, such as crankshafts, rotors, flywheels, and spindles can be rapidly balanced in production, as static balancing is rendered unnecessary, and the operator, who need not be highly skilled, has only a few simple steps to perform.

Briefly, the operation is as follows: The part to be balanced is placed on the machine and rotated above a "critical" speed of about 100 to 110 revolutions per minute. The drive is then released, and the upper scale of the calculating rule *A* set according to the amount of unbalance shown by an indicator on the post at *B*. A 10-ounce vernier weight is next placed according to the reading, on the large disk *C* at the end of the rotating parts. Finally, the part is rotated



Gisholt Precision Dynamic and Static Balancing Machine

again, and the lower scale of the calculating rule *A* set from the indicator *B*, to locate the point where metal should be removed from the part to correct the unbalance.

It will be obvious that the work is attached at one end to a headstock *D* and rests on rollers *E*, which are adjustable and mounted on ball bearings. The headstock and rollers are carried by a spring-mounted and pivoted frame. Because of the form and location of the springs, a free vertical vibration of the frame may take place with the pivot springs as a fulcrum point. In balancing a part, when the driving power is disengaged, the construction of the frame permits a gradual diminution of speed down to and through the free critical speed of the frame, and by observing the dial indicator *B*, the amount of correction required is accurately determined.

The weight on disk *C* is adjustable radially by means of the vernier, which reads to 0.01 inch, parts being exactly balanced when the weight is at zero. The disk may also be revolved to any desired angular position on its axis by reference to a protractor dial. When the correction has been arbitrarily applied, after rotating the part the first time, the second amplitude in the process bears a relation to the first dependent on the angle between the point of application and the point required. After determining and setting off this angle, a third run will check the result. When the first determination has been finished, the position of the work is reversed to complete the operation. The critical speed of from 100 to 110 revolutions per minute permits visual observation of the amplitude, and does not result in distortion of the work from centrifugal force. The machine is adapted to a wide variety of work, receiving bodies up to 25 inches swing, 32 inches between the support bearings, 48 inches over-all length, and up to 1000 pounds weight.

CHROBALTIC "FIRE-ARMOR" CONTAINERS

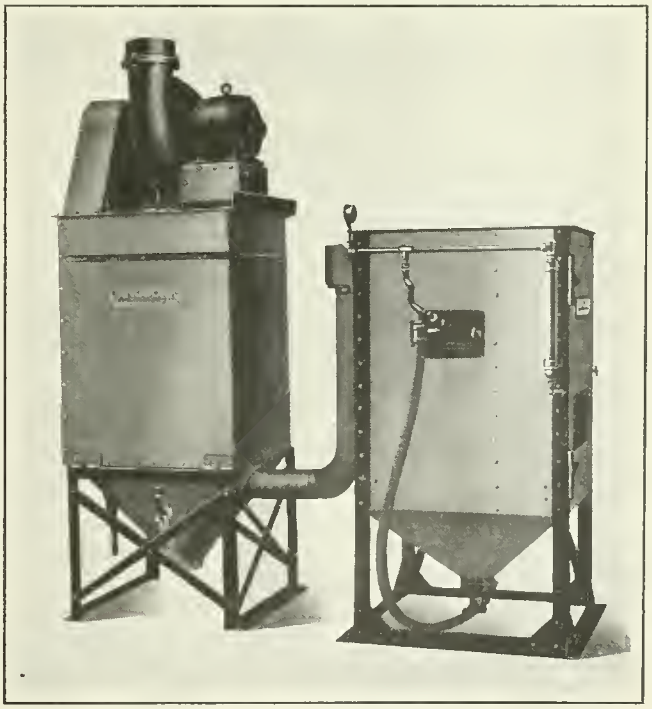
Containers that are not affected by temperatures up to 2350 degrees F. have been placed on the market by the Chrobaltic Tool Co., Railway Exchange Bldg., Chicago, Ill., for use in heat-treating high-speed steel tools by the "Fire-Armor" method in which the highest temperature required is 2215 degrees F. The term "Fire-Armor" has been given to the alloy from which the containers are made. This method of heat-treatment consists of heating the tools in a protected atmosphere to a predetermined temperature, holding them at this temperature for a predetermined length of time, cooling, and then tempering by again heating them to a specified temperature and holding them at that temperature for a certain length of time. This method is said to result in the full development of the cutting structure throughout the entire piece at the lowest possible temperature.

The tools are placed in a container, surrounded by charcoal and the cover put in place. In some large containers a pyrometer is inserted through the cover to the center of the box. The box and its contents, after preheating, are raised to that temperature point in the critical range at which the carbide transformation takes place, and held there a sufficient length of time to complete the change. It is said that this transformation is obtained between 2200 and 2210 degrees F. when high-speed steels are accurately held between these two temperatures in a protected atmosphere for a sufficient length of time. The length of time depends on the form of the piece, but in no case is it less than approximately forty-five minutes from the time the temperature has been reached. It is said that if the steel is held at this temperature for periods of from two to three hours, the structure is not altered, and that this method overcomes most of the irregularities found in high-speed steels after heat-treatment.

PANGBORN SAND-BLAST UNIT

A barrel sand-blast unit equipped with an exhauster and a cloth-screen dust arrester, and driven by direct-connected motors, has been placed on the market by the Pangborn Corporation, Hagerstown, Md., for cleaning small heat-treated, forged, stamped, or cast parts. This equipment is also intended for use in plants having only a limited production. Satisfactory ventilation and suppression and accumulation of dust is claimed for the unit. It is ready for operation by simply connecting it to a ventilating pipe and a compressed air line.

The outfit is made in two sizes, the No. 1 barrel being equipped with a drum 20 inches in diameter and 16 inches long and, with the arrester, occupying a floor space of 3 feet 3 inches by 7 feet; and the No. 2 barrel having a drum 30



Pangborn Barrel Sand Blast equipped with Exhaust and Dust Arrester inches in diameter and 20 inches long, and requiring a floor space of 3 feet 7½ inches by 7 feet 5½ inches. The over-all height of both barrels is 8 feet 10 inches. The unit handles gray and malleable iron, steel, and brass castings, forgings, and stampings.

PORTER-CABLE CENTER-DRIVE LATHE

For simultaneously turning both ends of automobile axle shafts, camshafts, driving shafts, and similar parts, the Porter-Cable Machine Co., 1708-1712 N. Salina St., Syracuse, N. Y., has brought out the double-end center-drive lathe shown in Figs. 1 and 2. A headstock of heavy construction, having a hardened and ground spindle 6¼ inches long with a 2½-inch hole through it, is mounted at the center of the bed. The spindle is supported in large ball bearings, and is driven through a worm and worm-gear. The control of the machine is through a lever on the headstock, which is manipulated to operate a clutch on the driving shaft of the headstock. This clutch is of the expanding type, and is made sufficiently strong to permit of taking heavy turning cuts; it is arranged to stop the lathe the instant that it is thrown out. The shell of the clutch runs continually, being driven through a three-horsepower motor under the pan by a silent-chain drive.

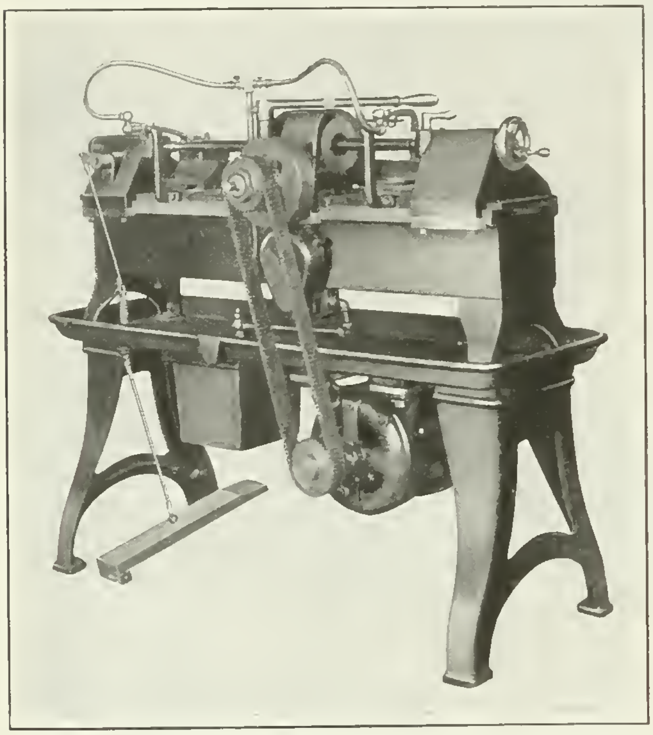


Fig. 1. Porter-Cable Center-drive Lathe for simultaneously turning Both Ends of Camshafts and Similar Work

The two tool carriages are operated by means of a hardened steel cam and roller. Important features of the carriages are that both straight and taper work can be turned, and that they are automatically returned to the starting point after reaching the end of the cut, thus relieving the operator of any movements other than those required in loading and unloading the work and starting and stopping the machine. The carriages are equipped with chip shields for the cross-feed screw, and the bed is covered the entire length, thus protecting the working parts of the lathe from dirt and chips. The chain that transmits the drive from the motor to the clutch shaft is also covered when the machine is in operation.

The tailstocks may be set to give a maximum center distance of 32 inches. The spindle of one of the tailstocks is operated by a screw, while the other is designed for a quick movement which is obtained by means of the foot-treadle.

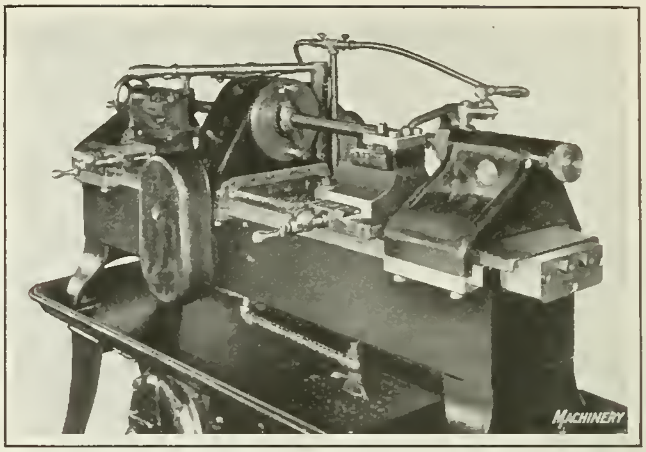


Fig. 2. Front View of the Center-drive Lathe

The bed is of the heavy box type and is solidly ribbed, while all gears are made of steel and run in oil in their respective housings. The machine can also be furnished with a countershaft for driving by belt. Its weight is about 1500 pounds.

AMS GANG SLITTER

A number of improvements have been made in a gang slitter which is built by the Max Ams Machine Co., 101 Park Ave., New York City, for slitting large quantities of thin sheet metal into strips. This slitting machine was designed primarily for use in making cans, but it is also adapted for cutting stock for armatures, electric switch parts, etc. From Fig. 1 it will be seen that the machine has a heavy frame in which are supported two power-driven parallel shafts or arbors, on which is mounted a series of circular cutters. The cutters of one shaft slightly overlap those of the other so as to slit the metal.

The table may be equipped with a power stock-feeding device or "back gage" for bringing the stock up to the cutters, and a gage which is attached to the left-hand side of the table for locating and guiding one edge of the stock. This power-feed mechanism and gage are not seen in Fig. 1, a hand feed being substituted in the machine shown in this view. With a hand-fed back gage, the stock is gripped at one place by this gage and at two places by the "disappearing" gage at the right-hand side of the table. After the cut has been started on the metal, the side gage releases its

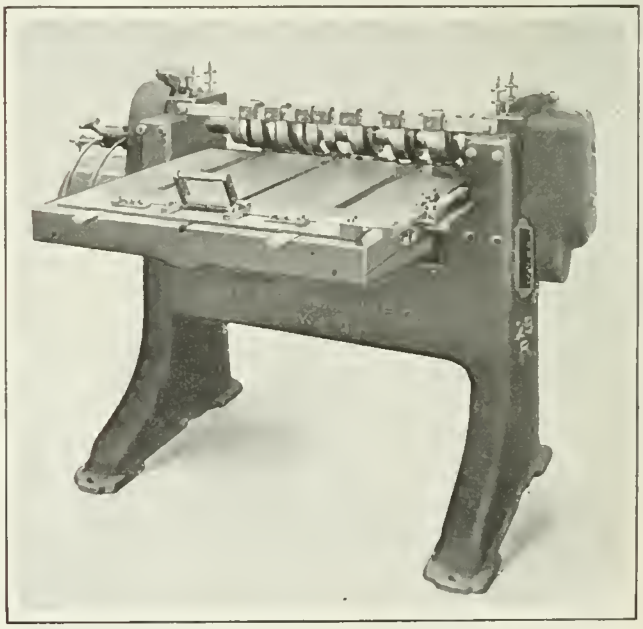


Fig. 1. Ams Improved Gang Slitter for Light Metal

hold and swings out of the way to permit the back gage to pass. This arrangement is especially useful in slitting decorated or lithographed metal. An attachment may be provided for grinding the cutters, power being transmitted from the machine to an overhead shaft which, in turn, drives a grinding wheel mounted parallel to the cutter shafts. Cutters may be ground without removing them from the machine or disturbing them from their relative positions.

One of the improvements in this machine is that the cutter shafts have been enlarged to 3 inches in diameter, and are ground and lapped to fit the hole in the cutters. The shafts run in bronze bearings, held by caps in housings that are integral with the frame. The split of the bearings is vertical to eliminate shaft play, the thrust of the shaft being at right angles to the screws that secure the caps in position.

Another feature of the cutter shafts is that no shoulder on them is larger than the diameter on which the cutters are mounted, and consequently the cutters can be removed from either end. A third new feature, for which patents are pending, is the method of securing the cutters on the shaft. This method is illustrated in Fig. 2, from which it will be seen that in a recess in the hub of each cutter are mounted two segmental pieces between which there is interposed a wedge-shaped piece that may be moved in or out by means of a screw in a tapped hole in the hub. By advancing this screw, the wedge-shaped piece is forced between the segmental pieces and wedges them between the cutter hub and the shaft, thus locking the cutter firmly in position. The cutter is not thrown out of alignment by this method of locking, since there is no play between it and the shaft, because of the lapped fit.

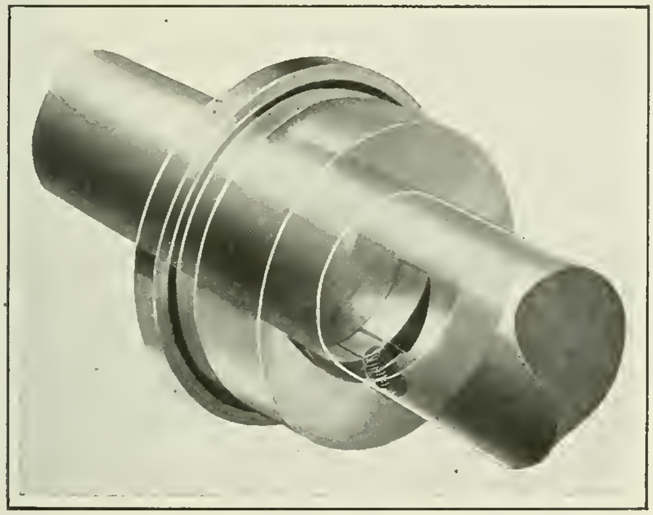
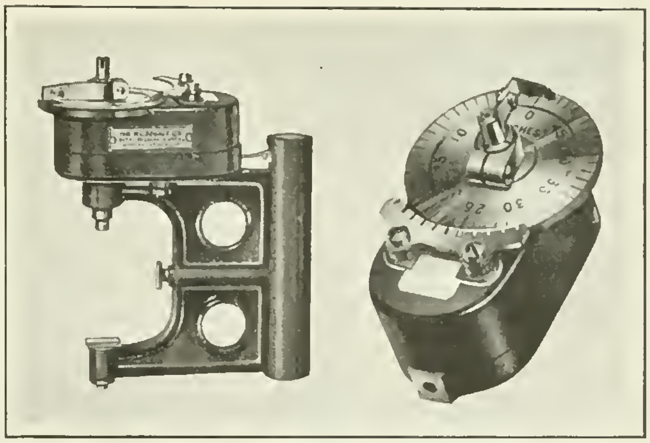


Fig. 2. Phantom View, illustrating the Method of locking the Cutters on the Arbors

MICROGAGE

The "Microgage" is a measuring or gaging instrument in which are combined the functions of both the micrometer and the limit snap gage. Variations from the nominal size of a part are indicated by a dial, graduated in thousandths of an inch, the variation being indicated both in amount and direction. This instrument is manufactured by the Microgage Co., Box 1126, Boston, Mass., and is shown in the accompanying illustration.

When the device is placed on a piece of work, the center plunger is automatically displaced, releasing a retaining brake from a spindle drum, and allowing a spring coiled inside the drum to screw the spindle on the work at a definite pressure. The operator then tries to shift the instrument sidewise so as to give it an opportunity to square itself or to show positively if it has already done so. When the microgage is withdrawn from the work, the retaining brake is automatically applied before the gaging surfaces of the instrument have changed their setting. The position of a scribed line on the right-angled pointer relative to the dial graduations is thus positively retained until the microgage is used again. This process is repeated for each successive machining in finishing the work within specified limits, and when a new piece is started, the microgage is turned back by hand to make its contact points clear the piece. A measurement may be made in less than two seconds by the use of one hand, the other hand being free to start and stop the machine on which the part is machined.



Microgage Automatic Measuring or Gaging Instrument

The microgage is set for a particular line of work, by means of standards in the same way that it is applied to the work, at the same pressure and at the same position on the gaging surfaces. As the instrument is withdrawn from the standards, the retaining brake holds the spindle until the index-arm is set and clamped to the zero graduation. This fine adjustment takes less than one-half minute and is positive. The standards used may be basic-size plug gages, size-blocks, or reference disks. A tolerance segment facilitates setting the instrument.

Readings are taken quickly with the instrument held loosely in one hand. The frame is deep, the throat shallow, the radiating surfaces large, and the grip insulated on the larger sizes, all of which tends to reduce variations due to temperature. No skill or training is required for making the adjustment or using the instrument on work. The microgage is made in sizes to cover the complete range of from 1 to 5 inches, inclusive, the range of each instrument being ½ inch. It opens an additional 0.1 inch beyond its size to receive unfinished work.

HEXAGON MILLING TOOL

A milling tool for finishing the six sides of a hexagon in one operation has been brought out by the Geometric Milling Tool Co., 108-120 N. Jefferson St., Chicago, Ill. This tool, which is shown in the accompanying illustrations, was

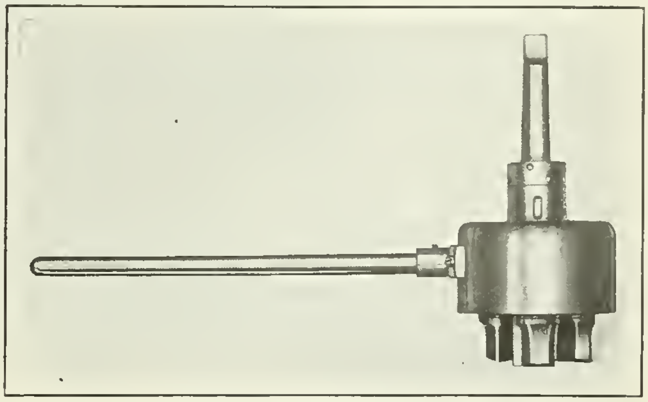


Fig. 1. Hexagon Milling Tool

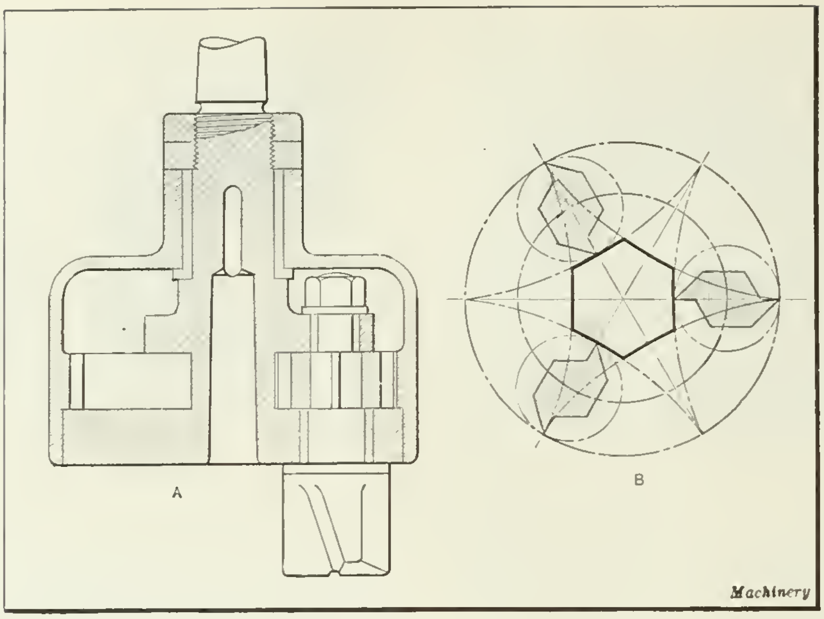


Fig. 2. Sectional View of the Hexagon Milling Tool and Lay-out of the Cutters

designed primarily for use in valve manufacture, but it is also adaptable to producing locomotive nuts, oil-cups, etc. The six sides of a hexagonal part are produced by the planetary motion of three cutters, each of which has two cutting edges. These cutters revolve on their own axis and also about the center of the tool, thus generating a cycloid curve, as shown by the cutter diagram in Fig. 2. It will be obvious that the sides of the hexagon are curved, but this is so slight that it is not objectionable in most cases.

The tool can be employed in an ordinary drilling machine in conjunction with a simple fixture for holding the product and for guiding the casing or body of the tool. The body must be held from rotating by means of an arm gib, or pilot pin, but should be permitted to move up and down. In first setting up, the tool is indexed to conform with the outline or the center line of the hexagon to be milled, after which it remains permanently fixed. The cutters are interchangeable and easily sharpened and replaced. It is said that their wear is slow and that they do not leave any burrs on the corners of the hexagon or elsewhere. The tool is bronze-bushed throughout, and made in standard pipe sizes of ⅜, ½, ¾, 1 and 1½ inches. This tool may also be used for drilling and facing, and in an operation on standard ¾-inch valve bodies it has drilled, faced, and milled the body in about fifteen seconds, the tool running at 180 revolutions per minute.

GRAY "MAXIMUM-SERVICE" PLANERS

Planers of the "Maximum-Service" type built by the G. A. Gray Co., Gest and Depot Sts., Cincinnati, Ohio, are now built in 60- and 72-inch sizes. In general design these machines, which are the largest this company has ever built, closely follow the planers of smaller sizes described in MACHINERY, December, 1921. The grouping of controls on the operator's side of the machine considerably facilitates the operation. To raise the rail, the operator pushes up the stirrup at his end of the rail, which gives him a control of the movement without leaving a position from which he can observe the work and tools. The rail stops without drifting, and so it can be set to a line. It is clamped by a few turns of the clamping screw at the right-hand end of the rail. This results in locking both ends of the rail to the inside edge of each housing and ties the entire structure firmly together. Having located the rail, the operator can move a head into position by simply shifting one lever, and the slides may be rapidly raised or lowered by manipulating the middle traverse lever which is also at the right-hand end of the rail. The feed dial of the "Cantslip" feed is locked in place until the operator's hand touches the knob, when it can instantly be set to any desired feed between 0 and 1 inch in steps of 0.01 inch.

Oiling of the planer has been carefully considered: The gears, which are helical throughout, run in a bath of oil, and from the oil-pan under the gears oil is taken through a strainer and pumped through a filter to each of the shaft bearings and to the center of each vee. The corner of the table vee is cut away almost to the ends of the table, and into the space thus formed the filtered oil is pumped through a hole. This channel is always closed at each end, and from it small oil-grooves conduct lubricant over the vee surfaces. Since the oil in the grooves is all under the same pressure, an even distribution is insured.

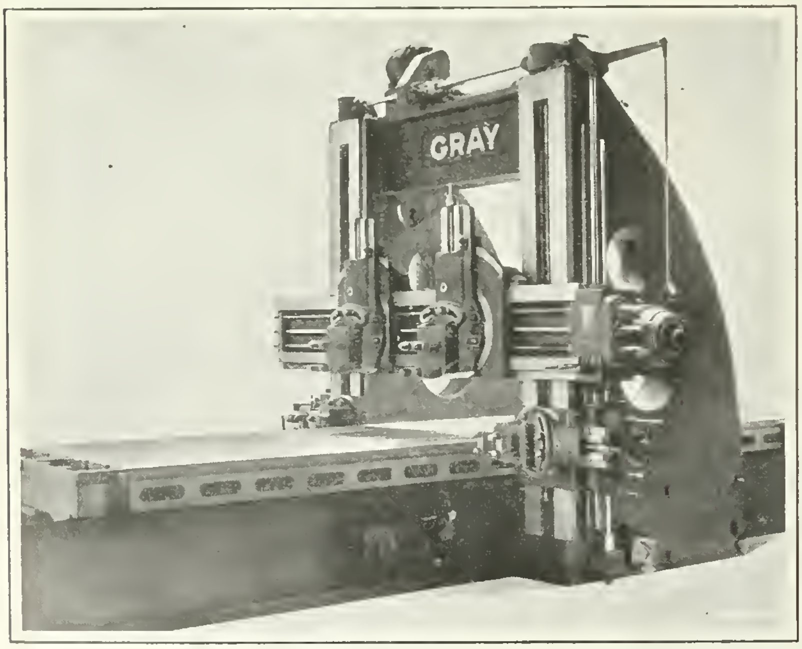


Fig. 1. Gray "Maximum-Service" Planer which is now built in 60- and 72-inch Sizes

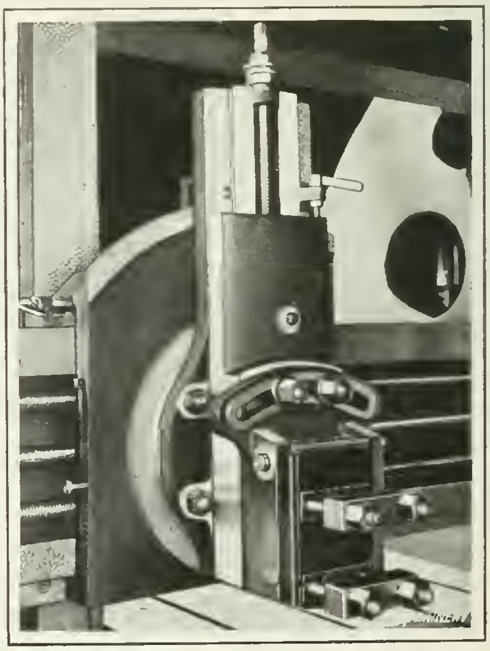


Fig. 2. Close-up View of the Rail Head

A close-up view of the new type of rail-head supplied on these planers is shown in Fig. 2, from which it will be seen that "twin-purpose" gibs are provided between the slide and harp. A turn of the gib handle in one direction adjusts the gib to the operating position, while a turn in the opposite direction results in rigidly locking the slide to the harp. Similar gibs are provided between the saddle and the rail. There is also a clamp for locking the harp to the top of the saddle.

NEWTON PLANER-TYPE MILLING MACHINES

A new series of planer-type milling machines has been added to the line of heavy-duty milling machines known as the "Multi-Millers" which are built by the Newton Machine Tool Plant of the Consolidated Machine Tool Corporation of America, 17 E. 42nd St., New York City. The machines are provided with a wide range of feeds and table speeds to adapt them for both light- and heavy-duty milling. Control levers are located on both sides of the machine in front of the housings, so that the operator may have complete control from the side that may happen to be the most convenient. The bed is of one-piece box construction, with a closed top, and has an internal gib which clamps the table to the bed when the vertical heads are fed along the cross-rail. The table is of double-plate construction, and when the machine is equipped with a cutter lubrication system, the table is fitted with shields and arranged to handle the lubricant in large volume.

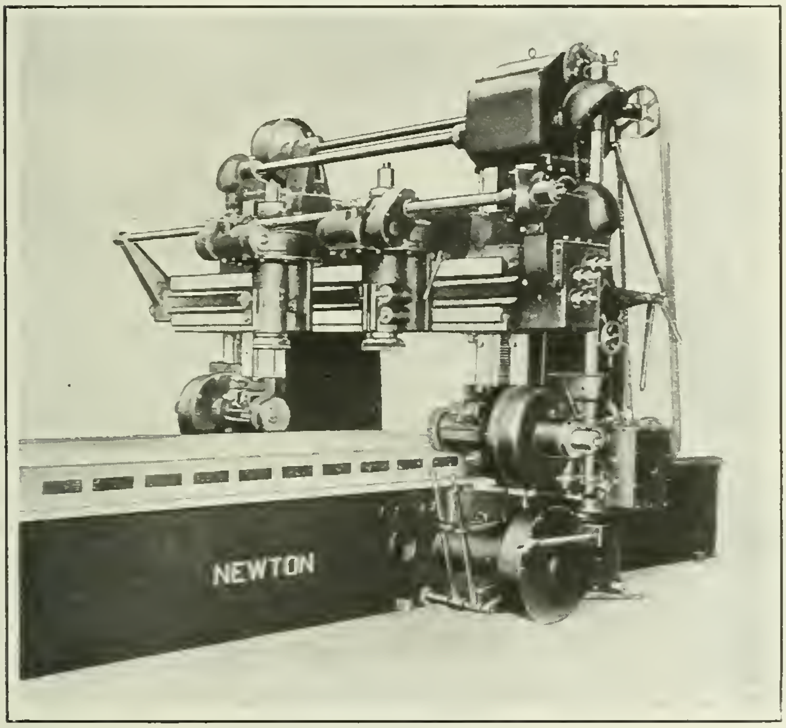


Fig. 1. Newton Planer-type Milling Machine with Four Heads

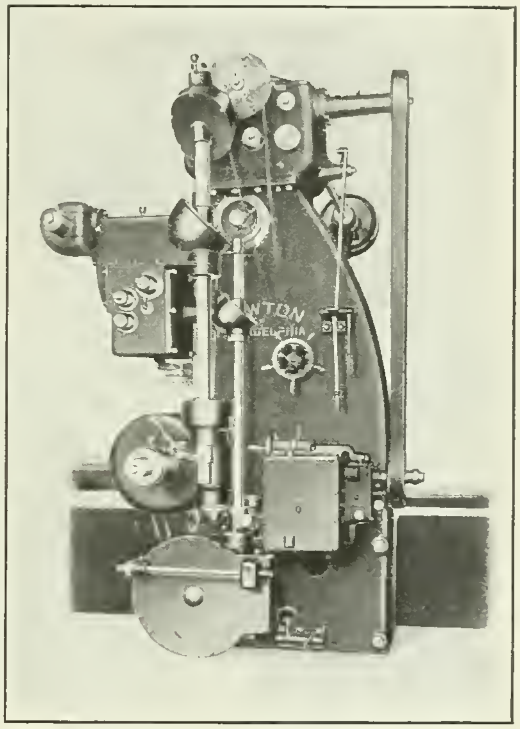


Fig. 2. View of the Right-hand Housing

Power rapid traverse is provided to move the table at the rate of 12 feet per minute in both directions, and there is also a hand adjustment. The table length is sufficient to allow a 12-inch cutter to clear the work at both ends when the table has traveled a distance equal to the rated length of the machine. There are eighteen table feeds ranging from 1 to 33 inches per minute which are obtained independently of the spindle speeds. The housings are reinforced at the top by a deep-section tie-beam. The cross-rail can be raised and lowered by means of a power rapid traverse in both directions, at the rate of 3 feet per minute, and there is a hand adjustment controlled from the crank at the end, the adjustment being 1/8 inch for each turn of the crank. The cross-rail is clamped to the inner and outer faces of both housings by cam-actuated clamps controlled from the front of the machine.

The head saddles on the cross-rail are independent of one another, even though the feed and rapid traverse are taken from the same shaft. Each saddle has a hand adjustment, feed and rapid traverse in both directions, and a means of clamping when a table feed is being used. The feed of each head is engaged or disengaged from the end of the cross-rail, and ranges from 1/2 to 16 1/2 inches per minute. The saddles for the horizontal spindles are separately counterweighted, independently controlled, and so arranged that they can be bolted to the under side of the cross-rail when desired.

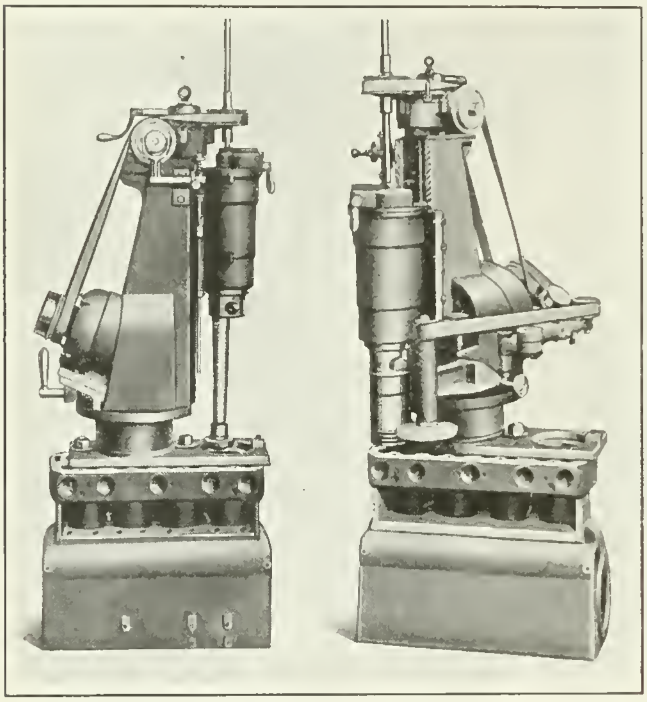
All head spindles are made from solid steel forgings, and have a Morse taper hole, face keyway, and a draw-in bolt. They run in bronze bearings and are fitted with double splines and take-up collars to compensate for wear. The quills have a 6-inch adjustment and may be fitted either with Ames dials or scales. On each head there is provision for disengaging the spindle so that it does not operate except when required. The machine can be arranged for either a belt or motor drive through a friction-clutch pulley mounted on top of the left-hand upright, the power being transmitted through a horizontal shaft to a twelve-speed gear-box on the right-hand upright. The motor can be mounted on the floor, wall, or ceiling, as preferred, and belted to the main pulley.

GISHOLT "DU-ALL" CYLINDER AND PISTON GRINDER

Both automobile cylinder bores and pistons can be reground by means of a portable equipment that has been developed by the Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis. This "Du-All" grinder may be clamped directly on the cylinder block, as shown at the left in the accompanying illustration, or to a bench for grinding single or double cylinders. The wheel-spindle is mounted in a vertical slide, which is fed up and down, either automatically or by hand, to traverse the wheel along the bore. The eccentricity of the grinding wheel in revolving is regulated to suit the particular bore by operating a graduated worm dial. Power for rotating the wheel-spindle and for feeding the slide is obtained from a motor mounted on the machine, which may be supplied for either direct or alternating current taken from an ordinary lighting circuit.

A unique self-aligning fixture is provided for accurately locating the wheel-spindle relative to a cylinder bore before grinding. This fixture has a flange which fits snugly into a hole in the base of the machine near the front, and it also has three balls which are expanded radially from the center of the fixture when it is in place in the base, so that they will contact with the wall of the bore. This results in the machine being swiveled into the proper position, and permits locking in correct alignment with the cylinder bore. Grinding is performed on both the up and down strokes. There is a suction blower on the right-hand side of the machine for carrying away the grinding dust. The wheel-slide has a travel of 14 inches. The length and range of the slide movements are controlled by means of a tripping mechanism which operates friction clutches and pulleys on top of the machine.

In grinding pistons, the vertical slide is provided with a special adapter for holding the work, as shown at the right in the illustration, and a grinding wheel is mounted on the shaft that drives the exhaust blower in cylinder grinding. The piston is fed up and down past the wheel. There is an adjustment to regulate the grinding depth, and adjustments for regulating the tension on all belts.



Gisholt Equipment for regrinding Both Cylinder Bores and Pistons

"MACALENE"

A mixture known as "Macalene," which is added to quenching water or oil to harden and toughen iron castings, is made by the McCadden Laboratories, St. Cloud, Minn. Hardening by this method is recommended by the maker for automobile pistons and cylinder blocks; forming and bending dies; clutch plates; machine tool parts such as cams, turrets, and tailstock castings; locomotive valves; brake-shoes; and other parts. The preparation is mixed with ordinary pure water in the ratio of one gallon to fifty gallons of water. The work is heated to a temperature of about 1440 degrees F. and quenched in the solution, after which it is drawn to a blue color, in most instances. In this condition the work is said to be from 25 to 50 per cent stronger than ordinary cast iron. An automobile piston tested by the Brinell process had a hardness of 450 as compared with 223 of a soft untreated piston. "Macalene" has no effect on steel.

KINGSBURY AUTOMATIC SENSITIVE DRILLING MACHINES

A description of an automatic sensitive drilling head made by the Kingsbury Mfg. Co., Keene, N. H., was published in November, 1922, MACHINERY, and an application of this head on a machine equipped with an indexing dial for cross-drilling rivets appeared in the March, 1923, number. The accompanying illustrations show two more applications of this head. Fig. 1 shows a machine equipped with two heads for simultaneously drilling two holes from opposite sides, or for drilling and reaming through holes. In the set-up illustrated, the head at the left is used for drilling, and that at the right for reaming. After clamping the work in a fixture, the operator presses the trip-lever at the left, and when the drill reaches the forward end of its travel, the opposing spindle is automatically tripped to cause the reamer to enter the work as the drill is withdrawn.

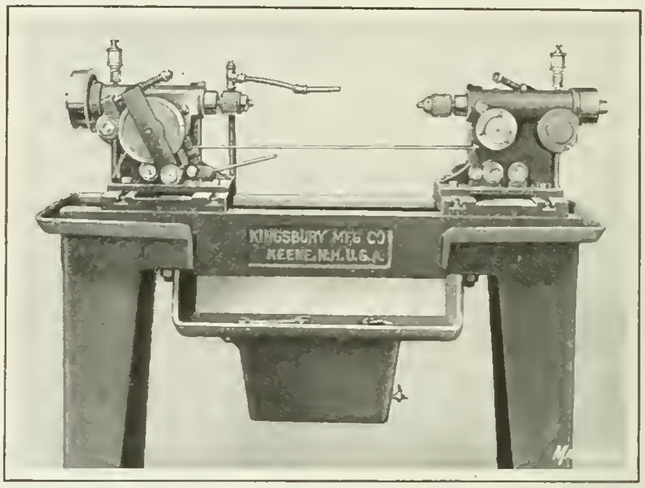


Fig. 1. Kingsbury Automatic Sensitive Drilling Machine with Opposed Heads

In Fig. 2 is illustrated a machine equipped with four heads, the spindles of which are located at right angles to the length of the table. This machine is intended for small single-hole drilling. The countershaft is mounted on

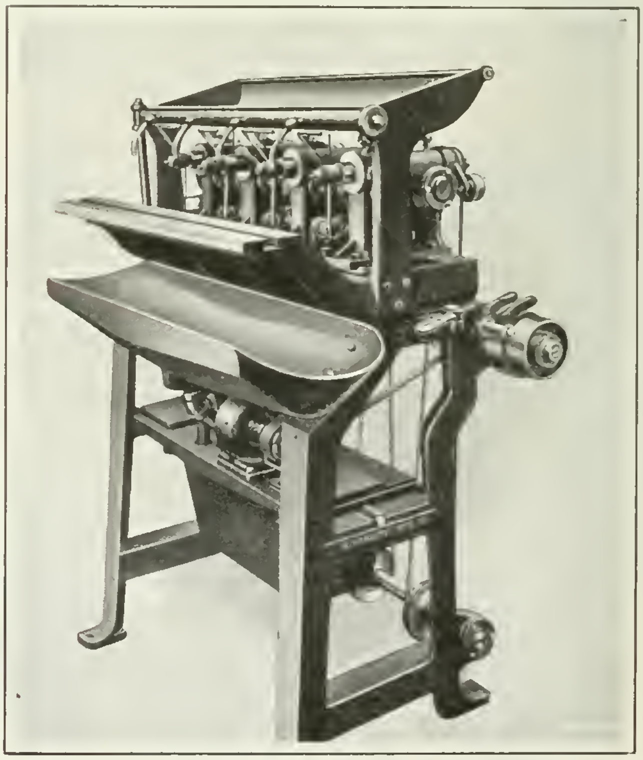


Fig. 2. Multiple-spindle Horizontal Gang-type Machine

S K F ball bearings, and gives three spindle speeds of 4000, 3200, and 2500 revolutions per minute; however, a single-speed countershaft may be furnished if desired. The machine is also built with two or three heads. The weight of a four-head machine with the spindles spaced 8 inches apart is approximately 800 pounds.

TUBE SHEAR

A machine for cutting off pipe and tubing, which operates on a new principle, has been developed by the Tube Shear Co., Marquette Bldg., 140 S. Dearborn St., Chicago, Ill. In this machine the tubing is sheared over an arbor with a non-rotating ring shearing knife, and this method is successfully applied to steel, brass, and aluminum, with particular efficiency on the thinner wall sizes. One of the advantages that are claimed for this construction is that it is unnecessary to chuck or clamp the tubing, as neither the ring shear knife nor the tubing rotates. A further advantage is that the load-sustaining shear blocks bear directly in the plane of shear, regardless of the tube length. The arbor knife is supported through the tubing directly in the plane of shearing, and so the casting to which the arbor knife is attached receives none of the shearing load, its purpose being merely to align the shear knife.

The head of the machine is driven from an overhead motor, and is rotated once to cut off a piece of tubing. The machine is of the back-geared type, operated by means of a foot-treadle and a positive clutch mechanism. It has a fixed stroke which, contrary to the common conception that a shear stroke is governed by the shearing angle of the knife, is governed by the maximum wall thickness of the tubing for which the machine is designed. It is said that, regardless of the size of the shearing machine, the fixed stroke need in no case be greater than the maximum wall thickness, as it is not considered necessary on any class of stock for the knife to pass completely through the wall of the tube.

The shearing angle is established by the difference in diameter between the ring knife and the outside diameter of the tube, and is controlled by the main knife adjustment and not by the stroke. This adjustment is located on the shear head directly in line with the stroke-actuating member, and governs the eccentricity in which the ring shear block operates. This eccentricity is fixed by the shearing angle, or the difference in diameter between the ring knife and the outside of the tube.

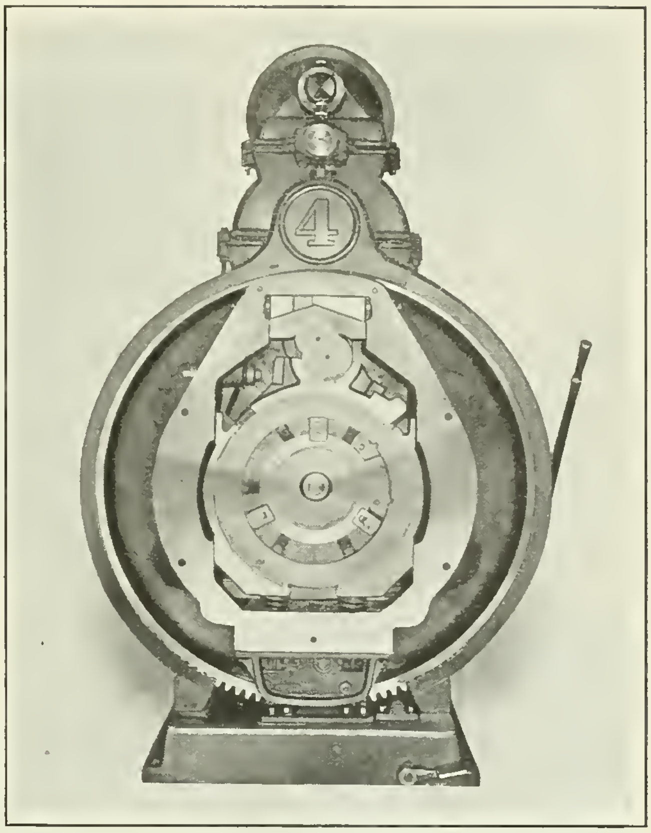


Fig. 2. Front View of the Tube Shear with the Cover Plate removed

An adjustment for knife alignment is made from the front of the machine, the arbor being detachable without affecting this alignment. Any flexibility of the arbor due to its length is compensated for by supports which position themselves automatically as the tube is fed out. The tube travels on rolls which are adjustable to suit various diameters. The stop and feed mechanisms are also adjustable for shearing to different lengths and for feeding different diameters. A feature of the machine is the accessibility of the ring and arbor knives, which are plain, hardened rings.

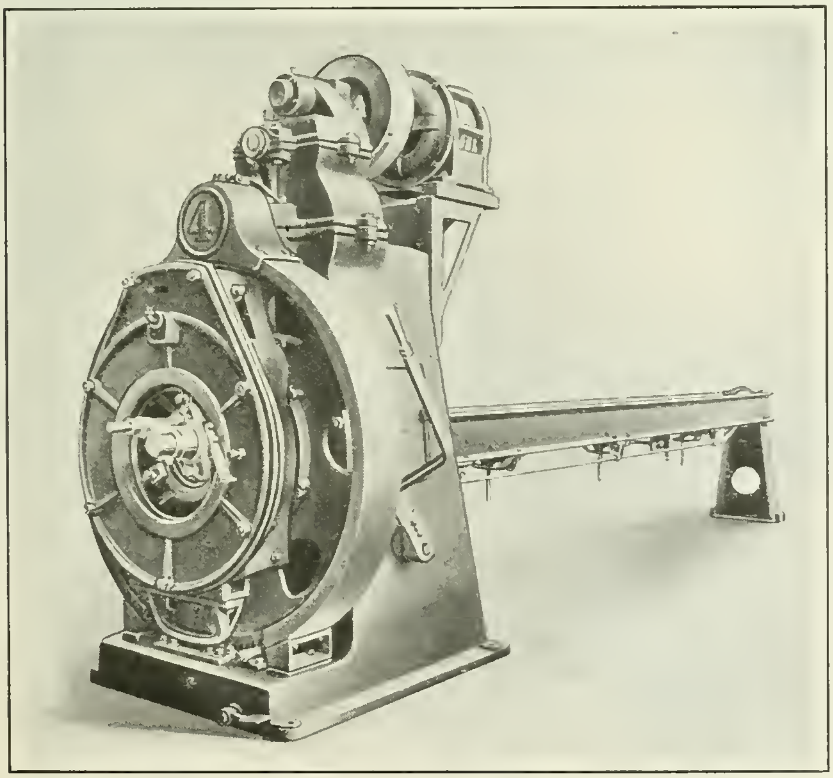
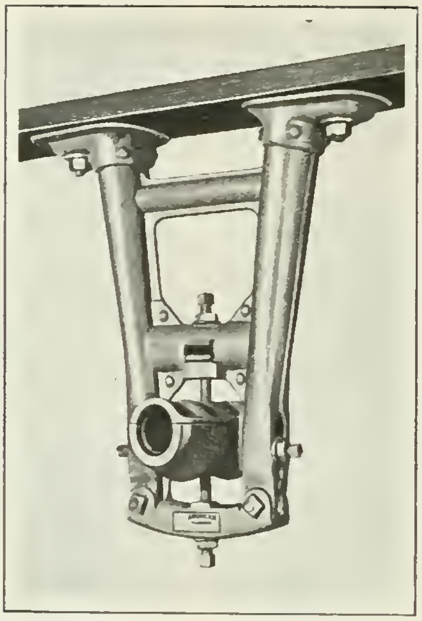


Fig. 1. Tube Shear in which the Work is cut by a Non-rotating Ring Knife while supported on a Stationary Arbor

AMERICAN PRESSED-STEEL SHAFTING HANGER

A pressed-steel shafting hanger of the four-point set-screw type is being introduced to the trade by the American Pulley Co., Philadelphia, Pa. This hanger is of the "parting" variety; that is, it has a swing yoke which readily permits the removal of the shaft or bearing. The main frame of the hanger is constructed of two stampings, placed face to face with in-turned flanges extending the entire length of the legs. The flanges are said to provide unusual strength and rigidity. The cross-brace is integral with the legs. All bolts, nuts, and set-screws are standard and accessible, so that replacements may be conveniently made. The foot of the hanger is made of heavy cold-drawn seamless metal, and is ample to sustain the pressure of the clamping bolts or lag screws.

It is attached to the oval frame leg by means of rivets. The frame is smooth, with rounded surfaces that eliminate dust pockets and projecting parts. This hanger is made in the regular drop sizes from 7 to 24 inches and for all shafting up to 3 inches. The bearing box is babbitted and the bearing is broached to size.


American Pressed-steel Shafting Hanger

MUELLER GEARED-HEAD LATHE

The 18-inch geared-head engine lathe shown in Fig. 1 is built by the Mueller Machine Tool Co., of Cincinnati, Ohio. On this machine there is an apron control of sixteen spindle speeds, and the forward and reverse movements of the spindle are also controlled from the apron. All speed changes are made without stopping the driving pulley. The long vertical lever at the front of the head controls four changes of speed from the main driving shaft through patented friction clutches, only one of which can be operated at a time. These four speed changes are transmitted direct to the spindle with the back-gear pinion withdrawn from the spindle gear and with the sliding clutch collar on the spindle engaged.

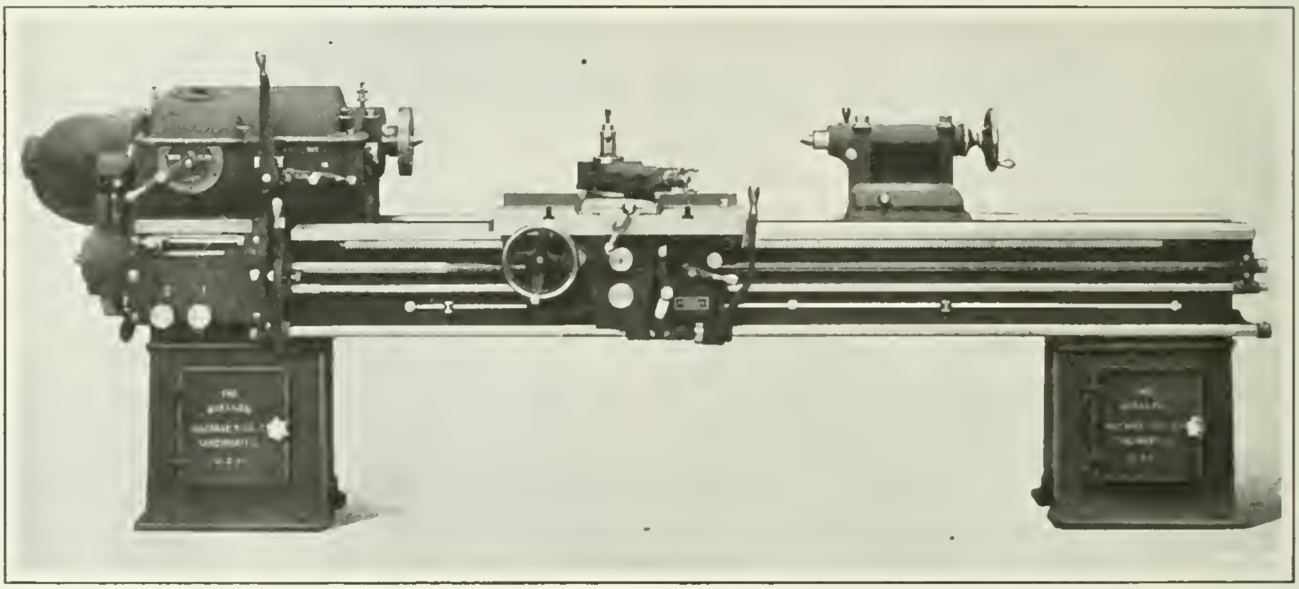


Fig. 1. Mueller Geared-head Engine Lathe

The small lever on the headstock to the right of the vertical lever alternately operates both the spindle clutch and the back-gear pinion, and the lever to the left controls a double- and a single-jaw clutch on the back-gear shaft in such a way that only one of these clutches can be engaged at a time. The engagement is made through spring pressure, and so the operating lever can be placed where required, even though the clutch jaws are not in mesh. The action is positive in disengaging any of the jaw clutches. By multiplying the triple back-gear speeds with those of the first driving shaft, twelve speeds are obtained in addition to the four secured without the back-gear, making sixteen speeds in all. The three gears and clutch on the spindle are on one quill and revolve on the spindle. All keys are milled integral with the shafts, and all bearings are bronze-bushed and self-oiling. The jaw clutches are made of nickel steel and hardened, and the gears are of stub tooth form.

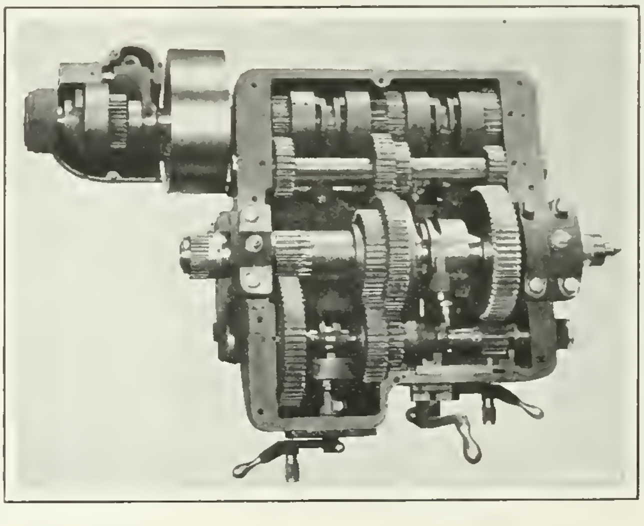


Fig. 2. View of the Geared-head Mechanism

The reversing mechanism is a separate unit which is bolted to the head, and it supports the first driving shaft in two radial ball bearings. The driving pulley has an internal gear on the left side and a friction clutch on the right, the latter being engaged for imparting a right-hand motion to the first driving shaft. For a left-hand drive, a pinion is engaged with the internal gear of the pulley to deliver power across to a friction gear and give this gear a reverse motion to that of the pulley. A sliding collar controls the two friction clutches, the collar being operated by means of a fork, as shown in Fig. 2, and a lever below the attachment. This lever is connected under the lathe head to the levers on the lower splined shaft on the front of the bed. By this arrangement the lever mounted at the right end of the apron has full control of starting, stopping and reversing the lathe spindle. Adjustable dogs are attached on a flat bar at the front of the bed to trip the automatic feed at any desired point. This machine may also be arranged for motor drive; when so arranged, the motor is bolted to the rear of the cabinet leg beneath the headstock of the machine.

ROLLER-BEARING LOOSE PULLEY AND COUNTERSHAFT BOX

Loose pulleys from 2½ to 22 inches in diameter, equipped with adjustable taper roller bearings for taking end thrust, as shown in Fig. 1, are manufactured by the St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo. When the pulleys are small in diameter, as on polishing machines and many other types of high-speed equipment, the bearings are mounted directly on a shaft, but it is preferable to mount them on a sleeve. An advantage of the sleeve installation is that the pulley can frequently be mounted on worn shafts and arbors.

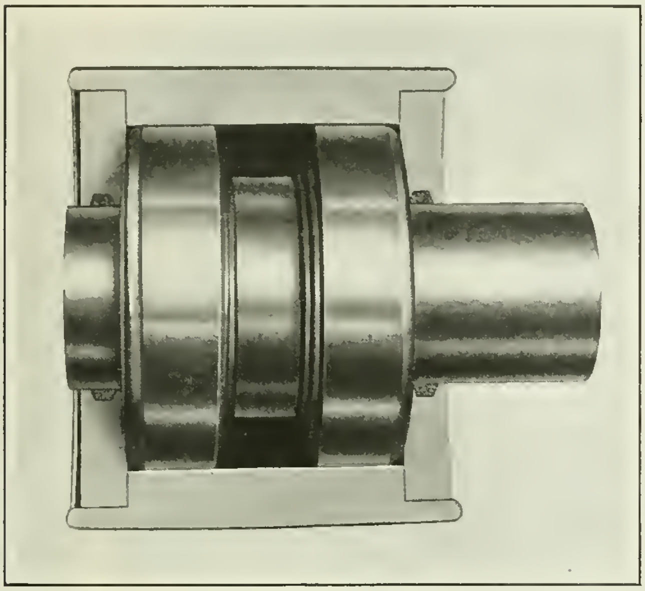


Fig. 1. St. Louis Loose Pulley equipped with Taper Roller Bearings

Roller bearings of the same type are also being supplied in the countershaft box that is shown in Fig. 2 in place in a hanger. The box has sockets to provide for adjustment of its position by means of set-screws. The back of the box is solid, while on the front there is an end plate. A felt groove and retainer is provided at both the front and back. The box can be furnished with or without the pressed-steel hanger shown.

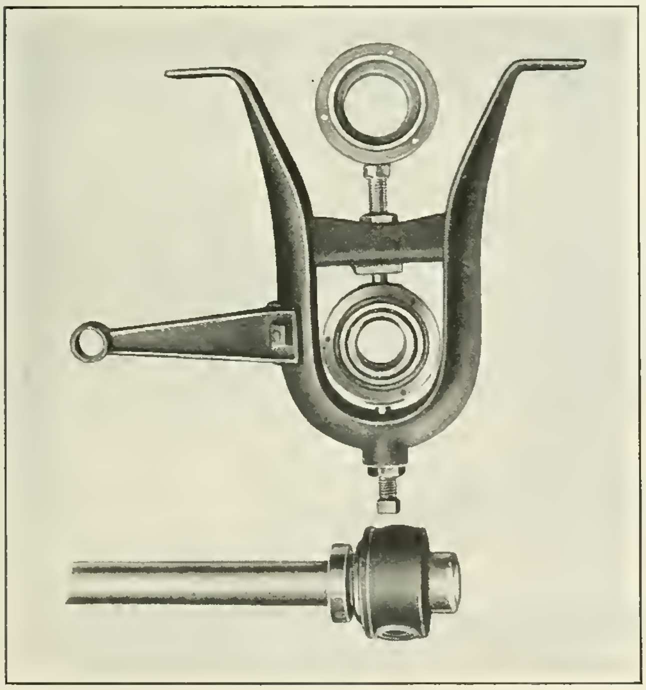
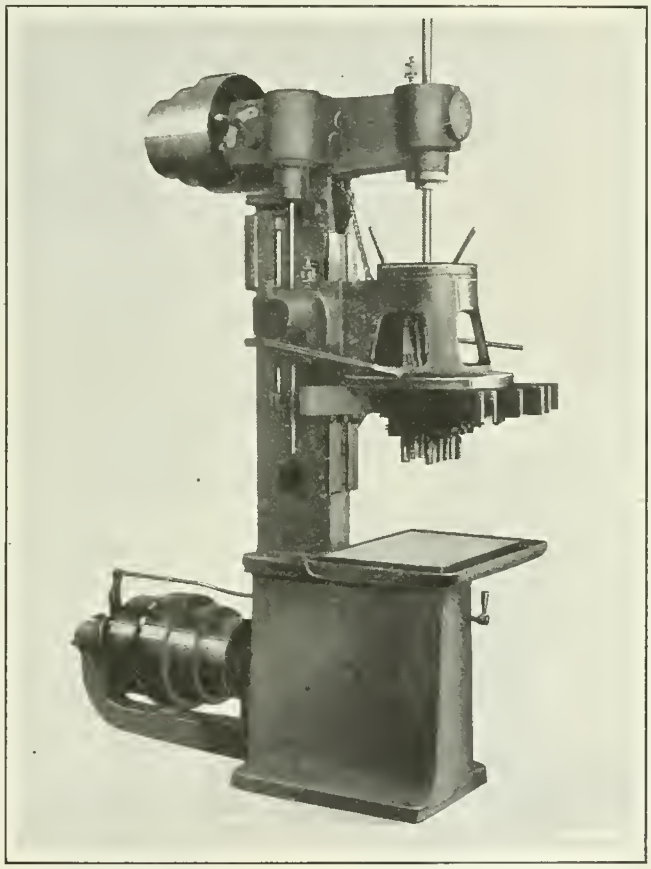


Fig. 2. Roller-bearing Countershaft Box and Pressed-steel Hanger

FOX MULTIPLE-SPINDLE DRILLING MACHINE

A cone-pulley-driven multiple-spindle drilling machine designated as the No. 12-A is being introduced to the trade by the Fox Machine Co., Jackson, Mich. The lower cone is mounted on a countershaft which runs in Hyatt bearings and is driven by an Edgemont clutch controlled from the front of the machine, and the upper cone is mounted on a 1⅜-inch shaft which runs in S. R. B. ball bearings. The cone pulleys are intended for a 4-inch belt. The yoke that supports the upper driving pulley also contains the feed gearing. Three changes of feed are obtained by means of sliding cone gears which transmit power through a worm and worm-gear to the vertical feed shaft. The worm and worm-gear are always in mesh, and they are submerged in oil, while the feed gearing also dips in oil. A clutch for engaging and disengaging the feed is operated by means of the lever at the left. The pilot wheel on the right-hand side of the machine is rotated to raise and lower the head through a rack and pinion mechanism.

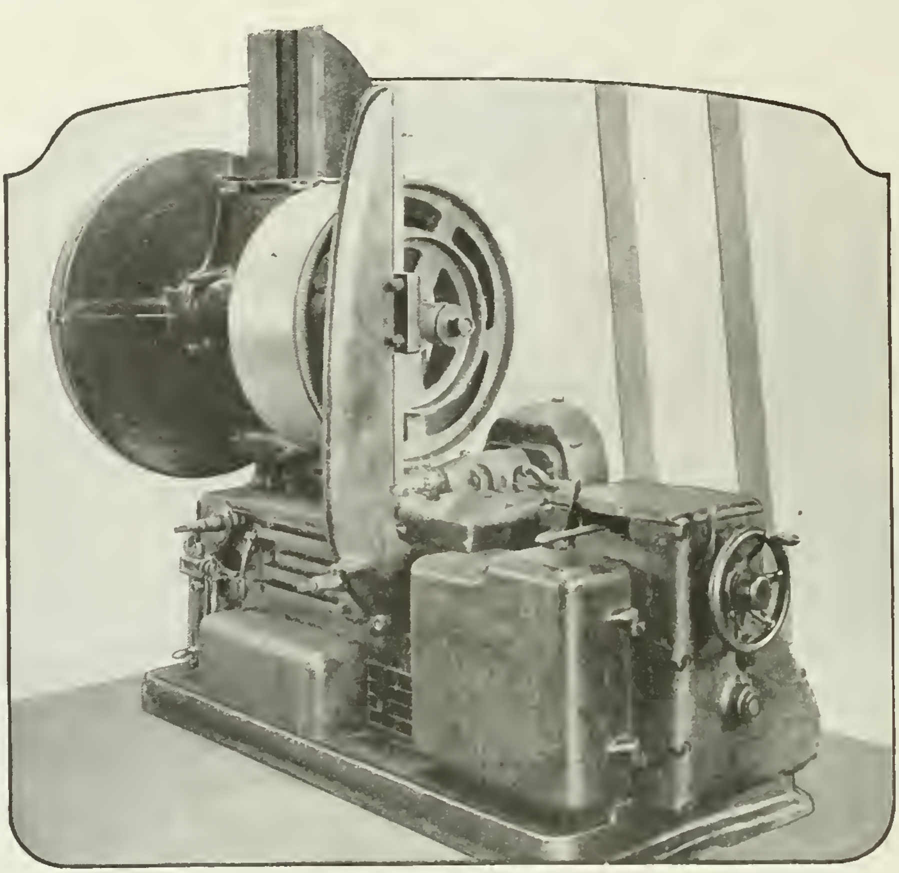


Fox Multiple-spindle Drilling Machine

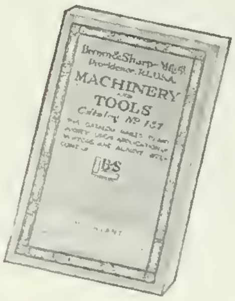
Power is transmitted to the vertical driving shaft through bevel gears at the front of the yoke which are mounted in ball bearings. A round head accommodating twelve spindles, ⅞ inch in diameter, which may be located at any point within a 12-inch circle is furnished on the machine. The head is counterbalanced by a weight in the column, and the spindles have a vertical adjustment in their holding arms. This machine is designed especially for using small high-speed drills, and it has a capacity of 10 horsepower. A motor may be mounted on a special bracket in place of the lower cone pulley when a motor drive is preferred. The weight of this machine is about 3070 pounds.

* * *

In 1869 the value of the manufactured products of the United States was slightly over $1,000,000,000. In 1919 it was $62,418,000,000. The power used in 1869 was 2,350,000 horsepower. Fifty years later, in 1919, it was 30,000,000 horsepower.



Strength and Accuracy—Features of Brown & Sharpe Gear Cutting Machines



Our catalog listing a complete line of mechanical equipment is a valuable source of information for mechanics, foremen or shop superintendents. Six hundred pages — yet small enough to fit the pocket. Ask for No. 137.

Brown & Sharpe Gear Cutting Machines have the strength and precision essential for accurate work on heavy gears. The sturdy upright and arbor support and the long bearing for the work arbor hold the work rigidly. Accurate spacing is assured by an extremely accurate index wheel of large diameter in proportion to the diameter of the work.

The indexing mechanism on Brown & Sharpe Machines operates without shock—an important feature when cutting big gears. In Brown & Sharpe Machines, the indexing cycle begins and ends gradually—the wearing effect of sudden jars is eliminated—the accuracy of the indexing mechanism is preserved—and accurate spacing of the teeth on large gears is insured. Consider these advantages of Brown & Sharpe Machines in connection with your own gear cutting.

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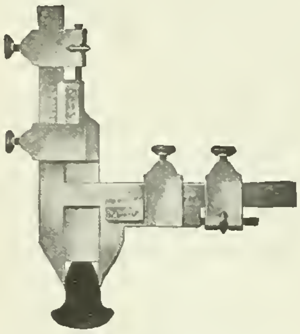

Gear Tooth Vernier No. 580 measures thickness of gear teeth at pitch line or chordal thickness and distance from top of tooth to the chord. Provide your gear men with this accurate tool.

Gear Makers Need the Help of Brown & Sharpe Tools

Proper tools play an important part in making accurate gears. Every step from turning the blank to testing the finished gear needs the help of Brown & Sharpe Tools. Use Vernier Caliper No. 573 for measuring the blank and the bottom diameter of gears. Gear Tooth Micrometer No. 249 is handy for scribing blanks to show extreme depth of teeth. In setting up large gears a Dial Test Indicator is essential.

Gear Tooth Vernier No. 580, shown above, is valuable for accurately measuring the size of teeth when starting to cut a blank. Supply your men with these Brown & Sharpe Tools —gears of more uniform accuracy will be the result.

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Fine Tools—2,000 of them—all of the same high accuracy—are shown in our Catalog No. 28. This catalog also contains much information on Gear Cutters and many formulas used in cutting gears. Write for your copy today.

BROWN & SHARPE TOOLS

for Accurate Work

PERSONALS

Stanley P. Seward has been appointed advertising manager of the White Co., Cleveland, Ohio, succeeding M. H. Newton.

Thad Dean Wheeler, formerly of the McGraw-Hill Co., has been appointed vice-president of the Sweet & Phelps Advertising Agency, 210 E. Ohio St., Chicago, Ill.

Alexander T. Galbraith, formerly general manager of the Halcomb Steel Co., Syracuse, N. Y., has been made general manager of sales of the Crucible Steel Co. of America, Syracuse.

L. M. Dalton has succeeded E. J. Burnell as manager of the Boston Branch office of the Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Mr. Burnell resigned his post to enter business for himself.

F. H. Worthington, associated with the Jacksonville, Fla., office of the General Electric Co., has been appointed local manager of the Jacksonville office to succeed G. C. Henry who recently resigned.

Howard W. Gillette, who has been connected for several years with the Ogden R. Adams Co., Inc., Rochester, N. Y., has been transferred to the Syracuse office of the company, of which he will be in charge.

Fred R. Low, of New York City, editor of *Power*, was nominated for the presidency of the American Society of Mechanical Engineers for the year 1924, at the spring meeting of the society held in Montreal, Canada.

C. F. Rogers, who formerly represented C. E. Johansson, Inc., in the eastern territory, has been appointed factory representative for the W. B. Knight Machinery Co., of St. Louis, Mo., manufacturer of milling and drilling machines.

H. R. Sargent, formerly manager of the wiring supplies division of the Bridgeport Works of the General Electric Co., has been appointed managing engineer of this division under a development plan that will create several unit divisions at the Bridgeport factory.

Charles P. Hery, who has had many years' experience in the sale of metal- and wood-working machinery, mill supplies, and small tools, has become associated with the Ogden R. Adams Co., Inc., Rochester, N. Y., and will be located at the main office of the company.

George A. Stetson, assistant professor of mechanical engineering at Yale University, and for the last four years editor of the transactions of the American Society of Mechanical Engineers, has resigned both these positions to enter the wholesale coal business in Boston.

W. R. Whitney, director of the Research Laboratory of the General Electric Co., Schenectady, N. Y., was recently elected a member of the corporation of the Massachusetts Institute of Technology for a term of five years. He was graduated from the institute in 1890, and has for some time been a non-resident professor of theoretical chemistry there.

W. H. Townsend, formerly factory manager of the Automobile Screw Products Co., Cleveland, Ohio, and prior to that time connected with the Atlas Bolt & Screw Co., also of Cleveland, has become affiliated with the Cleveland Duplex Machinery Co., Inc., 1224 W. 6th St., Cleveland, as sales engineer, specializing in semi-automatic and automatic machinery.

Lewis S. Edgarton, professor of metallurgy at the Mechanics Institute, Rochester, N. Y., has become associated with the Ogden R. Adams Co., Inc., of Rochester, and will be connected with the Buffalo office of the company. Mr. Edgarton is a graduate of the Massachusetts Institute of Technology and a member of the American Society of Mechanical Engineers.

Franklin S. Terry, co-manager of the National Lamp Works, Neal Park, Cleveland, Ohio, was elected vice-president of the General Electric Co., Schenectady, N. Y., and B. G. Tremaine, also co-manager of the National Lamp Works, was elected a director of the company, at a meeting of the board of directors held in New York City, June 22. Both Mr. Terry and Mr. Tremaine have long been prominently identified with the electrical industry.

Henry K. Spencer has been appointed manager of the Blanchard Machine Co., 64 State St., Cambridge, Mass., manufacturer of high-power vertical surface grinders. Mr. Spencer's connection with the company dates from the beginning of its surface grinder business. Prior to the death of the late Winslow Blanchard, Mr. Spencer was assistant manager and chief engineer. The business will be continued by the same interests and along the same lines as heretofore.

Gerard Swope, president of the General Electric Co., Schenectady, N. Y., was awarded the honorary degree of Doctor of Science at Rutgers College on June 12. Owen D. Young, chairman of the board of directors, was given the degree of Doctor of Literature at St. Lawrence University, of which he is an alumnus, and Dr. Irving Langmuir, assistant director of the Research Laboratory, received the honorary degree of Doctor of Science from Union College, Schenectady. David B. Rushmore, consulting engineer, was given the degree of Doctor of Science by his alma mater, Swarthmore College. All of these men have been greatly interested in furthering scientific education in our colleges and schools, and have taken a leading part in the forward-looking movement of cooperation between the colleges and industry.

OBITUARIES

CLYDE M. CARR

Clyde M. Carr, until recently president of Joseph T. Ryerson & Son, Inc., Chicago, Ill., died June 5 after an illness of several weeks. Mr. Carr retired as president last February on account of poor health, but continued to serve as a director until the time of his death. He was born in Illinois in 1869, and was educated at Princeton and Northwestern Universities. He first became associated with Joseph T. Ryerson & Son in 1890, and was elected president in 1911. Previous to his connection with the Ryerson Company, he had been associated with the People's Gas Light & Coke Co., and W. S. Mallory & Co. Mr. Carr had always been an active leader in civic and industrial circles, and his far-reaching influence accomplished much wherever he was interested. He was a member of the American Iron and Steel Institute.

Williard T. Sears research and experimental engineer of the Niles-Bement-Pond Co., New York City, died recently at Montclair, N. J. Mr. Sears had been with the company for over twenty years. Prior to this he was connected with the Pennsylvania Steel Co. for a number of years. He was a member of the class of 1887 of the Massachusetts Institute of Technology. Mr. Sears was an inventor of exceptional imagination and the machine tool industry has greatly benefited from the many developments which he originated.

INDUSTRIAL MACHINERY IN CHINA

It has long been believed, states W. H. Rastall, chief of the Industrial Machinery Division of the Department of Commerce, that the conditions in China are practically unchanging. Recent developments show, however, that the market for industrial machinery is rapidly increasing in that country, and that American products occupy an important position in the trade. In 1921 China imported over $41,000,000 worth of industrial machinery, as compared with about $5,000,000 in 1913, which was the highest importation up to that time. The United States furnished $16,000,000 worth of industrial machinery in 1921, as compared with about $500,000 worth in 1913. Expressed in percentages, the United States supplied less than 10 per cent in 1913, and nearly 40 per cent in 1921. Of the machine tools imported into China in 1921, the United States, the United Kingdom, and Japan supplied practically 30 per cent each. In textile machinery, the United States supplied 44 per cent; the United Kingdom, 42 per cent; and Japan nearly all the remainder.

* * *

Between 1916 and 1921 there was a decrease of 2200 miles in the length of railroad lines operated in the United States. In the period from 1910 to 1915 there was an increase in the operated mileage of 20,000 miles.

Rush! So They Machined This Die on the Cincinnati Miller

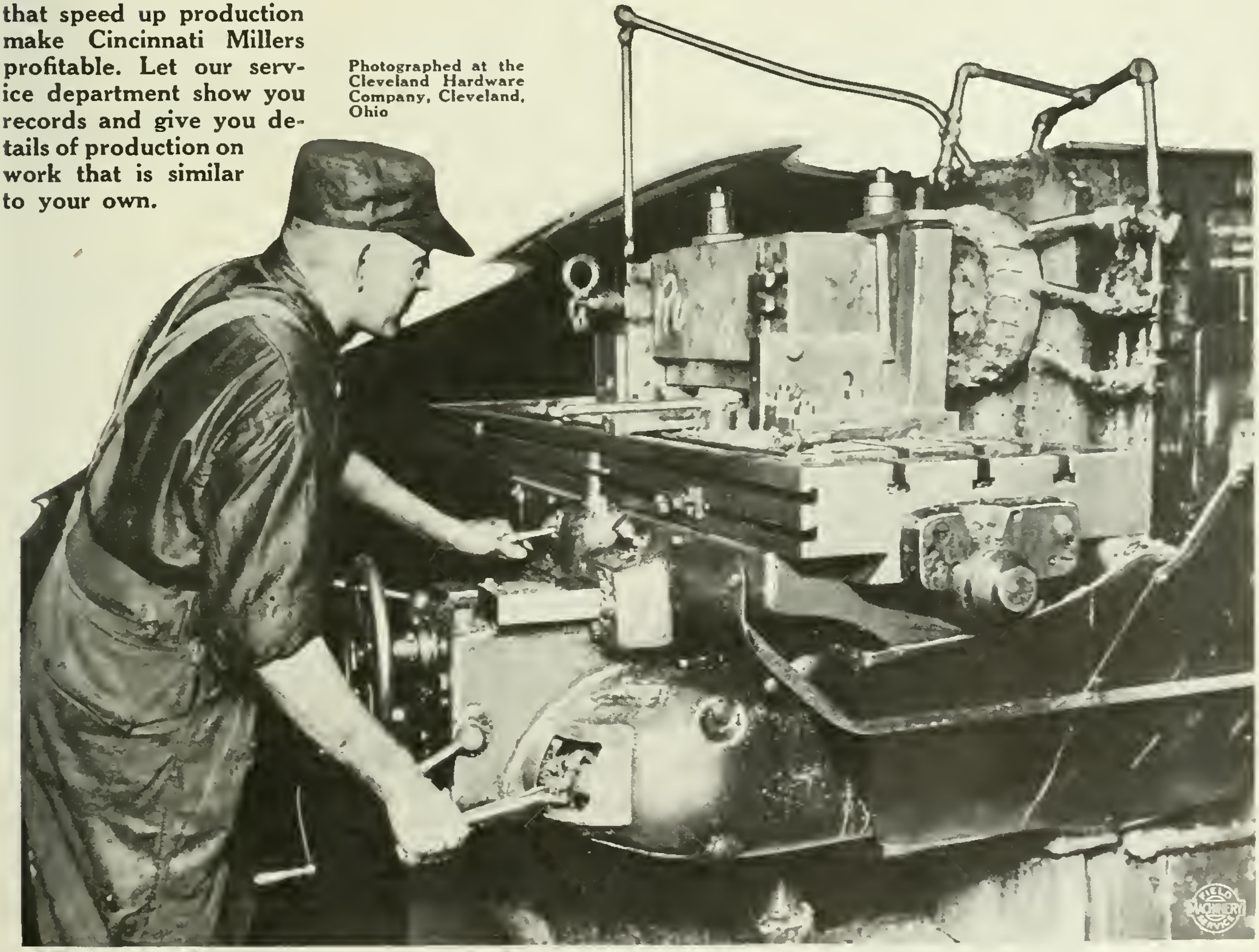
First, this nickel steel die block was needed in a hurry, second, the operator was a piece worker; two good reasons for putting it through on the Cincinnati Miller.

Two operations were performed; first, a roughing cut taken with a cutter 10" in diameter, then a shanking cut with a conical shanking cutter 3" in diameter. Time on the actual operation is not available but time for the change from one to the other is interesting.

Without moving from his position the operator lowered the table, ran it back to the starting end of the cut, engaged the cross feed for the proper distance, changed the tool and started the second cut in less than two minutes—which certainly cuts non-productive time to nearly the possible minimum.

THE CINCINNATI MILLING MACHINE COMPANY
CINCINNATI, OHIO, U. S. A.

Operating conveniences that speed up production make Cincinnati Millers profitable. Let our service department show you records and give you details of production on work that is similar to your own.



Photographed at the Cleveland Hardware Company, Cleveland, Ohio

CINCINNATI MILLERS

TRADE NOTES

Skinner Chuck Co., New Britain, Conn., have opened a new branch office in Cincinnati, Ohio, at 915 Broadway.

Aetna Ball Bearing Mfg. Co. is now located at 2737 High St., Chicago, Ill., in new quarters which have greatly improved facilities for production and service.

Electric Steel Co., Chicago, Ill., has changed its name to Nugent Steel Castings Co. No change has taken place in the management, ownership, or personnel.

West Coast Machinery Co., 1006 First Ave. S., Seattle, Wash., has been appointed representative of the Rockford Milling Machine Co. and the Rockford Tool Co. in the Seattle territory.

Triplex Machine Tool Corporation, 50 Church St., New York City, has appointed the Andrews & George Co., Tokio, Japan, exclusive sales agents for the Triplex combination bench lathe, milling, and drilling machine in Japan and Manchuria.

R. L. Barker & Co., 25 S. Clinton St., Chicago, Ill., has been appointed exclusive representative in Indiana, Illinois, Wisconsin, and Iowa for the Hisey-Wolf Machine Co., Cincinnati, Ohio, manufacturer of portable electric drills, screwdrivers, grinders, and buffers.

Pennsylvania Crusher Co., Philadelphia, Pa., has recently moved its Pittsburg office from the Peoples Bank Bldg. to larger quarters in the Oliver Bldg. to provide for their increasing volume of business in that district. H. M. Hallett will continue to serve as district manager.

Magnus Electric Co., Inc., Greenwich and Desbrosses Sts., New York City, manufacturer of electrical specialties, wiring devices, and radio accessories, has established a new district sales office at 231 N. Wells St., Chicago, Ill. Leo Hirschfeld and M. B. Geiger will be in charge of the new office.

Gits Bros. Mfg. Co., 1940 S. Kilbourne Ave., Chicago, Ill., manufacturer of lubricating devices and oil-cups, has just completed a large addition to its plant, and will now operate at more than double capacity. The company recently perfected a new line of cups and lubricating systems.

Oliver Machinery Co., Grand Rapids, Mich., has entered into an arrangement with the Canadian Fairbanks Morse Co., Ltd., whereby the latter company will represent the Oliver Machinery Co., exclusively throughout Canada, for the sale of its woodworking machinery and machine tools.

Dillon Electric Co., 1712 Eleventh St., N. E., Canton, Ohio, has just completed a two-story and basement addition to its Canton shop. The new building is 70 by 105 feet, of reinforced concrete construction, and when equipped with machinery, will double the capacity of the company's Canton plant.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., has moved its Cleveland office from Room 429 to Room 329 in the same building in which it has previously been located. The name of the building has been changed and in the future the address of the Cleveland office of the Link-Belt Co. will be 329 Rockefeller Bldg.

Hurlbut, Rogers Machinery Co., Nashua, N. H., manufacturer of cutting-off and centering machines, is now located in Nashua, N. H., its plant in South Sudbury, Mass., having recently been totally destroyed by fire. The larger facilities provided by the new quarters will enable the company to handle work to better advantage than previously.

Oilgear Co., 64 Twenty-seventh St., Milwaukee, Wis., has appointed the following companies sales representatives for its variable-speed hydraulic power transmissions: Federal Machinery Sales Co., 12 N. Jefferson St., Chicago, Ill.; Laughlin-Barney Machinery Co., Union Trust Bldg., Pittsburg, Pa.; and Elliott & Stephens Machinery Co., 721 Olive Ave., St. Louis, Mo.

American Emery Wheel Works, Providence, R. I., have just purchased a piece of property adjacent to their present plant, consisting of slightly over 34,000 square feet of land, and a substantial two-story brick building containing over 33,000 square feet of floor space. The acquisition of this property was made necessary by the increased demand for their product.

L. S. Starrett Co., Athol, Mass., referring to a prize contest recently conducted on "How Starrett Tools Have Helped Me Most in My Work," announces that toolmakers and machinists won 377 of the 474 prizes awarded. The four main prizes were won by Robert N. Walters, 824 Grand Ave., Racine, Wis.; Harry Gibler, DeBeque, Colo.; Leon H. Rice, 58 Riley Ave., Manchester, N. H.; and W. S. Clark, 430 N. Lawler Ave., Chicago, Ill.

Nielsen-Barton Chuck Co. has been reorganized under the name of the Nielsen-Barton Chuck & Tool Co., and has moved its plant from Chicago to Lawton, Mich. The officers of the reorganized concern are: President, C. W. Johnson; vice-president, H. E. Barton; secretary, Fred Lich; and treasurer, H. G. Nielsen. The new company has purchased six acres of land in the north part of Lawton, and has constructed a new brick factory, 50 by 100 feet.

Steelcraft Parts Co. has recently been incorporated with a capitalization of $100,000 to manufacture structural steel tools, including rivet sets, chisel blanks, pistons for riveting and chipping, hammers, chisel bushings, punches and dies, and hardened and ground bolts. The company will take over the plant of the Structural Tool Co. at 3160 W. 106th St., Cleveland, Ohio. The officers are: Charles L. Wasmer, president; Carl E. Kramer, vice-president; John L. Wasmer, secretary; and James J. Lally, treasurer.

Pelton Water Wheel Co., Inc., San Francisco, Cal., is planning to erect a two-story office and factory building, 150 by 200 feet, opposite its present building. The new building will house the office, drafting-room, pattern shop, pattern storage, and pump assembly departments. The present building will be devoted exclusively to the machine shop and turbine erection departments, the new arrangement enabling the present facilities to be virtually doubled. A number of additional machine tools will be installed.

Uehling Instrument Co., Paterson, N. J., manufacturer of carbon dioxide recorders and draft and vacuum gages, has appointed the Amsler-Morton Co., Fulton Bldg., Pittsburg, Pa, agent for its products in western Pennsylvania, and John A. MacDowell, 2039 Railway Exchange Bldg., St. Louis, Mo., agent for eastern Missouri and southern Illinois. H. R. N. Johnson who formerly represented the Uehling Instrument Co. in Minnesota and the Dakotas, has joined the W. P. Nevins Co., 120 S. Ninth St., Minneapolis, Minn., which is now the official Uehling representative in the territory mentioned.

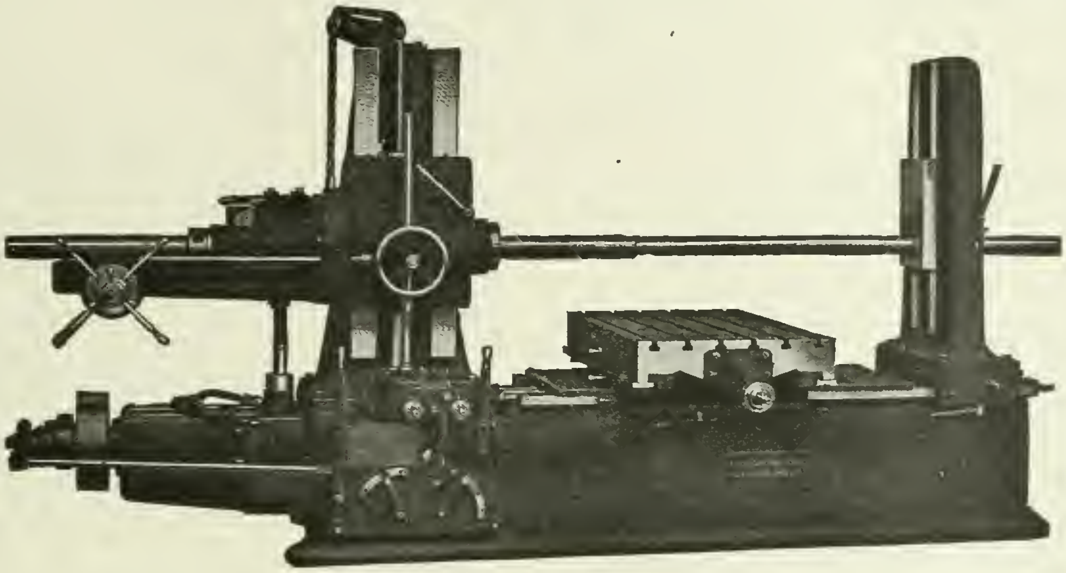
Henry Disston & Sons, Inc., Philadelphia, Pa., have opened a branch office at 130-132 Marietta St., Atlanta, Ga., in order to more adequately serve their customers in the southeastern states. In addition to the office, a showroom will be maintained at this branch, where samples of Disston products will be on display, including saws, files, machine knives of all kinds, and tool steel. A completely equipped repair department will also be maintained. E. F. Cooper has been placed in charge of the new branch. He has been associated with the company as a representative of the mill goods department for eight years.

B. F. Sturtevant Co., Hyde Park, Boston, Mass., has purchased the plant of the Wisconsin Engine Co. at Corliss, Wis. The plant covers nearly ten acres, and the buildings have approximately 150,000 feet of floor space. A full manufacturing and engineering staff will be maintained in this plant, and closer attention will thus be given to western customers. The new plant will be under the same direction as the other factories at Hyde Park, Galt, San Francisco, and Philadelphia. Harry W. Page has been selected as general manager in entire charge of the Wisconsin plant. For the last six years he has been assistant general manager and was located at the main office of the company at Hyde Park.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has recently acquired the plant of the Savage Arms Corporation, at Sharon, Pa. A large force of workmen is now engaged in remodeling and equipping the plant for the manufacture of transformers. The plant is expected to begin operations next fall. The transformer division now located at the East Pittsburg works will be transferred to Sharon, and 3000 persons will be employed in the new plant. C. H. Champlain, who has been assistant works manager at the East Pittsburg works, has been appointed works manager of the Sharon plant, and M. L. Fawcett, general foreman of the transformer department, has been made superintendent of the new works.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., announces the following changes in personnel: T. E. Simpers, formerly manager of the general mill section of the industrial department, has been appointed export representative of the industrial department. J. R. Olnhausen, manager of the textile section will have supervision over the industries formerly under the control of Mr. Simpers. C. H. Long, formerly manager of the contract section of the railway department, has been appointed a section manager of the light traction division, and is responsible for international negotiations and also for stocks and production schedules. R. W. Soady will succeed Mr. Long as manager of the contract section. W. P. Jend has been appointed manager of the merchandising division in the Detroit office, succeeding F. D. Koelbel who will take up general duties in connection with both the central station division and the merchandising division.

We Have Other Thoughts Than Gross Sales



"PRECISION"

Horizontal Boring, Drilling and Milling Machine

and we have a theory (which so far has worked to our satisfaction) that the more thought we give to making the best machinery we know how, and finding ways to make it better, the less thought we NEED give to anything else.

WE ALSO MAKE THE
LUCAS POWER
Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo. Aux Forges de Vulcain, Paris. Benson Bros., Sydney, Melbourne.

COMING EVENTS

August 20-30—Meeting of the American Institute of Mining and Metallurgical Engineers at Quebec, Canada. Secretary, F. F. Sharpless, 29 W. 39th St., New York City.

September 17-22—Ninth national exposition of chemical industries, in the Grand Central Palace, New York City. For further information address National Exposition of Chemical Industries, Grand Central Palace, New York.

September 24-28—Meeting of the Association of Iron and Steel Electrical Engineers at Buffalo, N. Y., in conjunction with the Iron and Steel Exposition held in the Buffalo Auditorium. Further information may be obtained from the Association of Iron and Steel Electrical Engineers, Empire Building, Pittsburg, Pa.

October 8-12—Annual convention of the American Society for Steel Treating to be held in Pittsburg, Pa., in connection with an international steel exposition. W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio, national secretary.

October 25-26—Production meeting of the Society of Automotive Engineers at Cleveland, Ohio. Further information may be obtained from the society's headquarters, 29 W. 39th St. New York City.

NEW BOOKS AND PAMPHLETS

Truck Operating Costs. By Ben H. Petty. 45 pages, 6 by 9 inches. Published by Purdue University, Lafayette, Ind., as Bulletin No. 10 of the Engineering Experiment Station.

An Investigation of the Fatigue of Metals. By H. F. Moore and T. M. Jasper. 100 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 136 of the Engineering Experiment Station.

Directive Radio Transmission on a Wave Length of Ten Meters. 16 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 469 of the Bureau of Standards. Price, 10 cents.

Thermal Stresses in Steel Car Wheels. By George K. Burgess and G. Willard Quick. 403 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 235, of the Bureau of Standards. Price, 15 cents.

Practical Perspective. By Frank Richards and Fred H. Colvin. 69 pages, 4½ by 7 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.

This is the fourth enlarged edition of a book showing how to make all kinds of mechanical drawings in isometric perspective. It contains examples of various classes of work, as well as illustrations showing the use of isometric paper for lettering. A chapter by C. W. Reinhardt is also included dealing with the elementary principles of true perspective. This is intended as an elementary guide in making perspective drawings.

A Symbol of Safety. By Harry C. Brearley. 290 pages, 6 by 9 inches. Published by Doubleday, Page & Co., Garden City, N. Y.

In view of the fact that one of the most important problems of the present day is the promotion of safety in industry, the work of the Underwriters' Laboratories, Inc., 207 E. Ohio St., Chicago, Ill., described in this book, should be of considerable interest. Although originally instituted to meet the need of insurance companies for exact knowledge as to the many elements of hazard that must be taken into account in underwriting fire insurance, its activities have been greatly widened. The book contains an account of the various kinds of tests that are made and the different lines of investigation carried out by the laboratories on fire protection devices and other safety appliances. The work includes the testing of devices for fire prevention, electrical appliances, appliances for protecting life and limb, and safety devices for automobile and aircraft. This work is carried on in close co-operation with the manufacturers. The various standards that have been specified by the laboratories are included in the form of an appendix.

Essentials of Drafting. By Carl L. Svensen. 194 pages, 6 by 9 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $1.75, net.

This is the second edition of a text book on drafting intended for use in connection with technical and vocational education. The revision has been based on changes that have been found advisable by the tests which have come from use by different teachers. Additions, rather than changes, constitute most of the work of revision. The chapter on orthographic projection has been made more complete, and the chapter on materials and stresses has been placed near the end of the book so that the continuity of the mechanical drawing study is not interrupted. The last chapter contains a collection of 240 problems to be worked out by the student.

Elements of Machine Design. By Dexter S. Kimball and John H. Barr. 446 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $4.

This book is the outgrowth of the experience of the authors in teaching machine design to engineering students in Sibley College, Cornell University. It is now in the second edition, and the revision has been based upon experience in the use of the book by various teachers in a large number of colleges. Certain changes in arrangement have been made, and a chapter on the fundamental principles of balancing has been added. The treatment presupposes a knowledge of mechanism and mechanics of engineering; however, a brief discussion of typical energy and force problems and of the more important straining actions is given, to make these important matters clear to the beginner. The largest part of the book is devoted to a discussion of the more important machine details, the purpose being to show how the theoretical considerations and equations discussed in the first part of the work are applied and modified in practice.

NEW CATALOGUES AND CIRCULARS

Biggs Boiler Works Co., Akron, Ohio. Catalogue of Biggs globe and cylinder rotary bleaching boilers for general paper mill service.

John Steptoe Co., Cincinnati, Ohio. Circular illustrating the Steptoe line of medium-priced shapers, milling machines, engine lathes, and die slotters.

Ingersoll Milling Machine Co., Rockford, Ill. Circular showing views in this company's factory and some of the equipment employed in building Ingersoll milling machines.

Pennsylvania Crusher Co., Philadelphia, Pa. Bulletin 1005, illustrating and describing the line of heavy-duty Pennsylvania "steel-built" hammer crushers made by this company.

United Machine & Mfg. Co., Canton, Ohio. Catalogue explaining the major features of the Harrington stoker,. which is adapted for the successful burning of a wide range of fuels.

Nielsen-Barton Chuck & Tool Co., Lawton, Mich. Circular illustrating and describing the Nielsen-Barton drill chuck, which is adapted for use on drill presses, hand and breast drills, and post drills.

Byers Machine Co., 300 Sycamore St., Ravenna, Ohio. Catalogue showing applications of the Byers Model 3A auto crane for loading, unloading, and rehandling crushed stone, sand, gravel and other materials, and for use in industrial plants.

Jeannin Electric Co., Toledo, Ohio. Catalogue descriptive of the line of single-phase repulsion induction motors made by this concern. A list of the machines and devices which these motors are adapted for driving is given, and various applications of the motor are illustrated.

Wagner Electric Corporation, St. Louis, Mo. Bulletin 132, (vest-pocket size), covering the design, construction, and special features of the "Pow-R-full" motor. This company is also distributing a calendar for the year June, 1923, to May, 1924, arranged to show three months at a glance.

Cone Automatic Machine Co., Inc., Windsor, Vt. Leaflet illustrating and describing the features of construction of the Cone automatic four-spindle machine. A list of standard equipment furnished with the machine and standard attachments that can be obtained extra, as well as complete specifications, are included.

McCadden Machine Works, St. Cloud, Minn., are distributing a card advertising hardened cast-iron pistons which are hardened by a new medium known as "Macalene," a mixture which is added to ordinary quenching water or oil and is claimed to produce such a degree of hardness that the pistons cannot be touched with a file.

Erie Foundry Co., Erie, Pa. Bulletin 100, illustrating and describing Erie board drop-hammers, which are built in sizes of from 200 to 4000 pounds. Bulletin 110, descriptive of the Erie roller leveler for use in sheet mills and galvanizing plants for flattening sheet steel, and which is also adapted to the needs of operators of drawing presses.

Foxboro Co., Inc., Foxboro, Mass., manufacturer of indicating and recording instruments, is distributing a circular in the form of a blueprint containing directions for installing the Foxboro triplex draft gage on a B. & W. boiler furnace equipped with a chain grate stoker This gage is equally applicable to other types of furnaces and stokers.

R. L. Barker & Co., 25 S. Clinton St., Chicago, Ill. Circular illustrating the line of electric tools, including grinders and buffers, lathes, heavy-duty drills and reamers, drilling stands, motor drills, etc., made by the Hisey-Wolf Machine Co., for whom R. L. Barker & Co. has recently been appointed exclusive representative in Indiana, Illinois, Wisconsin, and Iowa.

Campbell Auto Works, 238 N. El Dorado St., Stockton, Cal. Circular descriptive of the Campbell expansion cylinder reamer, which was developed to overcome some of the difficulties encountered in reboring automobiles or gasoline engine cylinders. Circular illustrating and describing Campbell bearing pullers and outer race extractors for removing bearings of electrical equipment.

Landis Machine Co., Waynesboro, Pa. Catalogue 26, covering the Landis line of bolt-threading die-heads and machines, as well as automatic screw cutting die-heads. The Landis die is described in detail, and an attaching chart and diagrams of clearance for the different sizes of die-heads are included. Complete specifications are given for the various sizes of threading machines. The book concludes with tables of standard threads, lag screws, and cutting speeds.

Bullard Machine Tool Co., Bridgeport, Conn. Bulletin descriptive of the Bullard 18-inch continuous chucking and turning machine, which was developed specifically for machining flywheels, but is also adapted to a wide variety of boring, turning, and facing operations on other work. In addition to giving complete specifications, this circular also shows tooling set-ups for machining Ford tractor flywheels, and illustrates by line drawings specimen work produced on this machine.

Precision & Thread Grinder Mfg. Co., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder, thread lead variators, lathe spacing attachments and "cold-set" diamond tools, has issued a new handbook and catalogue on thread grinding. This illustrates the use of the multi-graduated precision grinder for producing accurate ground threading tools, such as taps, dies, gages, hobs, chasers, etc. Engineering data relative to thread grinding is included. Copies will be sent upon request.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Supply catalogue, which is virtually an encyclopedia of electrical machinery and supplies, covering 1300 pages devoted to descriptive matter, technical data, drawings, specifications, and prices. The new catalogue includes all new apparatus that has been developed by this company in the last two years. The present edition is known as the 1923-1924 issue, and replaces all catalogues heretofore issued on electrical supplies by the company. The catalogue also announces the opening of a new plant at Homewood, Pa., which will be engaged exclusively in the manufacture of repairs and renewal parts for Westinghouse apparatus.

Rockford Milling Machine Co., Rockford, Ill. Circular containing illustrations and a detailed description of the Sundstrand double-end lathe, which has been built especially for such work as turning axle shafts, rear axle housings, camshafts, and similar parts that can be advantageously turned at both ends simultaneously. The machine is also adapted for turning short pieces, such as four-arm spiders, universal joint crosses, etc. Typical tooling lay-outs for different jobs are illustrated. Circular illustrating and describing the Rockford double-end drilling and centering machine, which is designed primarily for centering both ends of a shaft simultaneously, but which is also adapted for a wide range of work where it is desired to drill from opposite directions.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., is issuing a series of circulars dealing with the subject of leather belting. One of the circulars discusses the subject of brands versus specifications in leather belting, and points out how both advantages are combined in Chicago pre-tested leather belts; another describes methods of identifying quality in leather belting, a third circular discusses the material used in Chicago belts; a fourth describes the testing and inspecting of leather belting at this company's plant; a fifth circular is entitled "The Only Way to Save Money on Belting Purchases"; and a sixth, entitled "Reflections of Character," contains recommendations from various users. A folder is included which gives the prices of leather belting made by this concern.

Gits Bros. Mfg. Co., 1940 S. Kilbourne Ave., Chicago, Ill. Catalogue illustrating lubricating devices and oil-cups suitable for practically all purposes in the lubrication of machinery of different types. The catalogue shows an inexpensive and highly developed oiling system for application to practically every form of bearing used in machinery, providing lubrication for an average period of one month with but one filling of the oil reservoir. A large assortment of self-closing oil-cups, oil-hole covers, and oil gages is also shown, and illustrations and description of the Gits wired wick system for positive lubrication are included. Sections of bearings are shown, indicating how positive lubricating devices can be applied to different types of bearings, including those employed in machine tools and countershafts.

Cleveland Worm & Gear Co., Cleveland, Ohio. Book entitled "Cleveland Worm Gear Reduction Units," containing a complete description of the worm drives designed and built by this company for a number of different purposes. Complete tables of the horsepower rating of these worm-gear reduction units are included, and information on the application of these drives is given. Special sections of the book deal with lubrication, lineshaft drives, formulas and data for calculating worm-gearing, and horsepower of shafting. A number of useful tables are given relating to gear calculations, including complete tables of pitch diameters for circular pitch gears; equivalent values of electrical, mechanical, and heat units; and useful factors in mechanical calculations. The book covers 101 pages, 8 by 10½ inches.

VOLUME 29 MACHINERY NUMBER 12

AUGUST, 1923

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE ST., NEW YORK CITY

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CIRCULATION FOR JULY, 19,000 COPIES

Member Audit Bureau of Circulations

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A Locomotive Testing Laboratory, Running-in Tests for Machine Tools, Polishing of Firearm Parts, Special Machines in a Typewriter Plant, and Draftsmen's Training, are some of the subjects dealt with in September MACHINERY.

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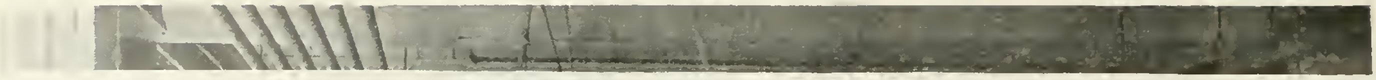

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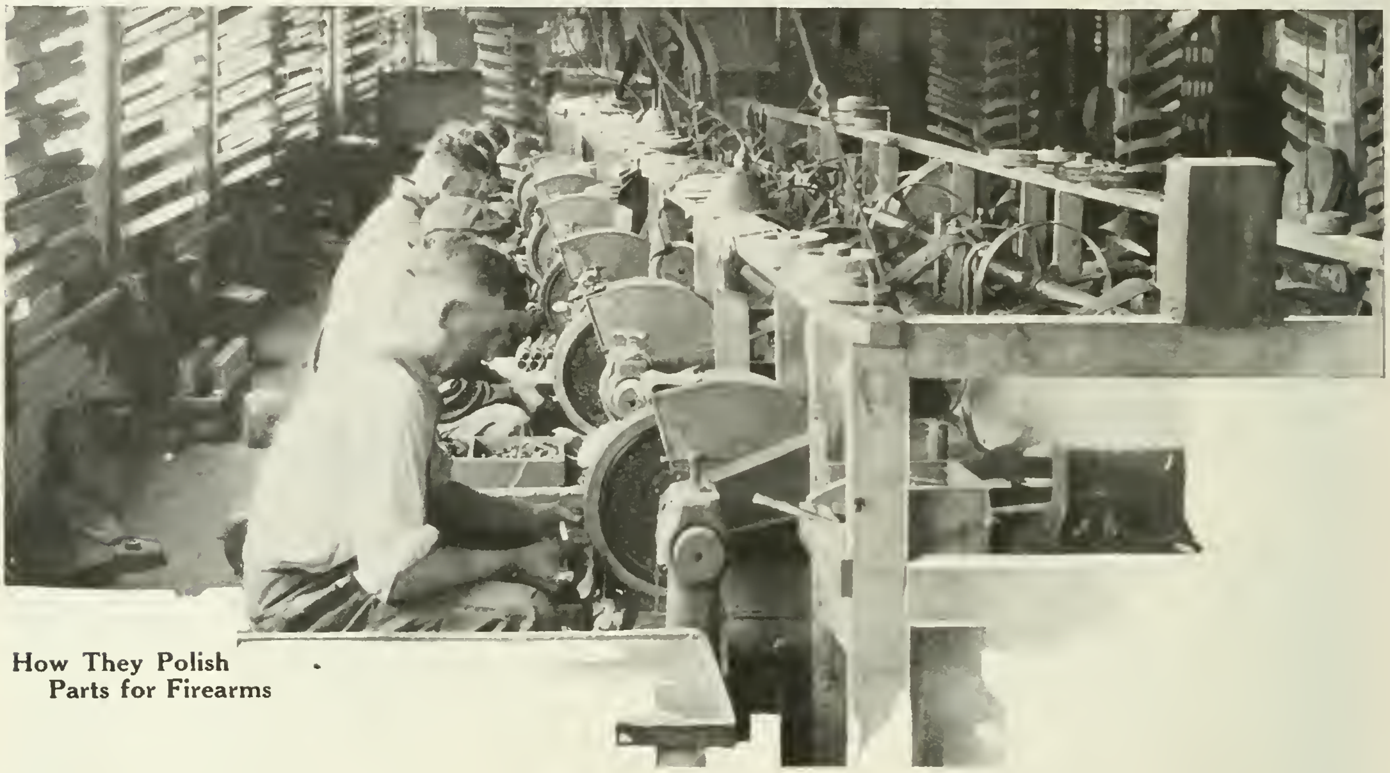


How They Polish
Parts for Firearms

An L. C. Smith
Typewriter
in Action

The present opportunity for inventive genius and the value of a thorough mechanical education are particularly stressed in September MACHINERY. The following quotations from two articles which will appear in September open a line of thought that leads far.

"Inventive Genius," says Carl Gabrielson, of the L. C. Smith Typewriter Company, "has a greater opportunity in the development of special metal working machines, intended for single purpose operations, than it has in the design of more or less standard machine tools"—

And Donald A. Nevin, tool designer, in the article "The Mechanical Education of a Draftsman," says this—"The most common deficiency among younger draftsmen is the lack of a thorough mechanical education. This is due not so much to the lack of opportunity for instruction as it is to failure to take advantage of the valuable opportunities that are offered for acquiring additional education"—

A Timely, Interesting,

September MACHINERY

Here are two writers, two totally dissimilar articles and a single moral. There are great opportunities—greater today than ever—for inventive genius in the machinery field; and there is an insistent demand for men with thorough mechanical knowledge to design and develop the tools and machines that are needed.

It is the fashion of the moment to ask "Why should I read, why should I spend hours in study when day laborers are demanding and getting more wages than I?" The two articles from which we have quoted go a long way toward showing why this is a false viewpoint—a viewpoint resulting from a temporary condition in the labor market which cannot last any length of time. A laborer, as such, will be always a laborer. With education men create, contribute great things to the advancement of civilization, and are recompensed in direct proportion to the value of their creations.

Read the Gabrielson and Nevin articles in September MACHINERY—there is real inspiration in them for the man who means to win out. They are plain, matter-of-fact stories which make their meaning clear in the direct manner common to mechanical men who write for publication when they have something to say which they feel is worth saying, but they carry a message.

A partial list of the articles MACHINERY will publish in September follows—and not one but might well be a stone in the structure of education.

Holding Work by Vacuum

Special Machines in a Typewriter Plant
The Mechanical Education of a Draftsman
Polishing Firearm Parts
Holding Work by Vacuum
Running-in Tests for Machine Tool Units
Die-casting Problems
Locomotive Testing Laboratory
Machines Used in Making Electric Lamps
High Speed Motors for Machine Tools
Laying Out Master Cam Templets

Educational Number

LELAND-GIFFORD-COMPANY
WORCESTER
MASS.
U.S.A.
MACHINE TOOLS · CRANK SHAFTS

Leland-Gifford Service

You Have Drilling and Tapping Problems?

Leland-Gifford Service Department wants to take up with you those drilling and tapping problems that have been troubling you and apply to their solution the knowledge and experience gained through years of specializing on this subject.

Branch offices are maintained in the following cities with experts in the solution of drilling problems in charge:

BOSTON CHICAGO DETROIT
NEW YORK ROCHESTER

THE PLANT BEHIND THIS SERVICE

The Service is backed up by the LELAND-GIFFORD FACTORY
which represents twenty-three years' steady growth.

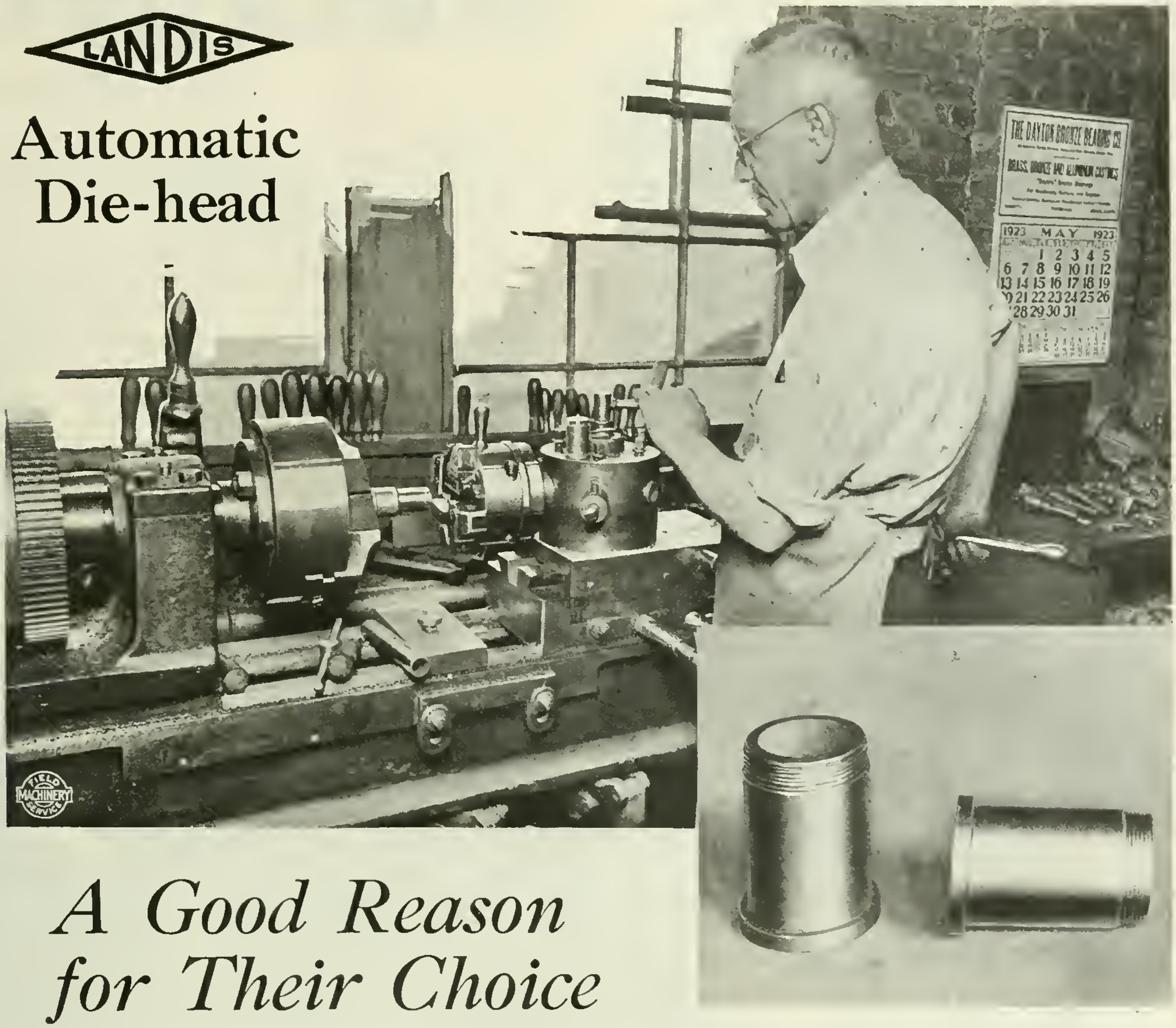
121,000 Sq. Feet Floor Space

LELAND-GIFFORD COMPANY

WORCESTER, MASS., U.S.A.

LANDIS

Automatic Die-head


THE DAYTON BRONZE BEARING CO.
BRASS, BRONZE AND ALUMINUM CASTINGS
1923 MAY 1923
FIELD MACHINERY SERVICE

A Good Reason for Their Choice

We're going to let the superintendent of the Philip Haas Company write this advertisement for us—going to quote what he said when we asked why he bought one of the new Landis Automatic Die-heads.

> "We have a Landis Bolt Threader down stairs," said he, "the first one in Dayton and it threaded our 1″ pipe so fast that people came here from outside to see it work. That machine sold other Landis Bolt Threaders in Dayton and it was due to our pleasant experience with it that we bought this Landis Automatic Die. The chasers are of the same design. When we got this die, a year ago, we put it on the hardest job in the shop, cutting 27 threads per inch for a distance of 5/16″ on brass tubing 1¼″ diameter. Our trouble on this job had been that we never were able to get a perfect thread with other dies, the first two threads would usually be stripped. The Landis, however, cut a perfect thread right from the start."

You too, can cut perfect threads with our New Automatic Die-head. Let us tell you about it.

LANDIS MACHINE CO., Inc., Waynesboro, Pa., U.S.A.

DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Company of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Company, St. Louis, Mo.; R. B. Whitacre & Co., St. Paul, Minn. Hamilton Machinery Co., Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga. Young & Vann Supply Co., Birmingham, Ala.; Woodward Wight & Co, New Orleans, La.; Joseph T. Ryerson & Son, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; Eccles & Smith Company, San Francisco, Calif.; Los Angeles, Calif.; Portland, Ore.; Hallidie Mchy. Co., Seattle, Wash. Hallidie Company, Spokane, Wash; CANADIAN AGENTS: Canadian Fairbanks-Morse Company, Toronto and Montreal. FOREIGN AGENTS: Burton Griffiths Co., London, England; Allied Machinery Company, Barcelona, Spain; Turin, Italy; Zurich, Switzerland; Tientsin, China; R. S. Stokvis & Zonen, Rotterdam, Holland; Dutch East Indies D. Drury & Co., Johannesburg, South Africa; Benson Brothers, Sydney, Australia; Alfred Herbert, Ltd., Calcutta, India and Yokohama, Japan.

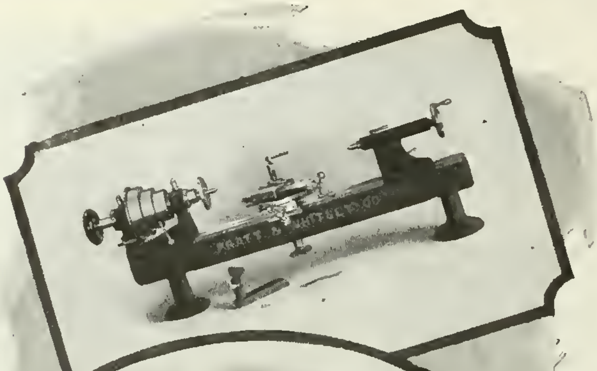
FOR LATHES of

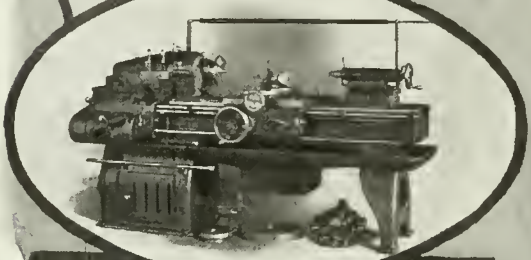
"Come to

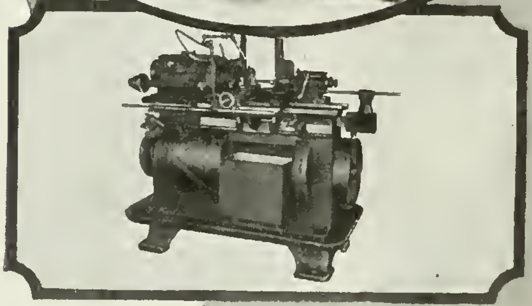
IN four of our six great plants are produced the lathes that have carried the Niles-Bement-Pond name to every corner of the industrial world.

From our Pratt & Whitney Works at Hartford, Conn., come the Bench and Toolmakers' Lathes, the high-production Automatic Lathes that so well sustain the Pratt & Whitney reputation for precision machine building.

In our Niles Tool Works, Hamilton, Ohio, are built the Carwheel and Driving Wheel Lathes, the Axle and Journal Lathes that for forty years have hung up production







PRATT & WHITNEY BENCH LATHE

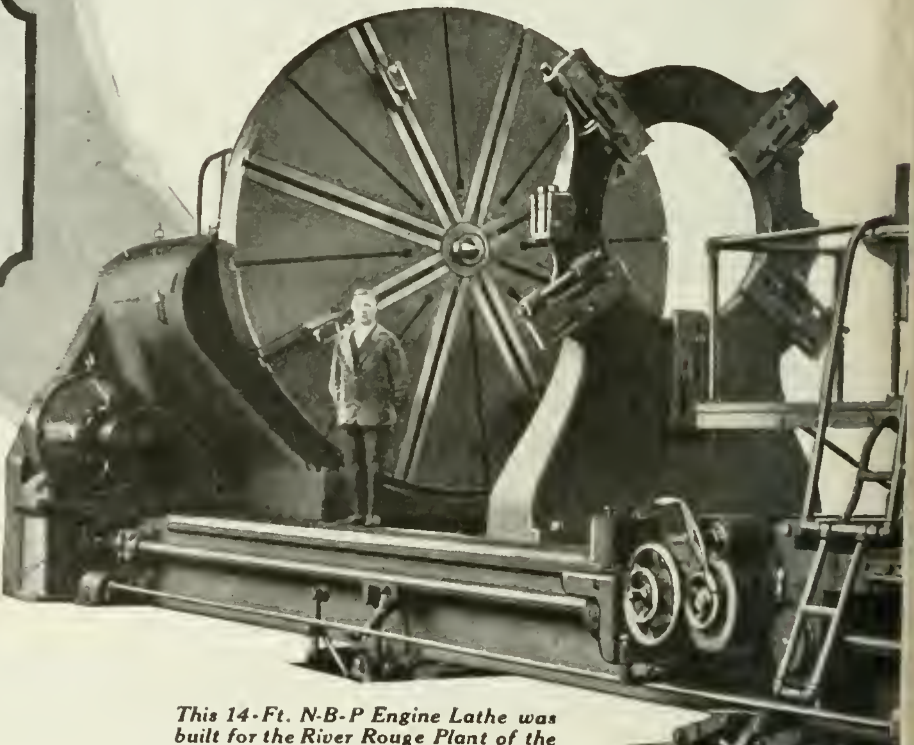
This 7" x 32" Bench Lathe is the smallest lathe we build. Its extreme accuracy, convenience of operation and adaptability to all kinds of small work, make it indispensable to the toolmaker. Pratt & Whitney quality throughout. Circular No. 289.

PRATT & WHITNEY 16-LATHE

A precision lathe of entirely new design. The most radical departure from usual practice is the new, compact headstock centered over the bed with all back gears mounted below the spindle. This eliminates overhanging parts and gives the operator uninterrupted light on the work. Maag gearing is used throughout. This machine represents the latest development of high production precision lathe building. Circular No. 300.

P & W FULL AUTOMATIC LATHE

Does entirely automatically all lathe operations ordinarily performed by hand operated engine lathe. Provided with magazine it also loads machine and discharges the finished work entirely automatically. Circular No. 284.



This 14-Ft. N-B-P Engine Lathe was built for the River Rouge Plant of the Ford Motor Co. The length of the bed is 50 Ft. and the distance between centers is 34 Ft. Total weight is about 250,000 lbs.

WORKS

Niles Tool Works,
Hamilton, O.

Bement Works,
Philadelphia, Pa.

Pond Works,
Plainfield, N. J.

Pratt & Whitney Wks,
Hartford, Conn.

Ridgway Works,
Ridgway, Pa.

Niles Crane Works,
Philadelphia, Pa.

NILES-BEMENT-

General Offices:

EVERY TYPE

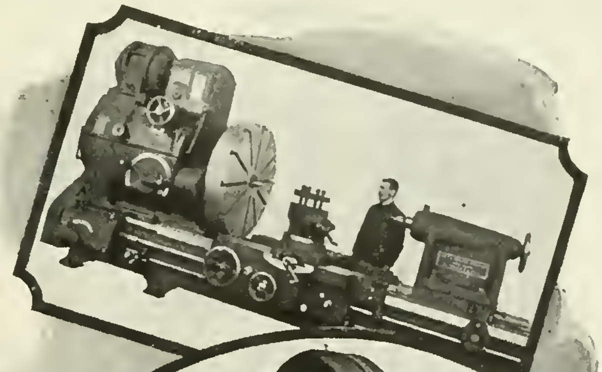
Headquarters"

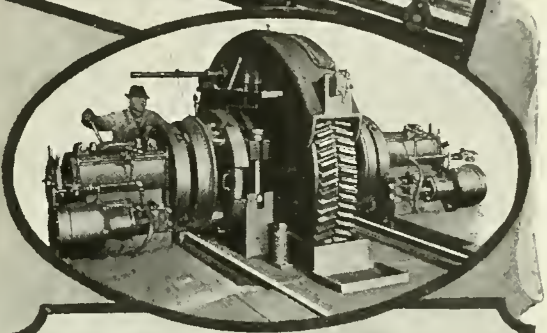
records in railroad shops throughout this country and abroad.

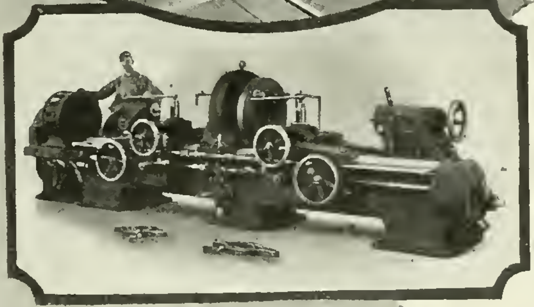
In Plainfield, N. J., the Pond Works produce the heavy Engine Lathes that are standard equipment in nearly every shop where metal is turned, while the monster gun-boring and turning lathes that make our arsenals the best equipped in the world are built by our Bement Works in Philadelphia.

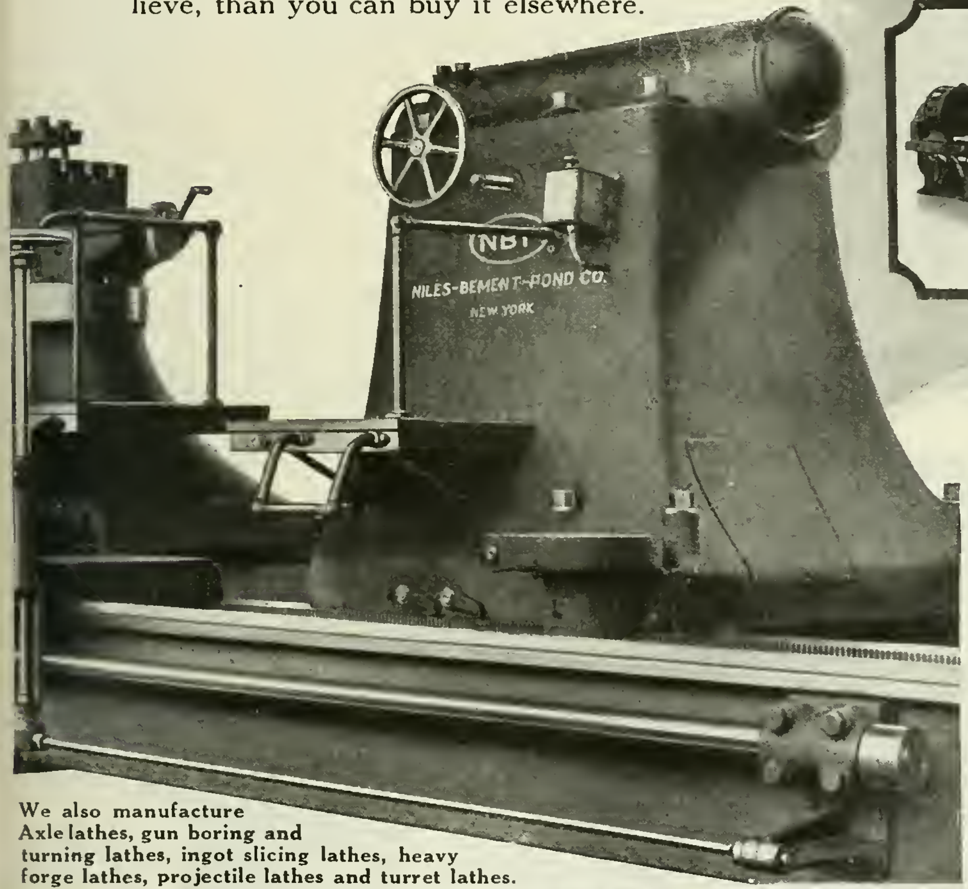
A generation of specialized experience is put into this equipment.

There's nothing in metal turning machinery that we cannot build for you—better, we believe, than you can buy it elsewhere.









We also manufacture Axle lathes, gun boring and turning lathes, ingot slicing lathes, heavy forge lathes, projectile lathes and turret lathes.

N-B-P ENGINE LATHES

Made in standard sizes, 26, 30 and 36", in heavy types from 36" to 96" size; lathes larger than 96" swing are made to order and have been made up to 168" diameter.

N-B-P CAR WHEEL LATHES

Built in end driven and center-driven types. Both types are high production equipment. The center-driven machine illustrated above is driven by herringbone gear, hinged segment operates automatically to admit wheel axles. Is equipped with patented equalizing drivers, pneumatically operated tailstocks and pneumatic tool clamps.

N-B-P DRIVING WHEEL LATHES

Built in sizes from 60 to 90 inches. Every improvement that will speed up operation and save labor has been incorporated. They include pneumatic tool clamps, patented equalizing drivers, rapid power traverse to headstock, pneumatic headstock clamp, push button speed control.

POND COMPANY

111 Broadway, New York City

SALES OFFICES

New York
Boston
Philadelphia
Birmingham
Rochester
Pittsburgh
Cleveland
Detroit
Chicago
Cincinnati
St. Louis
St. Paul
San Francisco
Los Angeles

A Lodge & Shipley

Why?

Merely because it is accurate? No!

Because it will retain its accuracy over a long period of time? No!

Because of its simplified construction and ease of operation? No!

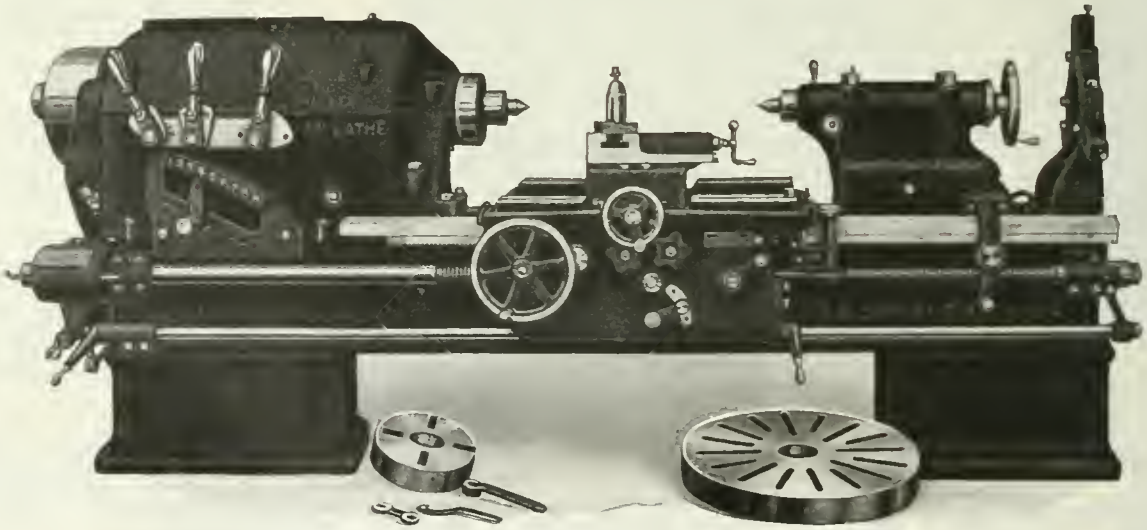
Well then, why is it?

It is because it has that rare combination of all these essentials. It is accurate and adaptable. Accuracy is retained throughout a long period of usefulness. It is easy to operate. Its construction is simple.

That is why YOU will never regret its purchase.
That is why it can do more and better work.
That is why it is a **better lathe!**

In short, it is a lathe you always will be proud to own.
—and that's that!

The Lodge & Shipley Selective Head Lathe



24″ Selective Head Lodge & Shipley Engine Lathe
Made in sizes 14″ to 48″

The Lodge & Shipley

CINCINNATI,

is better!

A few reasons why:

Ball Bearings on every transmission shaft of the Selective Headstock practically eliminate friction. This means less wear with consequent longer life.

Lubrication. In the Lodge & Shipley Selective Headstock all gears and bearings are always in a bath of oil or are thoroughly lubricated through a continuous splash system. All oil supplied the spindle bearings is thoroughly filtered.

Double Nosed Spindle. The inner nose, which is left blank, extends beyond the outer nose and accurately centers the faceplate or chuck plate so that it easily engages the internal threads of the outer nose.

Mechanical Apron Control eliminates lost time in starting and stopping the lathe. A handle at the right of the apron affords the operator control of the lathe without having to move from in front of the work.

Double Walled Apron. This construction allows solid support, both front and rear, to all shafts. All gears in the apron are of steel. All are of sufficient strength to withstand any feed change while a cut is under way.

Chilled Bed. The chilled ways of the Lodge & Shipley Lathe bed are so much harder than the carriage that they prolong the life of the lathe. What little wear does occur on the carriage can be compensated for by gibs that may be adjusted to remove all play.

Micrometer Ball Stop. This ingenious device on the cross feed screw greatly simplifies threading operations by providing an adjustable depth stop. When the friction is entirely released the Ball Stop in no way affects the ordinary operation of the screw.

There are other reasons

Send today for our general catalogue.

It tells the whole story. No obligation.

Machine Tool Co.

OHIO

BAUSH METAL

DURALUMIN

A Few Advantages
MACHINING

Better than aluminum.
Cost greatly reduced when compared with iron or steel.
Taps and threads well.

RECIPROCATING PARTS

Weight reduced without loss of strength.
Acceleration increased.
Inertia decreased.

Polishes easily.
Resists atmospheric conditions.
No plating required.

Can be rolled, forged, drawn, heat-treated and annealed.
Hot and cold worked.

A QUALITY METAL

Duralumin is an alloy produced after years of systematic endeavor to meet the demand for a metal which shall be as light as Aluminum and as strong as mild steel, yet without the many disadvantages of Aluminum in its pure state.

Duralumin is the only light metal that can replace steel in forgings. With a two-thirds saving in weight, heat-treated Duralumin Forgings approximate mild steel forgings in strength.

Wherever weight is a deciding factor Duralumin is the most satisfactory metal for most articles made by hot working or forging. Naturally, Duralumin Forgings are especially desirable for reciprocating or moving parts where inertia, due to their own weight, forms a large part of the total stress.

Minimum Physical Properties of Rolled or Sheet Metal (heat-treated) and of Forging Metal are:

Tensile	**55,000 lbs. per sq. inch**
Elastic Limit	**30,000 lbs. per sq. inch**
Elongation	**18% in 2 inches**

BAUSH MACHINE TOOL COMPANY

Metals Division
SPRINGFIELD, MASS., U. S. A.

Manufacturers of

BAUSH METAL
A Superior DURALUMIN
Blooms—Slabs—Billets—Sheets—Forgings

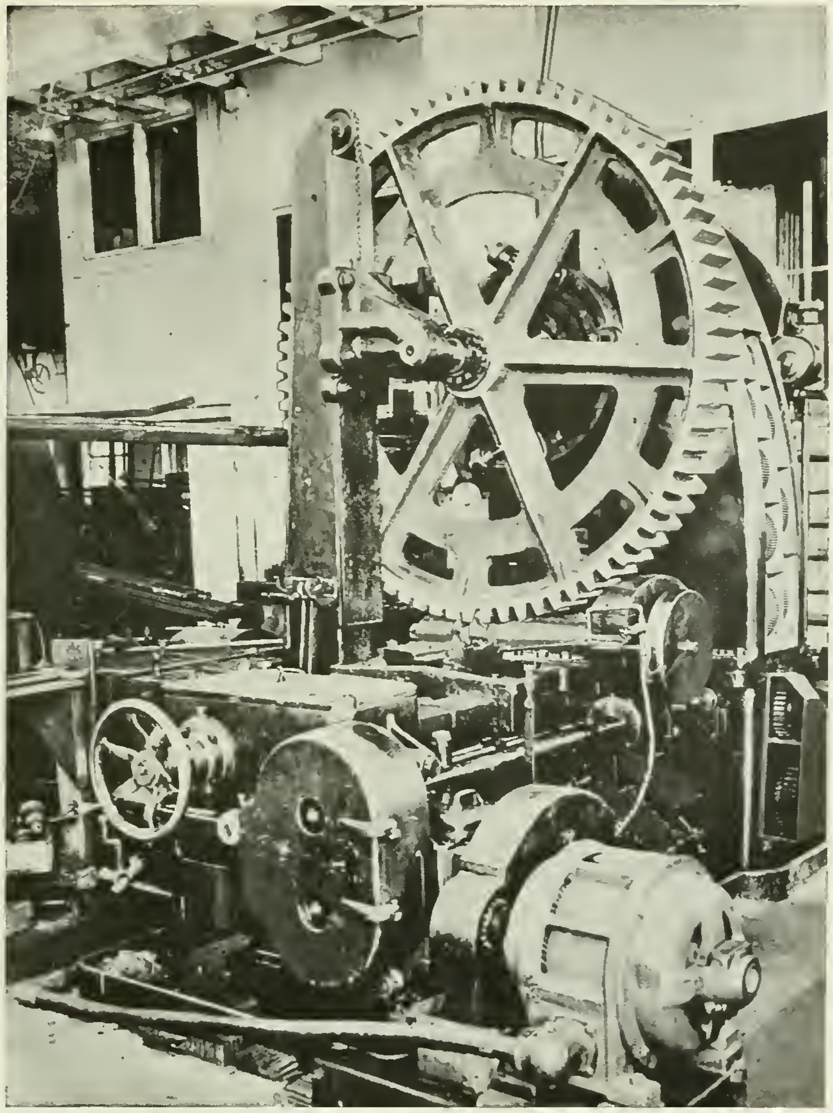
BAUSH CASTING METAL INGOTS

Aluminum Alloy of High Tensile Strength

Rolling Mill and Drop Forge Works
SPRINGFIELD, MASS.

DETROIT OFFICE:
1834 Dime Savings Bank Bldg.

Coarse Pitch Gears Finished for Quiet Running



In operation the sound of this finished gear and its mating pinion could not be detected at a distance of twenty feet.

These results are being obtained by The Smith & Watson Iron Works, Portland, Oregon; using an 84″ x 24″ Cincinnati Spur Gear Cutter.

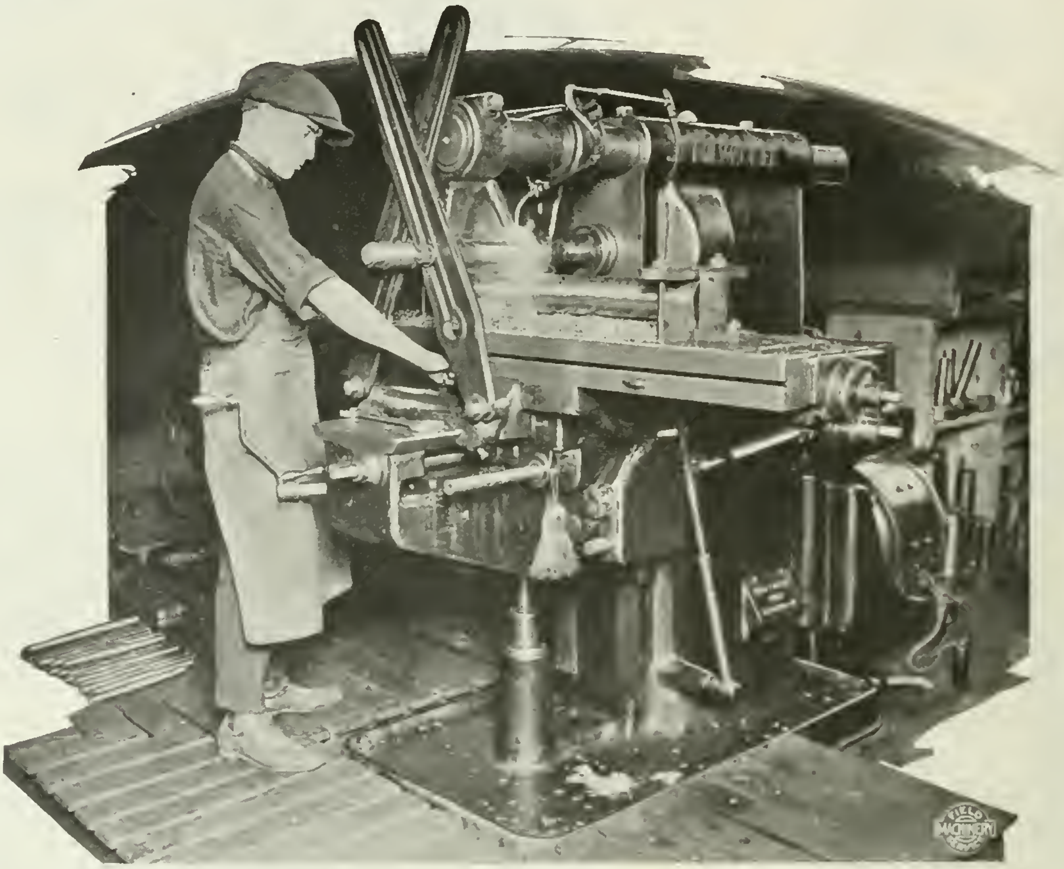
The operation pictured is cutting 76 teeth 3″ circular pitch for a cast steel gear 74″ diameter and 7″ face. Roughing and finishing feeds were 1¼ inches per minute. Cutter diameter is 8½ inches and speed 20 R.P.M.

The Cincinnati Gear Cutting Machine Co.

(Subsidiary of the Cincinnati Shaper Company)

CINCINNATI,
OHIO, U. S. A.

MILWAUKEE MILLING MACHINES

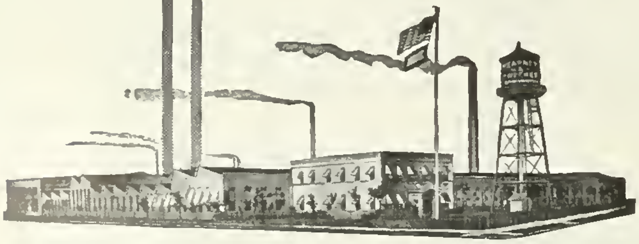


Some Feed!

Send for specifications of Milwaukee Milling Machines and details of other records.

Cutting keyways $\frac{7}{8}$″ wide by 7/16″ deep by $22\frac{1}{4}$″ long in .40 carbon steel transmission shafts in one cut at a feed of 10″ per minute, is going some.

That's what the Milwaukee Milling Machine was doing at the Austin Manufacturing Co., Harvey, Ill., when this photograph was taken. It is this sort of performance which makes them (as well as so many other users) pronounce Milwaukee Millers "great machines." Design gives wide range and great operating convenience, construction enables them to stand up to their work.



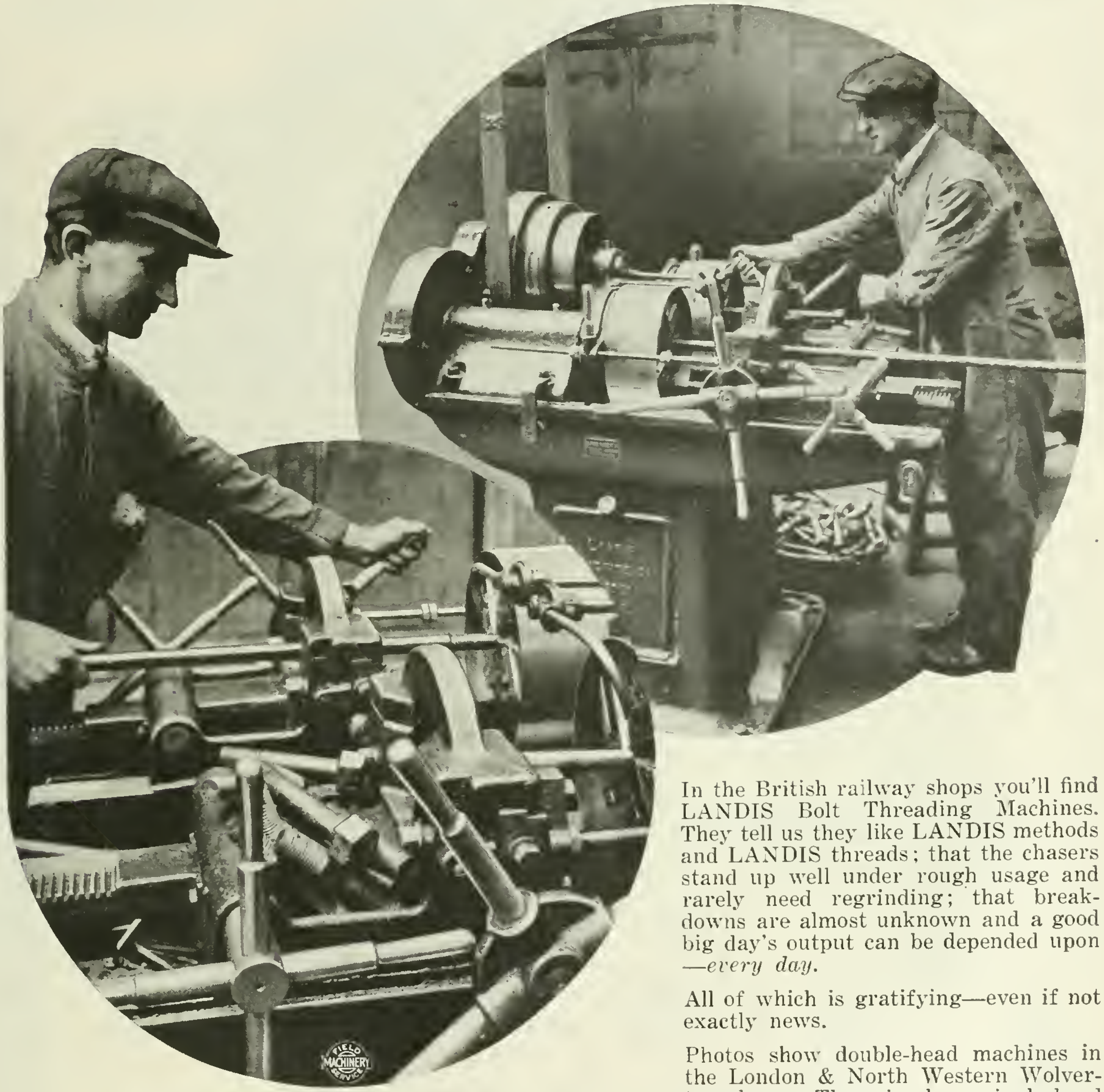
KEARNEY & TRECKER
CORPORATION
MILWAUKEE, WIS., U.S.A.

CHICAGO OFFICE
631 WASHINGTON BLVD

CLEVELAND OFFICE
738 SUPERIOR AVE. NW

NEW YORK OFFICE
50 CHURCH STREET

Around the World with LANDIS



In the British railway shops you'll find LANDIS Bolt Threading Machines. They tell us they like LANDIS methods and LANDIS threads; that the chasers stand up well under rough usage and rarely need regrinding; that breakdowns are almost unknown and a good big day's output can be depended upon —*every day.*

All of which is gratifying—even if not exactly news.

Photos show double-head machines in the London & North Western Wolverton shops. There is also a single head LANDIS in this shop. Wrought iron bolts are being threaded; ⅝″ x 2¾″ 11 threads per inch, Whitworth pitch, in 9 seconds each (actual threading time); and 1″ x 2½″ 8 threads, Whitworth, in 8 seconds each. Output per day (8½ hours) averages about 2000 in each instance.

You'll find LANDIS machines everywhere—always making good.

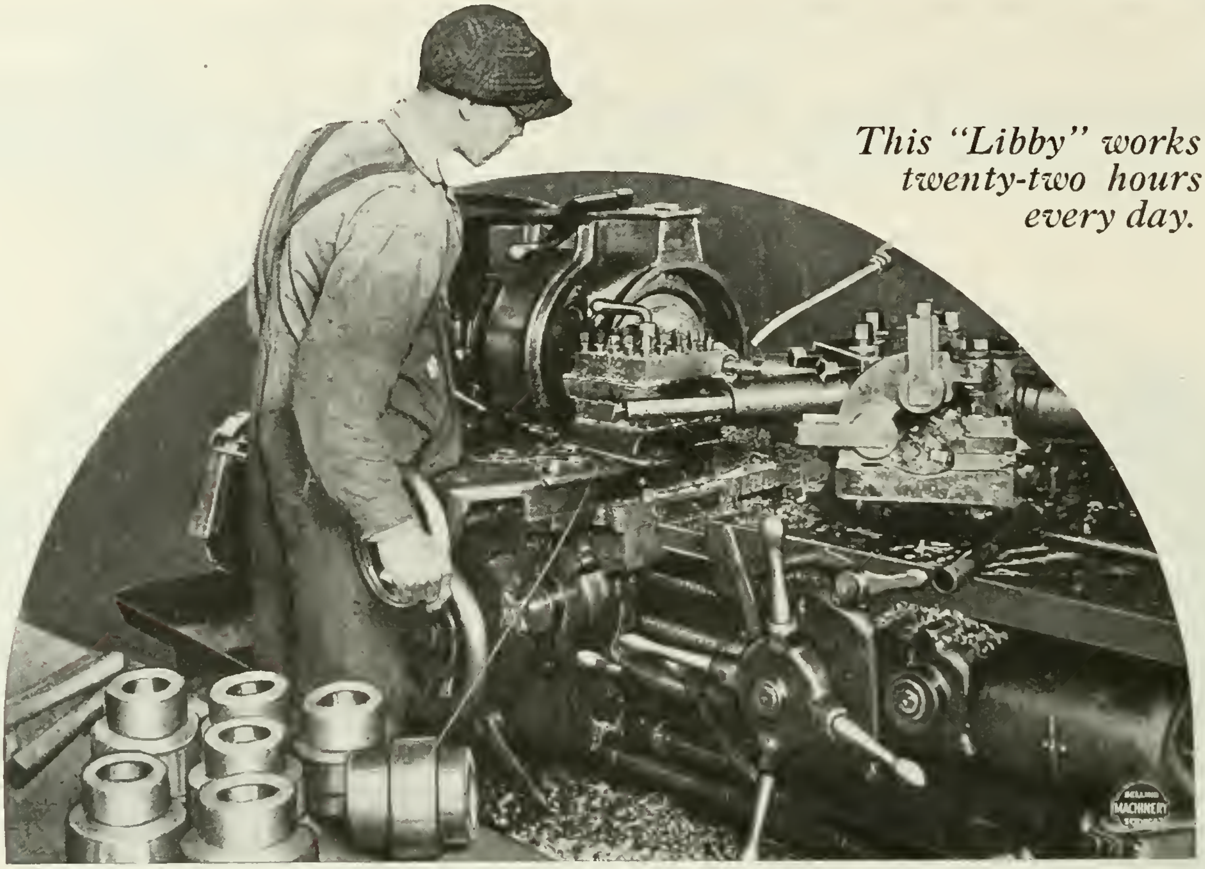
LANDIS

LANDIS MACHINE COMPANY

INCORPORATED

WAYNESBORO PA., U. S. A.

DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Company of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Company, St. Louis, Mo.; R B Whitacre & Co., St. Paul, Minn.; Hamilton Machinery Co., Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga.; Young & Vann Supply Co., Birmingham, Ala; Woodward, Wight & Co., New Orleans, La.; Joseph T. Ryerson & Son, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co, Salt Lake City, Utah; Eccles & Smith Company, San Francisco, Calif.; Los Angeles, Calif.; Portland, Ore.; Hallidie Mchy. Co., Seattle, Wash; Hallidie Company, Spokane, Wash; CANADIAN AGENTS: Canadian Fairbanks-Morse Company, Toronto and Montreal. FOREIGN AGENTS: Burton Griffiths Co., London, England; Allied Machinery Company, Barcelona, Spain; Turin, Italy; Zurich, Switzerland; Tientsin, China; R. S. Stokvis & Zonen, Rotterdam, Holland; Dutch East Indies; D. Drury & Co., Johannesburg, South Africa; Benson Brothers, Sydney, Australia; Alfred Herbert, Ltd., Calcutta, India and Yokohama, Japan.

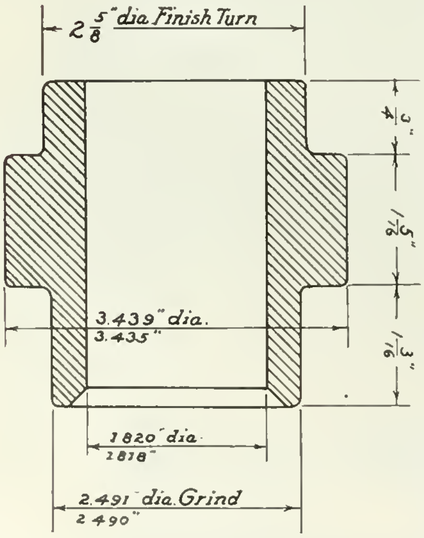


This "Libby" works twenty-two hours every day.

IF IT'S PRODUCTION—

"Leave It to Libby"

In this big shop quantity production was wanted on automobile axles, propeller shafts and their component parts, tough material—deep cuts—no let-up. A good specimen of the work is this differential gear blank. Bar stock of 3½" diameter is drilled, simultaneously two hubs are formed and outside diameter turned, two of these sizes are finished and outer hub roughed; latter is box-tooled to finish and hole bored to size with a .001" limit.



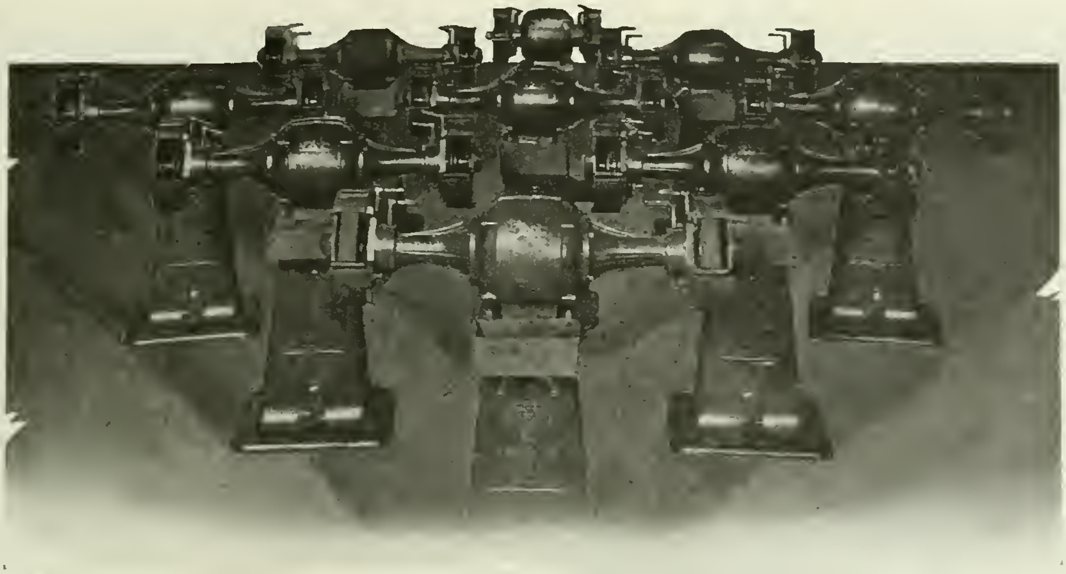
And the time—20 minutes! Pretty good? Write for a Libby estimate on your work. Cost—nothing but the effort.

International Machine Tool Co.

Indianapolis, Ind.

DOMESTIC AGENTS: Aumen Machinery Co., Baltimore, Md.; Blackman-Hill-McGee Machinery Co., St. Louis, Mo.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore., Seattle, Wash.; E. L. Essley Machinery Co., Chicago, Ill., Milwaukee, Wis.; Hill, Clarke & Co., Boston, Mass. Seifreat-Woodruff Co., Cincinnati, Ohio, Dayton, Ohio; Strong, Carlisle & Hammond Co., Detroit, Mich., Cleveland, Ohio; Syracuse Supply Co., Syracuse, N. Y., Buffalo, N. Y., Rochester, N. Y.; Vandyck Churchill Co., New York, N. Y., New Haven, Conn., Philadelphia, Pa.; Peden Iron & Steel Co., Houston, Texas. FOREIGN AGENTS: Coats Machine Tool Co., London, England; Ing. Ercole Vaghi, Milan, Italy; Isbecque Todd & Co., Belgium; Iznosskoff & Co., Petrograd, Russia, Moscow, Ekaterinburg, Russia; V. Lowener, Copenhagen, Denmark, Christiania, Norway, Stockholm, Sweden; Victor R. Mendoza Co., Havana, Cuba; Moerch & Roumet, Paris, France; Mitsui & Co., Japan.

SKF



Longer Life and Fewer Dressings
When Grinders are Ball Bearing Equipped

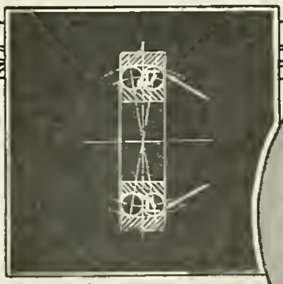
WITH **SKF** marked self-aligning ball bearings on the spindles of its grinders a large industrial plant found that it was necessary to dress the wheels only three times a day instead of every forty minutes as was necessary when babbitt bearings were used and that the life of the wheels was prolonged 40 per cent.

This better performance with self-aligning ball bearings is due to the fact that the chrome steel balls roll practically frictionless and without discernible wear over the hardened steel races and that dust and grit which play havoc with sleeve types of bearings are effectively excluded from the bearing housings by means of felt seals. Furthermore lubricant cannot escape and need be applied only at infrequent intervals.

May our engineers co-operate in bringing these advantages of ball bearings and their power-saving features to your grinders and other machine tools.

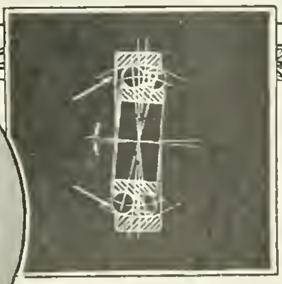
THE SKAYEF BALL BEARING COMPANY
Supervised by **SKF** INDUSTRIES, Inc., 165 Broadway, New York City

974



Normal View

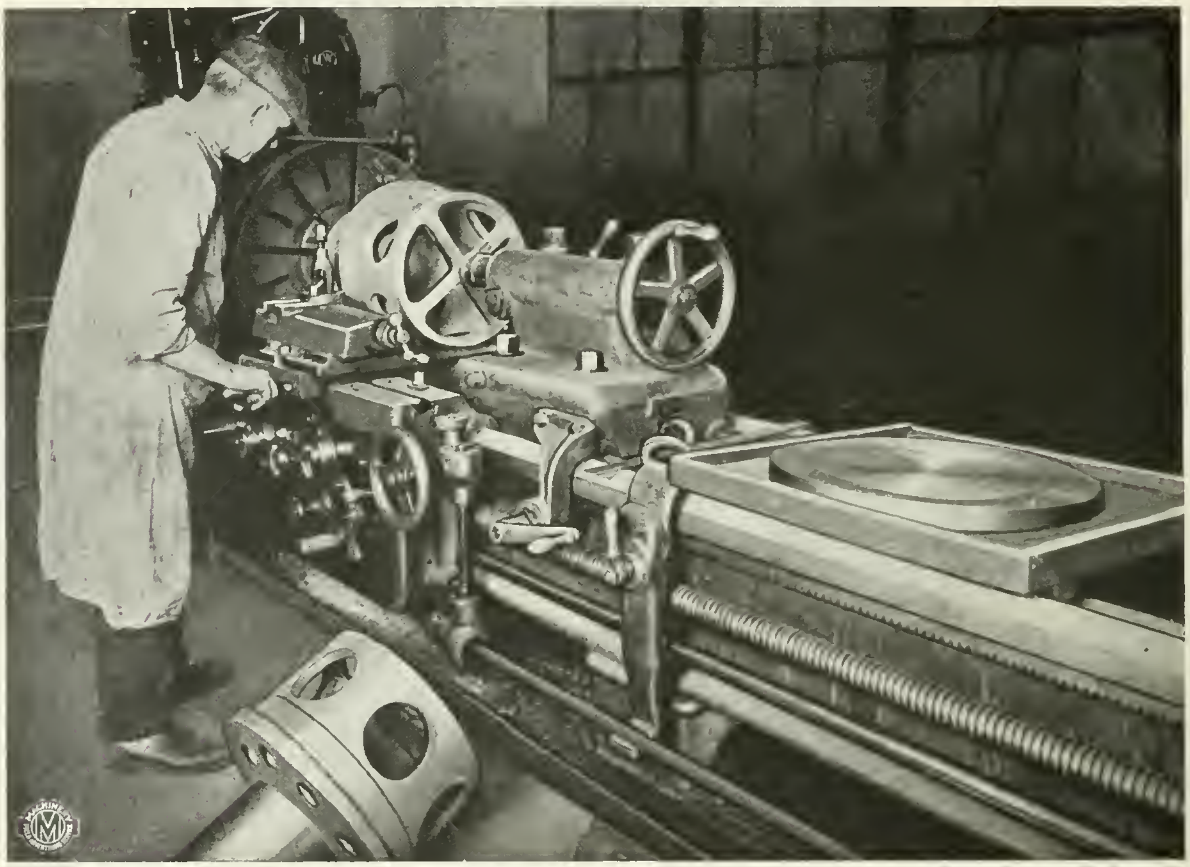
SKAYEF
The SELF ALIGNING BALL BEARING
SKF



Deflected View

BALL BEARINGS
The Highest Expression of the Bearing Principle

LATHES **AMERICAN** **PLANERS**



"None Better"—The Verdict Never Varies

Travel from shop to shop, the length and breadth of the land, you will find "American" Lathe users wherever you go—in Uncle Sam's big arsenals, in shipyards, automobile factories, contract shops and big repair shops; and practically every machine tool builder (the most critical class of machine users) counts his "American" units among his most important and profitable equipment. The heavy duty "American" Lathe shown was photographed while being used to put the finishing touches to the second of a pair of bodies—19" long overall and 17" at the plug end—which had been turned for their full length, ready for finish grinding. This, of course, means the maintenance of close limits and a surface correspondingly smooth.

THE AMERICAN TOOL WORKS COMPANY

CINCINNATI, U. S. A.

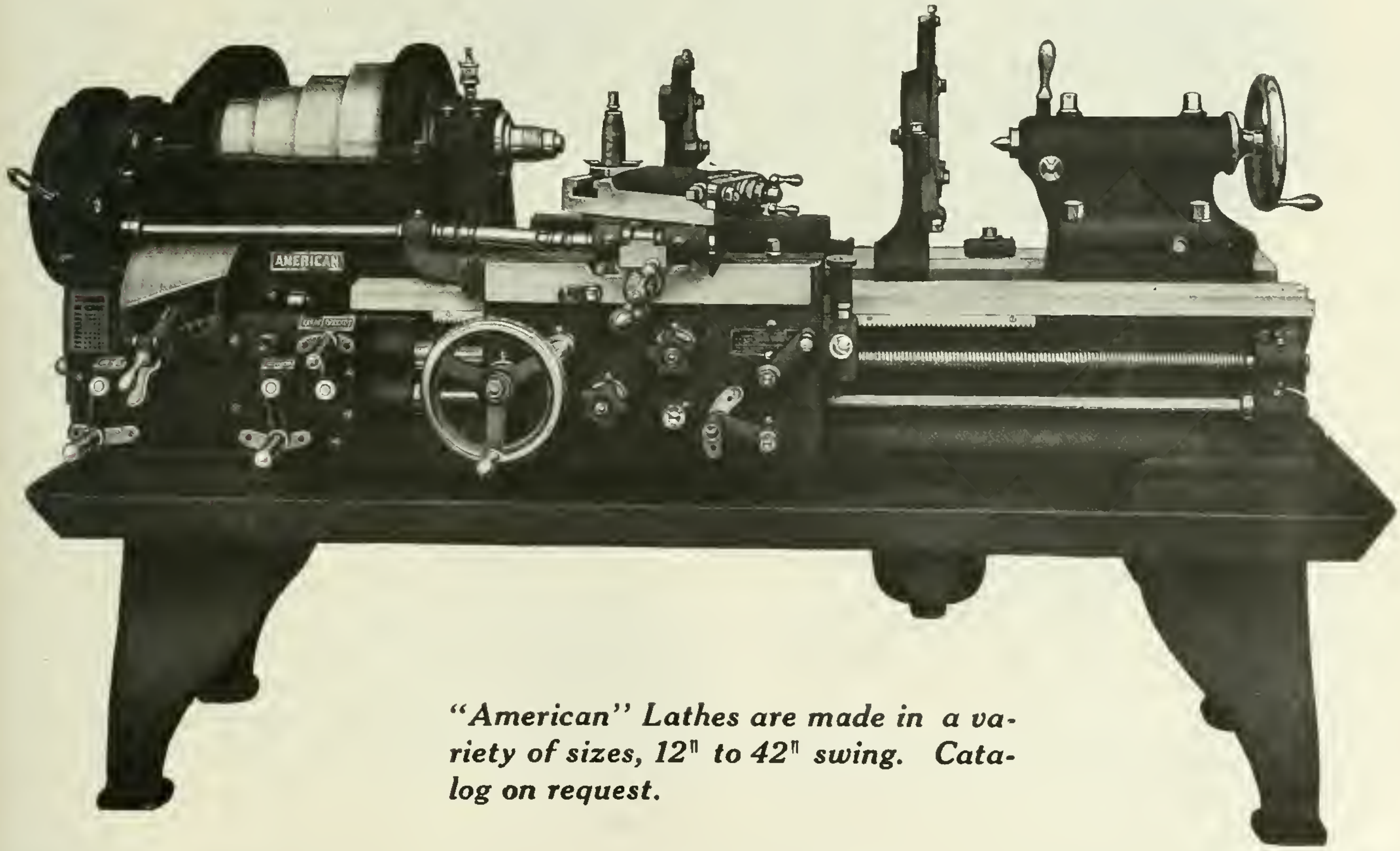
LATHES **PLANERS**

SHAPERS **AMERICAN** **RADIALS**

Tool-room to Heavy Duty, All "American" Lathes Satisfy

"Trouble is easier prevented than overcome." The reason complaints are rare from users of "American" Lathes is that we eliminate the trouble before it has a chance to develop. Every machine in the line is manufactured with highly accurate jigs and tools and assembled by experienced machinists; *every bearing surface is tested with templets, straight edges, tissue paper pulls, queen's levelers and other highly accurate devices specially designed for the purpose.*

In addition, we give a running try-out to each individual feed and thread. "American" Lathes *do* satisfy. Ask any user you meet.



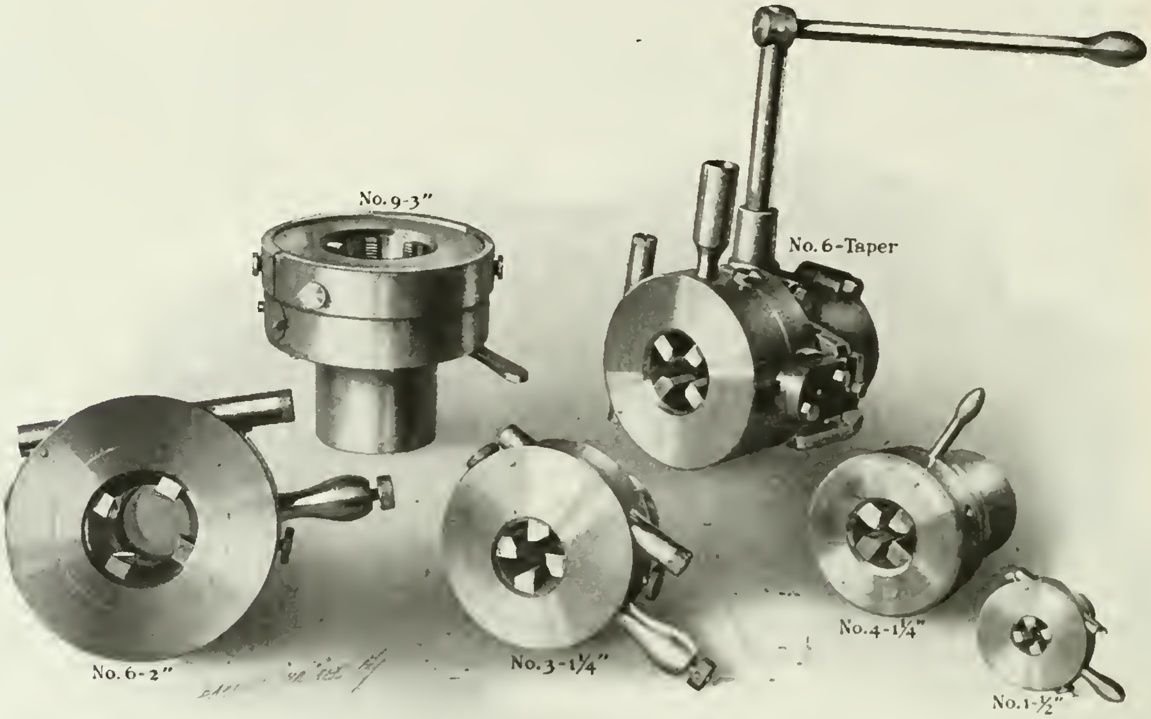
"American" Lathes are made in a variety of sizes, 12" to 42" swing. Catalog on request.

THE AMERICAN TOOL WORKS COMPANY

CINCINNATI, U. S. A.

SHAPERS **RADIALS**

—and the 3500th was a fine piece of threading



A representative group of Hartness Automatic Dies—

Read the letter on the opposite page. Mr. Hawke sent it to us entirely without solicitation or foreknowledge on our part. It is convincing evidence of the regard in which Hartness Automatic Dies are held by the Bessemer Gas Engine Company.

There is little mystery or luck in the good results obtained. We have succeeded by hard work in banishing these two uncertain elements from the manufacture of our dies and chasers.

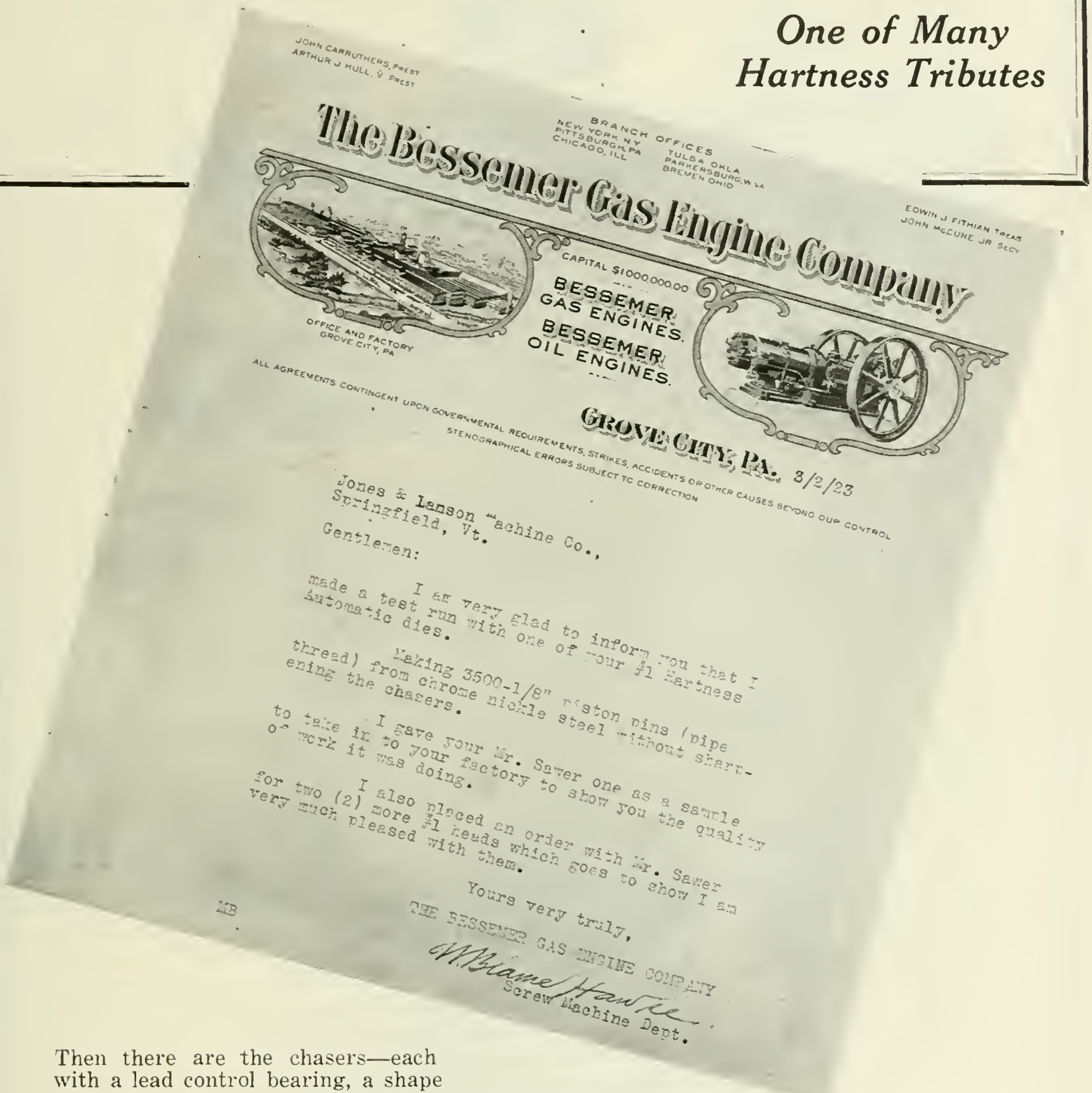
A rugged, durable Die-Holder is the first essential. The disc cam holds the chasers to their work right over the cutting edge—the stiffest way of the cross-section. It gives a cutting control, and an accuracy and durability of cutting edge not otherwise obtainable.

Branch Office:
San Francisco, California
503 Market Street
AGENTS:
Japan, Korea, Manchuria, Formosa
Mitsui Co., Ltd., Tokio
France, Spain and Belgium—F. Auberty & Co., 182 Rue Lafayette, Paris
Australasia—McPherson, Pty., Ltd.
554 Collins St., Melbourne

JONES & LAMSON

SPRINGFIELD,

One of Many Hartness Tributes



JOHN CARRUTHERS, PREST
ARTHUR J HULL, V PREST

BRANCH OFFICES
NEW YORK N.Y.
PITTSBURGH, PA
CHICAGO, ILL
TULSA OKLA
PARKERSBURG, W. VA
BREMEN OHIO

The Bessemer Gas Engine Company

EDWIN J FITHIAN TREAS
JOHN McCUNE JR SECY

CAPITAL $1000,000.00

BESSEMER GAS ENGINES.
BESSEMER OIL ENGINES.

OFFICE AND FACTORY
GROVE CITY, PA

GROVE CITY, PA.

ALL AGREEMENTS CONTINGENT UPON GOVERNMENTAL REQUIREMENTS, STRIKES, ACCIDENTS OR OTHER CAUSES BEYOND OUR CONTROL
STENOGRAPHICAL ERRORS SUBJECT TO CORRECTION

3/2/23

Jones & Lanson Machine Co.,
Springfield, Vt.

Gentlemen:

I am very glad to inform you that I made a test run with one of your #1 Hartness Automatic dies.

Making 3500-1/8" piston pins (pipe thread) from chrome nickle steel without sharpening the chasers.

I gave your Mr. Sawer one as a sample to take in to your factory to show you the quality of work it was doing.

I also placed an order with Mr. Sawer for two (2) more #1 heads which goes to show I am very much pleased with them.

Yours very truly,
THE BESSEMER GAS ENGINE COMPANY
W Blaine Hawke
Screw Machine Dept.

MB

Then there are the chasers—each with a lead control bearing, a shape and pitch accuracy checked on the Hartness Screw Thread Comparator, and a choice of material and heat treatment kept constantly abreast of the progress of the art.

Isn't all this what you want in a die?

MACHINE COMPANY

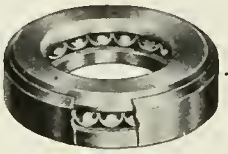
VERMONT, U.S.A.

Branch Office:
London, England
9-10 Water Lane, Queen Victoria St

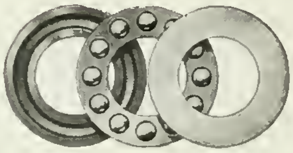
AGENTS:

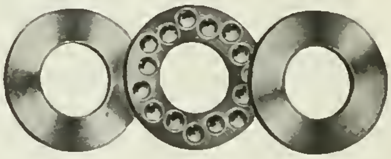
Holland—Spliethoff, Beeuwkes & Co.
Luevehaven, Wz., 159 Rotterdam

Sweden—A. Bol. Oscar Lindbom
Stockholm—Post Box 420



Get an Expert's Estimate on Your Friction Cost per Year

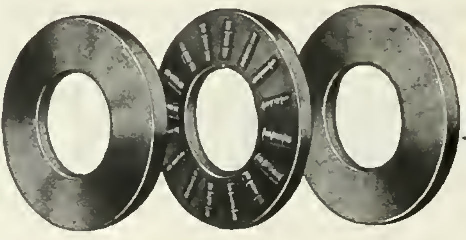


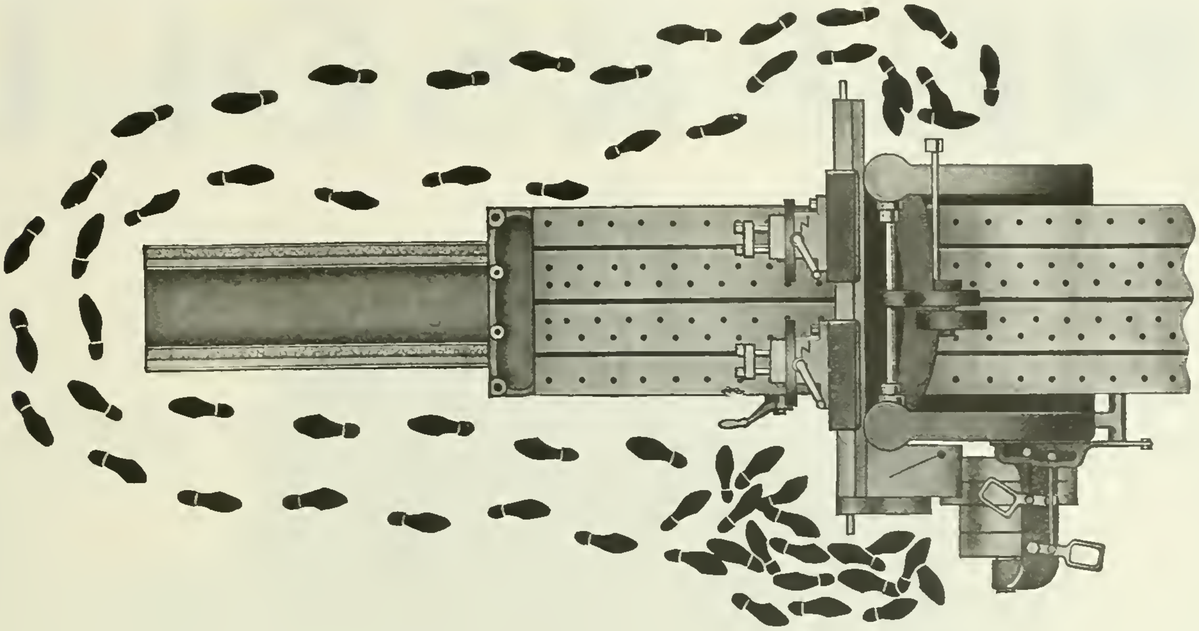


The power waste due to friction in bearings is amazingly high in the average plant. Anti-friction bearings, correctly placed, lower the power loss, greatly reduce wear on moving parts and permit continuous operation at high speeds without loss of efficiency.

Our Engineering Department will show you how to increase production and at the same time lower operation costs. Results in other plants will interest you—estimates on Ball and Roller installations in your own plant should convince you that efficient power transmission pays. Write us.

The Ball & Roller Bearing Company
Danbury, Conn., U. S. A.





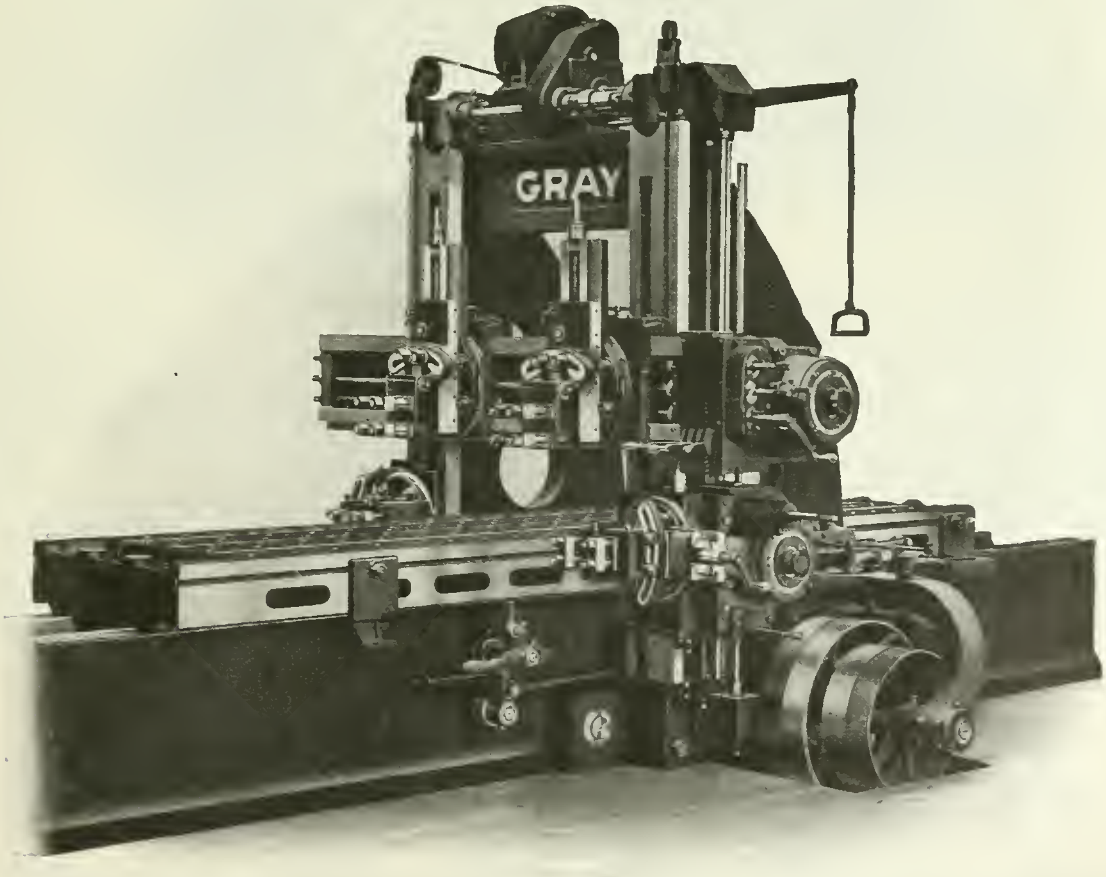
Why perambulate? Get a

GRAY MAXIMUM SERVICE PLANER

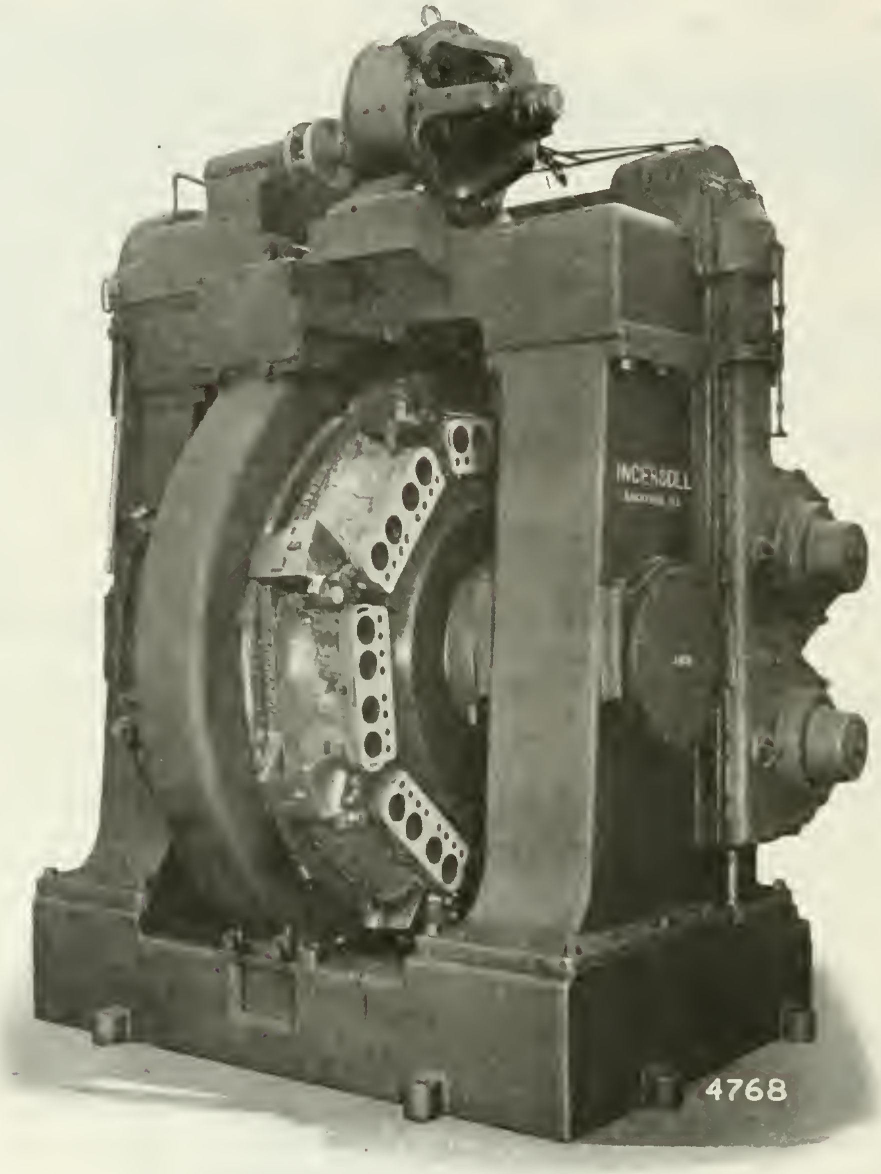
Complete centralized control is only one of the many distinctive features of these "super planers."

Write for our fully illustrated catalog which describes them all.

THE G. A. GRAY COMPANY, Cincinnati, Ohio



INGERSOLL



A 52,000-pound Ingersoll Drum Type Milling Machine
(Patented)

This Ingersoll Double Row Drum Type Continuous Milling Machine was built to take heavy roughing cuts and at the same time very accurately finish mill the top and bottom of cylinder blocks. It was built for this particular operation, having two sets each of eight special Ingersoll Fixtures, one set on either side of the heavy center drive worm wheel. The fixtures on the right of this worm wheel hold the castings while the tops of the blocks are milled and the set on the left when the bottoms are milled. It has massive sections and large diameter shafting to carry the power without loss or chatter to the cutters. It stands 11½ feet high and covers only 73 square feet of floor space.

Being the pioneer builders of the drum type continuous milling machines, we have acquired a fund of experience which is at your service in solving your production milling problems. Send us your blueprints with the production required, and without obligation we will recommend the equipment necessary to get this production.

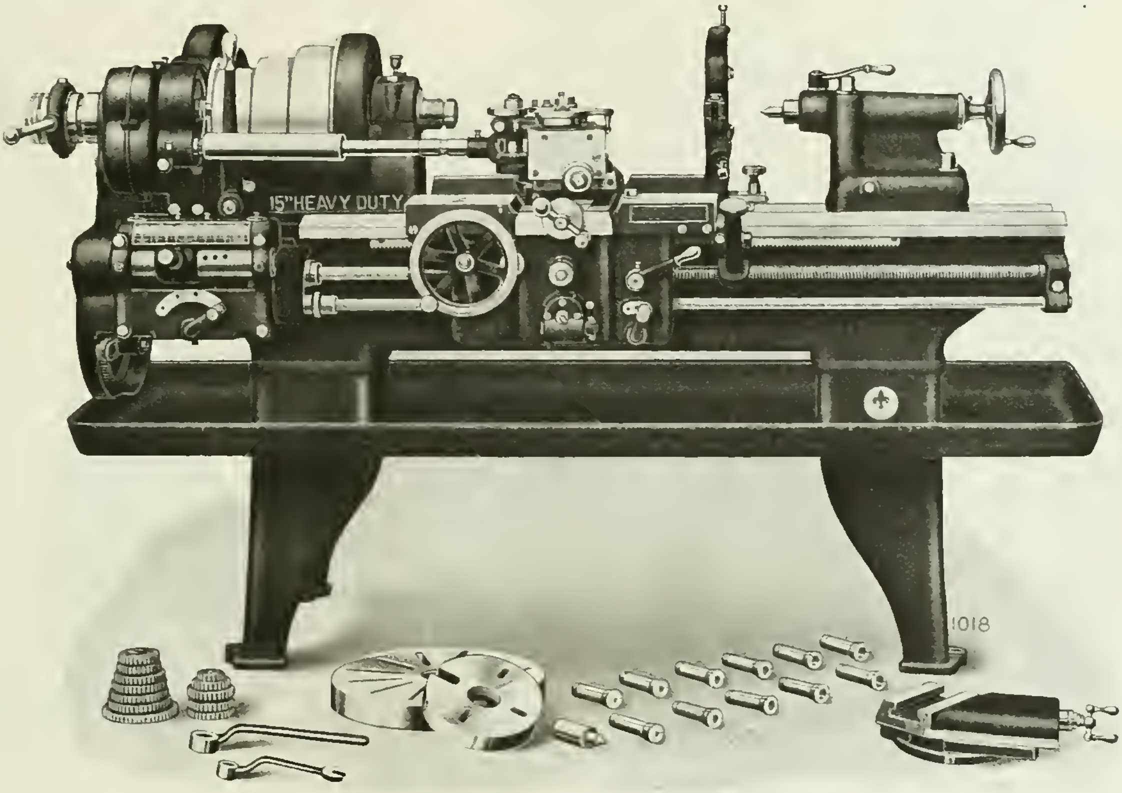
Bulletin No. 38, "Ingersoll Milling Cutters"
39, "Ingersoll Continuous Milling Machines"
40, "Ingersoll Installations of Milling Equipment"
42, "Ingersoll Drum Type Continuous Milling Machines"
43, "Ingersoll Face Milling Cutter Grinders"

The Ingersoll Milling Machine Co.

Milling Machines and Their Equipment

Detroit: David Whitney Bldg. ROCKFORD, ILL. 50 Church Street, New York

THE
LE BLOND
HEAVY DUTY
PRECISION TOOL-ROOM LATHE



We offer for the most exacting tool-room service our newly developed 15" Heavy Duty Lathes with any or all of the attachments required for tool-room practice.

These lathes are built to the highest standards of accuracy and with the utmost care. A complete system of jigs, fixtures, gauges and thread standards are used in their production and tests, and each lathe must be within our close standards of inspection. They are exceptionally accurate, rigid and convenient, and in addition they have a capacity for heavy service, without impairing this precision, not found in other tool-room lathes. The lead screws are cut on a special lathe, equipped with a master screw, and are guaranteed as precision lead screws for exacting tool-room requirements. All parts are scraped to master surface plates, and all approved systems of gauging and measuring are used to determine the accuracy and adhere to our established close standard of precision.

The fundamental requirement of a successful tool-room lathe is accuracy, and this accuracy can only be retained during long service by correct design and the proper selection of materials. The Heavy Duty features of our tool-room lathe contribute materially to their precision and long productive life without interfering with their convenience and ease of operation. The lathe can be furnished with single pulley drive geared headstock, double friction back geared headstock with three-step cone, or motor drive from constant speed alternating or direct current motors.

The R.K. Le Blond Machine Tool Co.

Cincinnati. Ohio.

It's the Power Deli

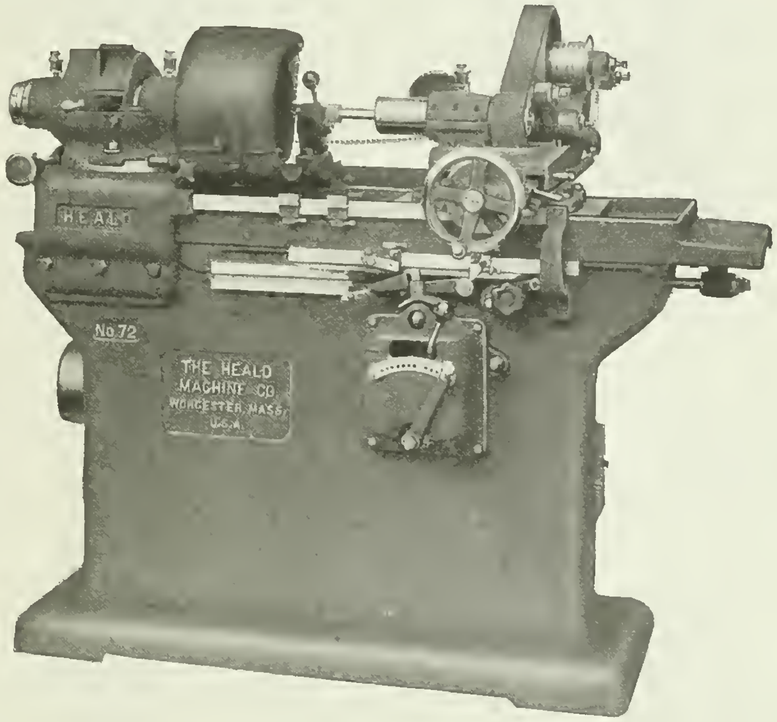
Only the power delivered right here gives you production

Grind with a HEALD and be Sure

vered to the Wheel

That Counts

One is easily led to think that a grinder with a big motor or extra wide belt must give big production. It is a fact, however, that the number of horsepower a machine consumes, or the width of its drive belt, is no indication of the work it does. You may put 10 or more H.P. into a grinder and consume it all driving its mechanism.



The Heald Hydraulic Internal

however, is of such simple construction, having no gears, racks, etc., that loss due to friction is negligible. Therefore, practically every ounce of driving power goes directly into the wheel where it counts.

The Heald has proven in a recent competitive test that it produces a greater amount of accurate work at lower operating cost than any similar machine on the market today.

Production figures mean nothing in an advertisement. There are so many variable factors and conditions connected with each job that only by an actual test under normal working conditions can the results be obtained.

We stand ready to make that test, and while we are anxious and glad to send Bulletin No. 72, which describes the internal in detail, we suggest that you also

Get in touch with our Service Department and let us show you what we can do on your own work.

THE HEALD MACHINE COMPANY
16 New Bond Street, Worcester, Mass.

BRANCHES:

CLEVELAND, OHIO
614 Cleveland Discount Bldg.
CHICAGO, ILL.
9 South Clinton St.

MILWAUKEE, WIS.
947 41st St.
CINCINNATI, OHIO
614 Provident Bank Bldg.

NEW YORK, N. Y.
839 Singer Bldg.
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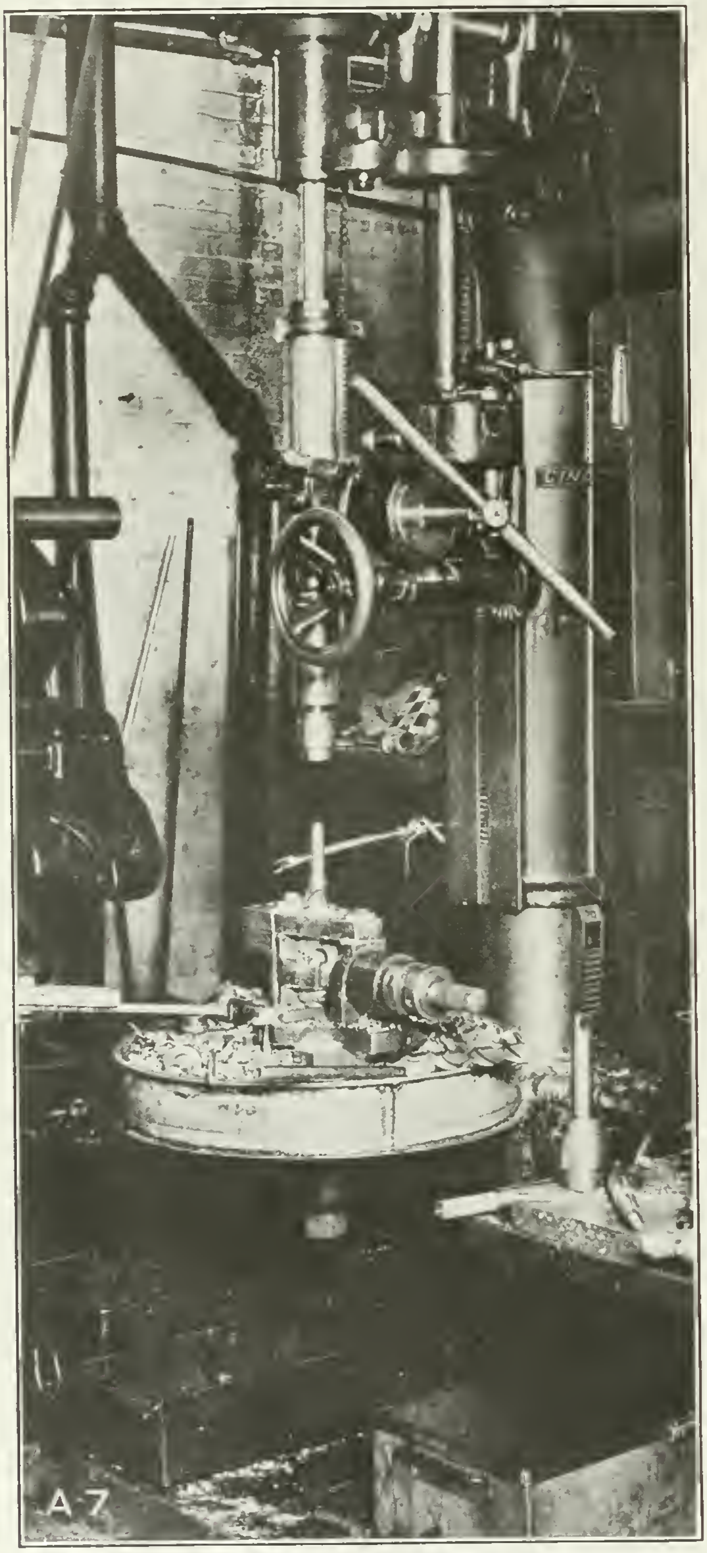
1302 Stephen Girard Bldg.

ST. LOUIS, MO.
709 Pontiac Bldg.
DETROIT, MICH.
400 Marquette Bldg.

Agents in all Principal Cities

Grind with a HEALD and be Sure



Severe Service a Joy to

THE CINCINNATI

UPRIGHT DRILL

The Studebaker Corporation, Detroit, Michigan, believes in forcing tools to their limit. The "limit" in this case was the tang of the drill which a CINCINNATI upright had just twisted off without apparent effort. The machine has stood up for years under just such service and is still in good condition.

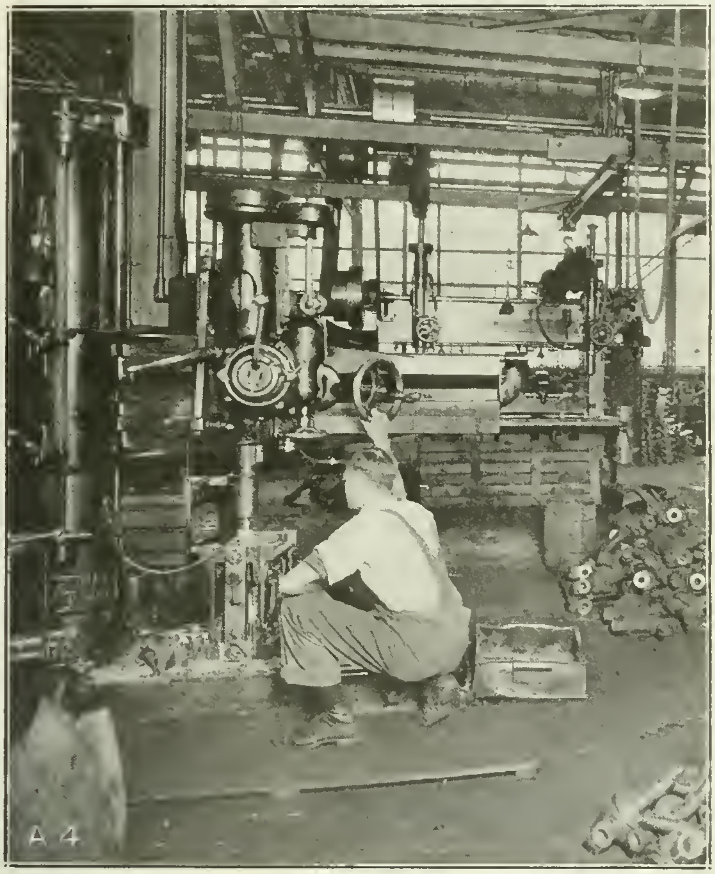
Is it any wonder that these tools are so popular, and that we should have grown to be the largest manufacturers of drilling machinery in the world? A good machine made by a reliable company and handled by responsible agents is bound to attain distinction.

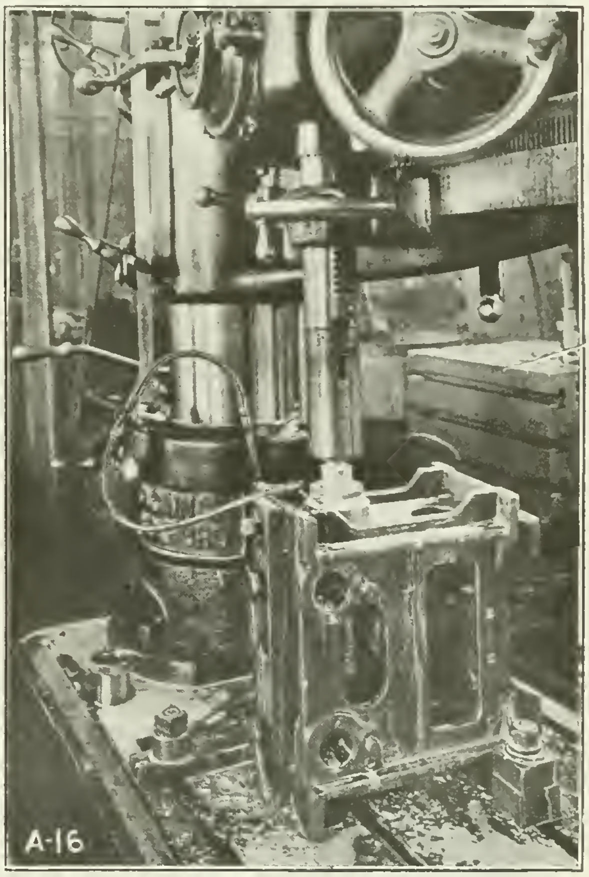
The CINCINNATI cuts chips cheerfully

The Cincinnati Bickford Tool Co.

Oakley, Cincinnati, Ohio, U. S. A.

Founded 1874





Confined to an Inaccuracy of .001

The International Motors Company, Allentown, Pa., installed this CINCINNATI BICKFORD radial to drill drop-forged chrome nickel steel steering knuckles. The holes are 2⅛ inches in diameter by 12 inches in depth and are drilled at the rate of four per hour with a tolerance of but .001.

If our tools did not excel in accuracy and strength, such results would be impossible. The clamping of the column always alters the position of the arm to a greater or less extent—depending upon where the sleeve is slit. To drill a hole with a drill that is cramped in its bushing entails overheating, the scarring of the drill and bush, and obtaining a hole that is both rough and out-of-perpendicular.

Particular people pick precise presses

The Cincinnati Bickford Tool Co.

Oakley, Cincinnati, Ohio, U. S. A.

Founded 1874

BETTS-BRIDGEFORD

Heavy Duty Engine Lathes

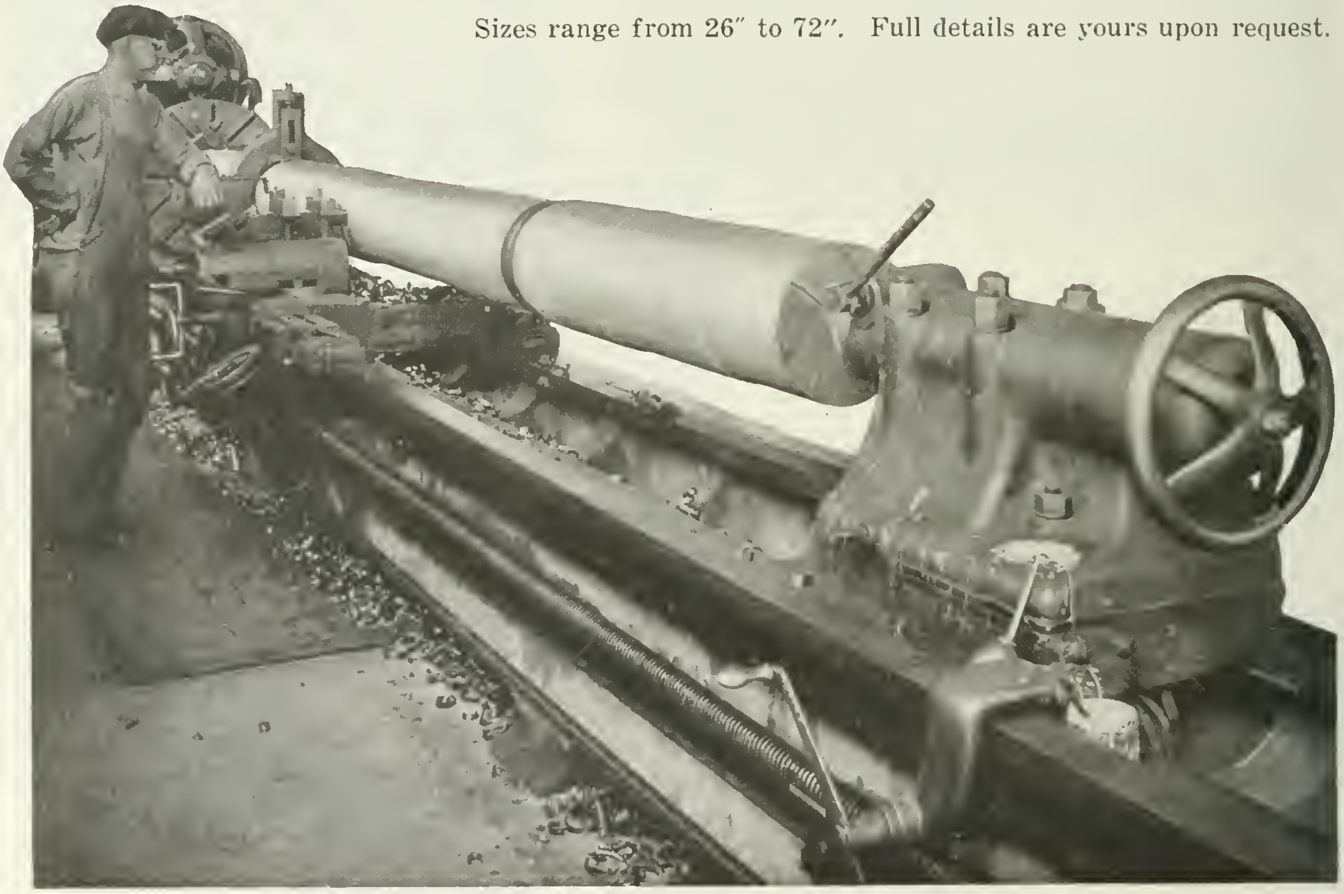
A Product of
BETTS
Machine Works

A Lathe may have strength enough to do a job but if it is not RIGID it is not the best machine for your work and more than likely will not stand up when the tough heavy jobs come along.

The weight of Betts-Bridgeford lathes is so distributed that the parts which are fixed and absorb the shocks are heavily constructed. They have the backbone, in other words, to take a lot of punishment and the sturdiness which keeps them producing continuously.

The illustration shows the kind of work Betts-Bridgeford lathes are called upon to do and they handle it in fast time. The geared headstock is self-lubricating, has all steel gears running in oil and all gear shifts are easy and convenient to make. The apron is of the one piece double wall construction and the tailstock is of heavy design and very easily moved along the bed.

Sizes range from 26″ to 72″. Full details are yours upon request.



WORKS:
Betts Machine Works
Rochester, N. Y.
Modern Tool Works
Erie, Pa.
Hilles & Jones Works
Wilmington, Del.
Newton Machine Tool Works
Philadelphia, Pa.
Colhurn Machine Tool Works
Cleveland, O.

CONSOLIDATED MACHINE
OF
General Office: 17 E.

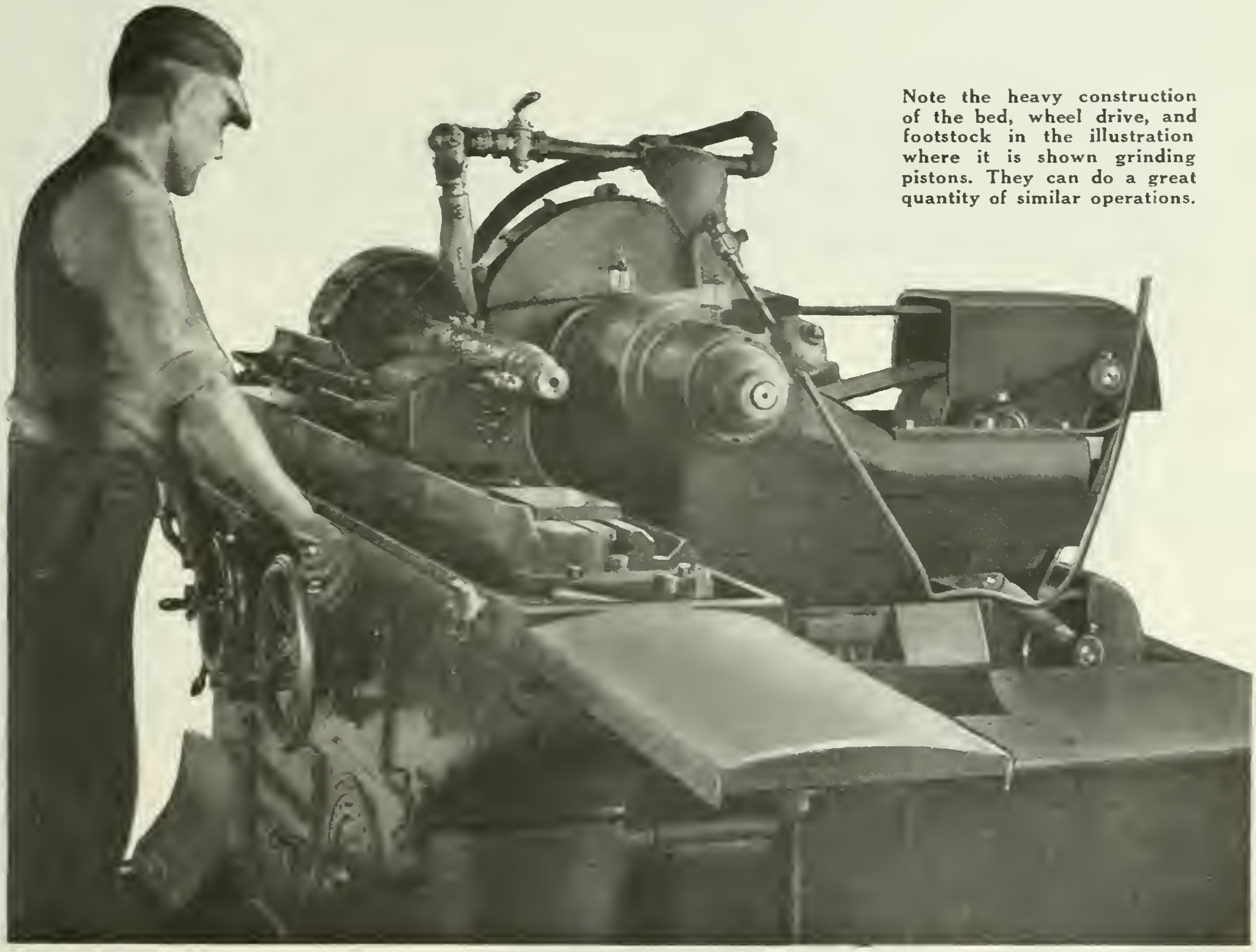
CONSOLIDATED

MODERN
Plain Cylindrical Grinders

Accuracy and quantity production are two terms much talked about, especially in the automotive industries and other large manufacturing plants where parts are turned out in great quantities.

It is on this kind of work that Modern Plain Grinding Machines have made exceptional records. On quantity production and in the tool-room they have demonstrated that they will stand up and maintain their accuracy under the most severe conditions. In other words they are correctly designed and the weight is properly distributed.

They are built in 8 sizes—8″x18″, 8″x30″, 12″x36″, 12″x48″, 12″x60″, 16″x36″, 16″x48″, 16″x60″. If your work is such that it can be done on a plain grinder refer it to our engineering department. They have solved many a puzzling problem.



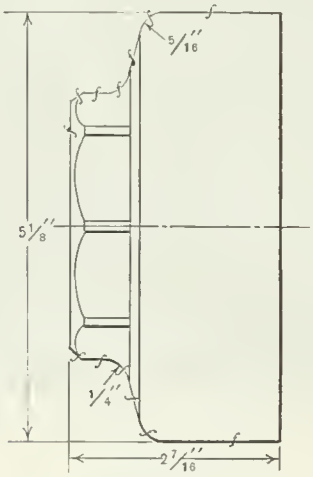
Note the heavy construction of the bed, wheel drive, and footstock in the illustration where it is shown grinding pistons. They can do a great quantity of similar operations.

TOOL CORPORATION
AMERICA
42nd Street, New York

DISTRICT
SALES OFFICES:
CLEVELAND
CHICAGO
DETROIT
NEW YORK
PHILADELPHIA
PITTSBURGH
ST. LOUIS

MACHINE TOOLS

A Typical Cincinnati-Acme Performance



Bronze Hub Caps for Cunningham Cars

James Cunningham, Son & Company, Rochester, N. Y., put bronze hub caps on Cunningham cars; turn them up on a Cincinnati-Acme Turret Lathe; machine them accurately and economically and with a comparatively small expenditure for the simple tools required.

Operations are as follows:—

1. Finish face; radius and bevel end.
2. Turn diameters; face ten degree angle portion.
3. Finish 5/16" radius.
4. Finish ¼" radius.
5. Finish turn outside diameter.

From 3/32" to ⅛" material is removed. Production seven per hour.

Let us show you what Cincinnati-Acme Machines can do for you.

THE ACME MACHINE TOOL CO., Cincinnati, Ohio, U.S.A.

Flat Turret Lathes ***Screw Machines*** ***Turret Lathes***

AGENTS

Henry Prentiss & Co., Inc., New York City, Boston, Buffalo, Rochester, Syracuse and Hartford.
Motch & Merryweather Machy. Co., Cleveland, Detroit, Pittsburgh and Cincinnati.
Marshall & Huschart Machy. Co., Chicago, Ill.
Marshall & Huschart Machy. Co., of Indiana, Indianapolis, Ind.
Robinson, Cary & Sands, St. Paul and Duluth, Minn.
Elliott & Stephens Machy. Co., St. Louis, Mo.
W. E. Shipley Machy. Co., Philadelphia, Pa.
Kemp Machinery Co., Baltimore, Md.
Seeger Machine Tool Co., Atlanta, Ga.
Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.
Dewstoe Machine Tool Co., Birmingham, Ala.
Harron, Rickard & McCone, San Francisco and Los Angeles, Calif.

CINCINNATI BORING MILLS

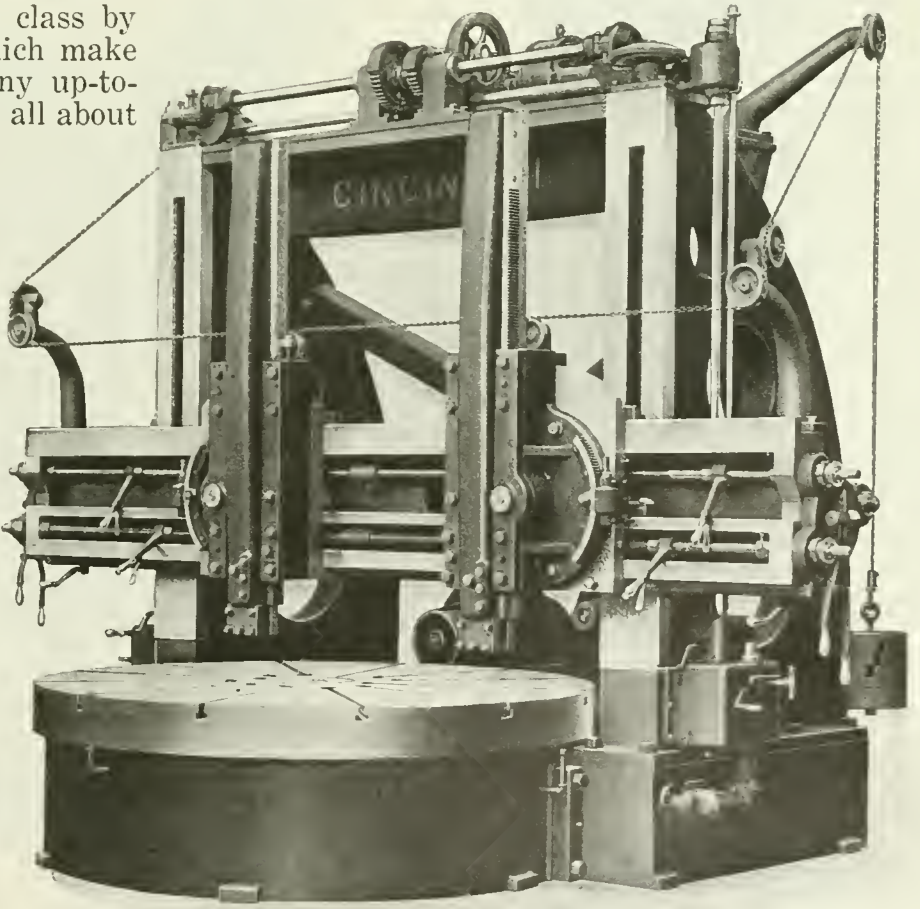
Capacities 2" Over Rated Size

Power, rigidity and convenience are all developed in generous measure in these machines; and they *don't* require big, husky operators to run them. The Rapid Power Traverse, with adjustable control levers, and the centralized location of all handles, dial plates, indices, etc., within easy reach and view from working position make the actual manual labor of operation an easy task. Designed and built to permit average men in average shops to make machining time most productive in the widest possible range and variety of work.

CINCINNATI PLANERS

Always come to mind when Rapid Power Traverse is mentioned.

Machines which have herringbone gears, box arch, forced lubrication and other advantages which put them distinctly in a class by themselves. Machines which make profitable additions to any up-to-date shop. Let us tell you all about them.



Rapid Production Mills 42", 48", 60", 72", and 84" Sizes. Massive Mills, 8', 10', 12', and 10' x 16'.

Bulletins on request.

**THE CINCINNATI
PLANER COMPANY**

CINCINNATI OHIO, U. S. A.

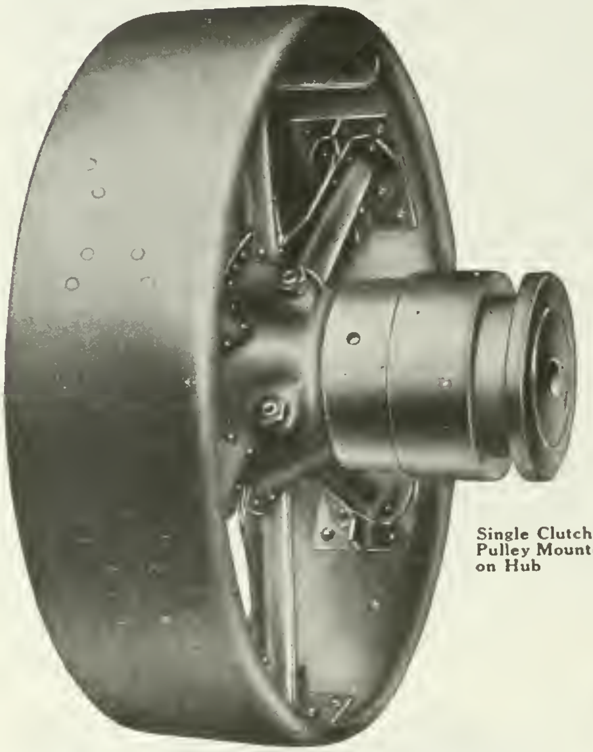
Manufacturers of

Planers and Boring Mills

THE JOHNSON FRICTION CLUTCH

as used on the

"New" Semi-Automatic Multiple-Spindle Cylinder Boring Machine



Single Clutch Pulley Mounted on Hub

The cylinders are mounted on a rotary fixture having six positions, five working and one loading. The loading and unloading is done while the machine is in operation.

The machine has five spindles which provide for taking all five cuts at the same time in separate cylinders.

The *Johnson Friction Clutch* is used on this machine to control these operations. The shifting lever is placed at the front of the machine where it is handy to the operator.

The *Johnson Clutch* gives perfect control over the machine at all times.

Consider some of the advantages of having friction control on the machine rather than the old way of operating machinery.

Positive control with a lever in front of machine.

Operating lever on a level with the hand. No reaching overhead as with a countershaft.

Elimination of the shifting belt nuisance. The belts last longer and edges are not curled over nor worn off.

Direct drive from lineshaft, that requires the minimum quantity of belting.

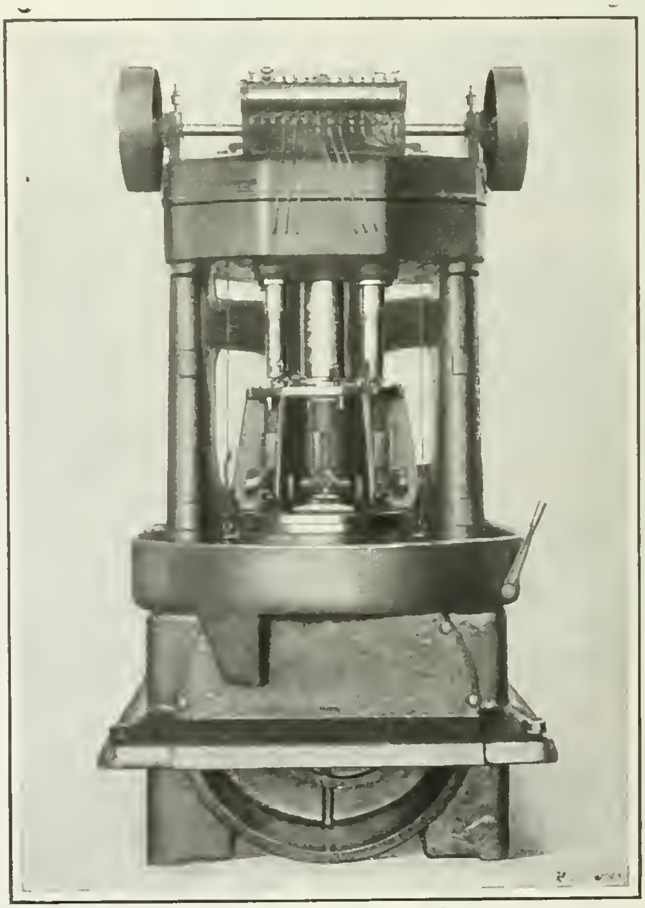
The Johnson Clutch is an asset to any machine and not an expense.

Be sure it's a *Johnson.*

Standard Clutches carried in stock in a multitude of sizes.

Write for stock list.

Catalog "A" should be in your files. May we send you a copy?



Courtesy: Manufacturers Consulting Engineers, Syracuse, N. Y.

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.

Look this High Speed Drill Over

It is a

"Morse" Product

Every Experienced Mechanic
Knows What That Means.

THE GENUINE "MORSE" DRILLS ENCIRCLE THE GLOBE

Made in New Bedford
Used Everywhere

MORSE
TWIST DRILL & MACHINE CO.
NEW BEDFORD, MASS. U.S.A.

Drill Faster and Truer

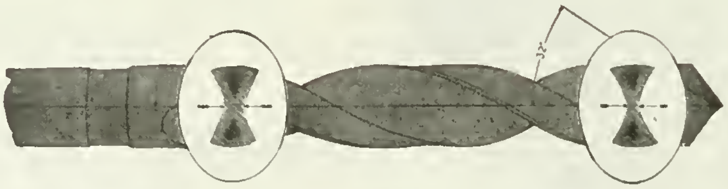
Cut down the cost per hole

For drilling drop forgings or hard alloy steel castings, specify Double-D Rolled Drills, and after a reasonable time compare the results with present production costs. This test shows up more clearly than any other the real superiority of Double-D's.

They combine the strength of the forged drill with the accuracy and uniformity of the milled type. The rolling process—which we control exclusively—gives greater density to the steel without introducing the rough inaccuracies of hammering.

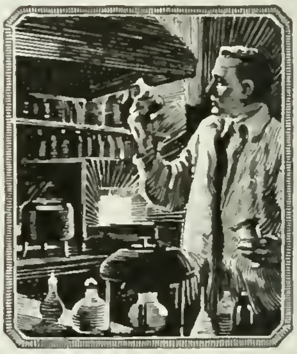
Try Double-D Drills on the toughest job in your plant and watch them "hog in".

We invite comparative tests.



The wide flute insures ample chip clearance for deep drilling.

Double-D hot rolled drills now available in sizes from ¼" to 1⅝"



Detroit Twist Drill Co., Detroit, Michigan

45 Warren Street, New York **Metropolitan Building, Atlanta**

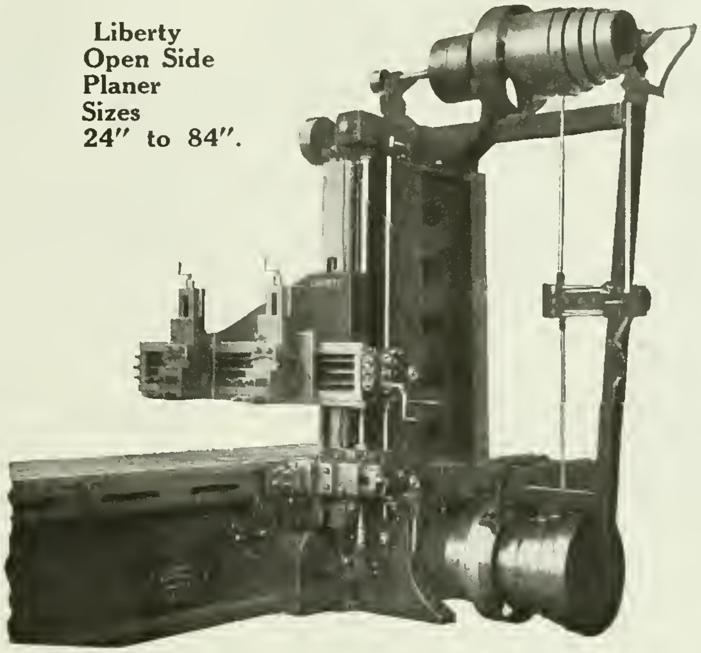
Canadian Detroit Twist Drill Co., Limited, Walkerville, Ontario

(54)

DETROIT DOUBLE-D ROLLED DRILLS

If it's a Liberty —you will have every feature essential to a modern high grade planer

First: plenty of speed, plenty of power and a high degree of accuracy.



Liberty Open Side Planer Sizes 24" to 84".

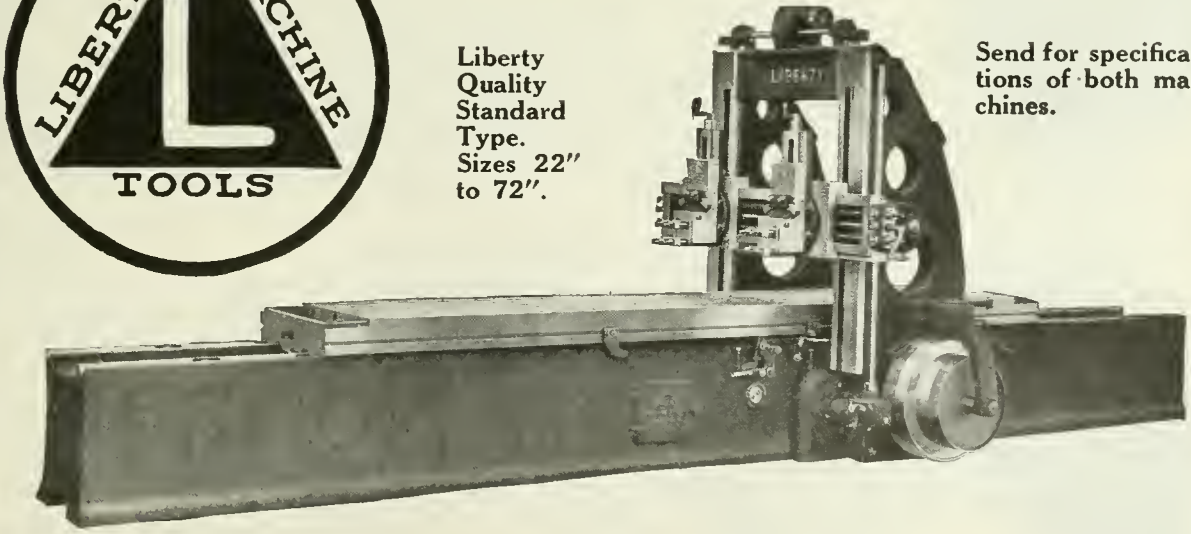
Then these special features: A feed mechanism that enables the operator to control or change the feed of any head at any time without stopping the machine or disturbing the other heads (Liberty Patent), a conveniently located dial that enables the operator to set the feed without difficulty and to read it easily. Patented four speed belt drive, patented micrometer collars, patented clapper box clamp, etc.

Liberty Open Side Planer has individual advantages for handling big awkward pieces, heavy odd shaped castings or any other work that's hard and sometimes impossible to set up on a standard type planer.

LIBERTY MACHINE TOOLS

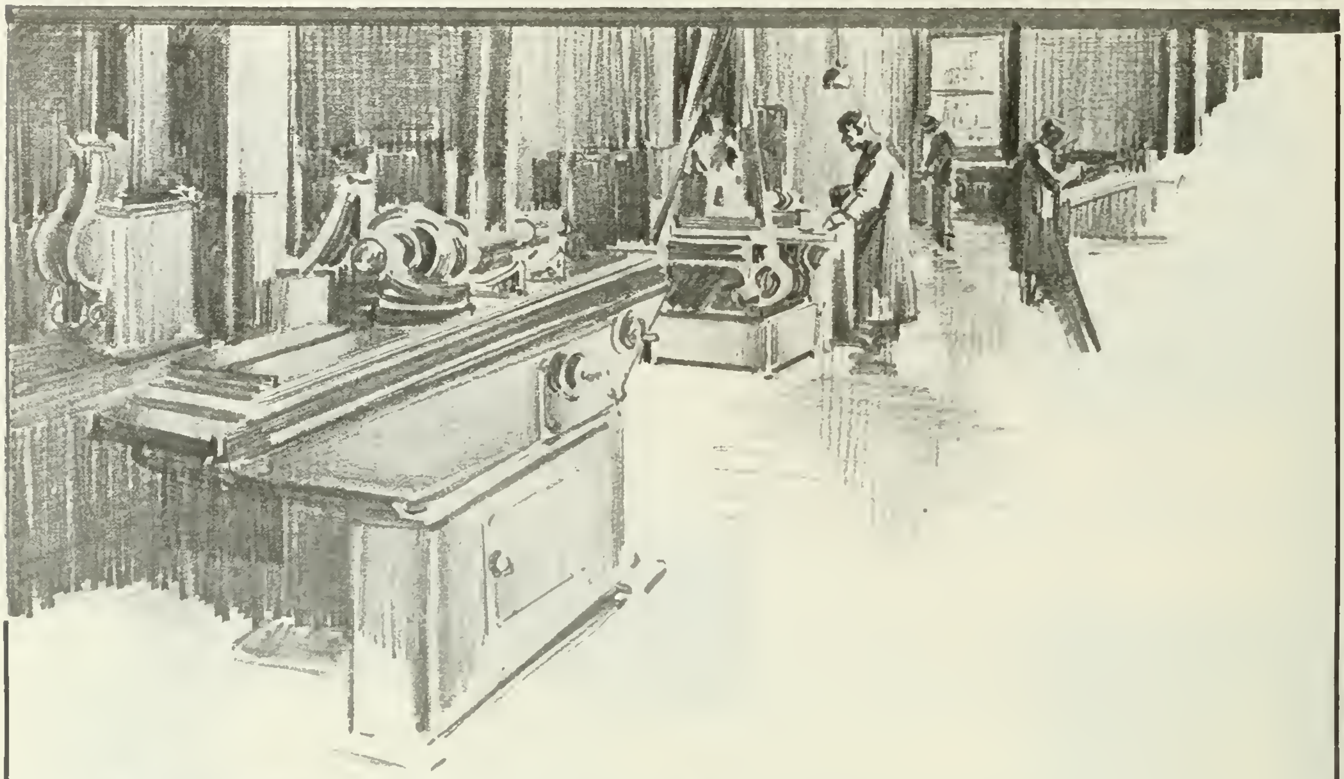
Liberty Quality Standard Type. Sizes 22" to 72".

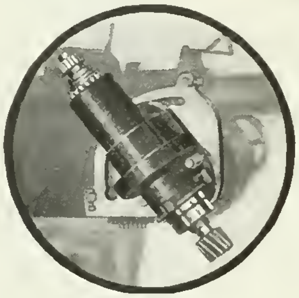
Send for specifications of both machines.



LIBERTY MACHINE TOOL COMPANY

HAMILTON, OHIO

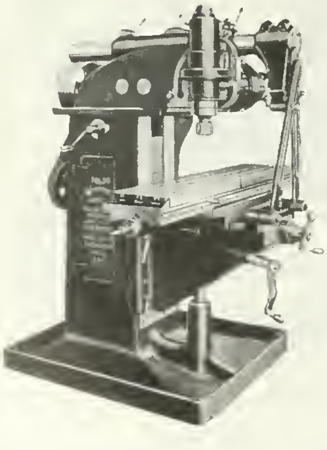




The Van Norman Duplex Miller is instantly adaptable to practically every milling requirement.

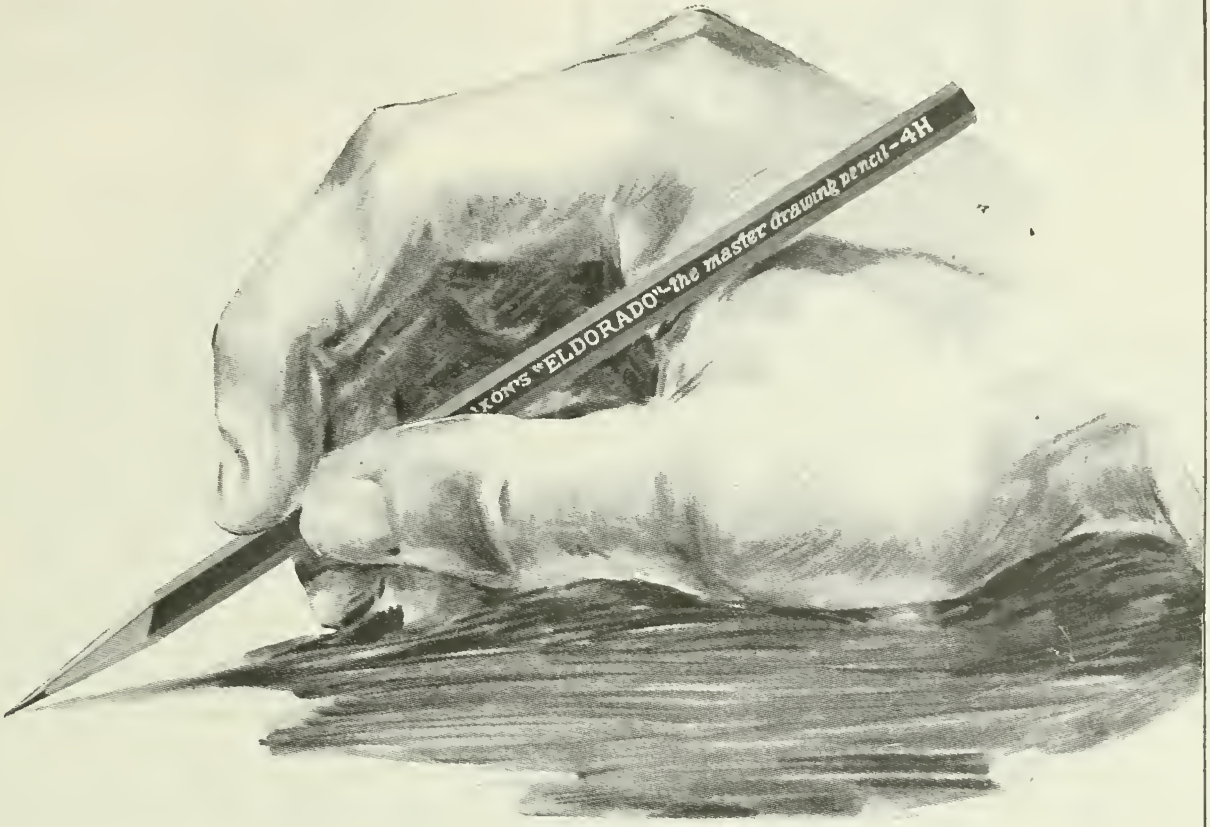
Adjustable cutter head and movable ram make it a simple matter to place the cutter in the most advantageous position relative to the work. Any number of different cuts can be made with but one clamping and carried through the full longitudinal movement of the table.

Users of the Van Norman Duplex regard it as an essential part of their tool-room equipment. It saves serious delays, heavy tool expenses, and unsatisfactory, makeshift jobs.



Van Norman
machine tool co.
SPRINGFIELD - - - - - MASS.

5413


DIXON'S "ELDORADO"-the master drawing pencil-4H

A Dixon's Eldorado 4H is always a 4H—no matter whether you buy it in New York or San Francisco—this week or next year.

So with every one of the seventeen leads—from 6B, the very softest, to 9H, the very hardest.

Uniformity and faithfulness to grade are outstanding characteristics of this master drawing pencil.

DIXON'S ELDORADO

"the master drawing pencil"

JOSEPH DIXON CRUCIBLE COMPANY
Pencil Dept. 74-J Jersey City, N. J.
Canadian Distributors: A. R. MacDougall & Co., Ltd., Toronto

SAMPLE OFFER

Write for full-length free samples of *"The master drawing pencil"* and of Dixon's "BEST" Colored Pencils. In their field, the "BEST" Colored Pencils hold the same position of supremacy as Dixon's Eldorado.

DIXON'S ELDORADO ERASER

A worthy partner of Dixon's Eldorado pencil. Soft—pliable—yet firm enough to clean the drawing without crumbling into aggravating little bits. Made in 12 sizes. Write for a sample. Free on request.

NATIONAL SEMI-AUTOMATIC HAMMER HEADER

Produces More Bolts at Lower Cost

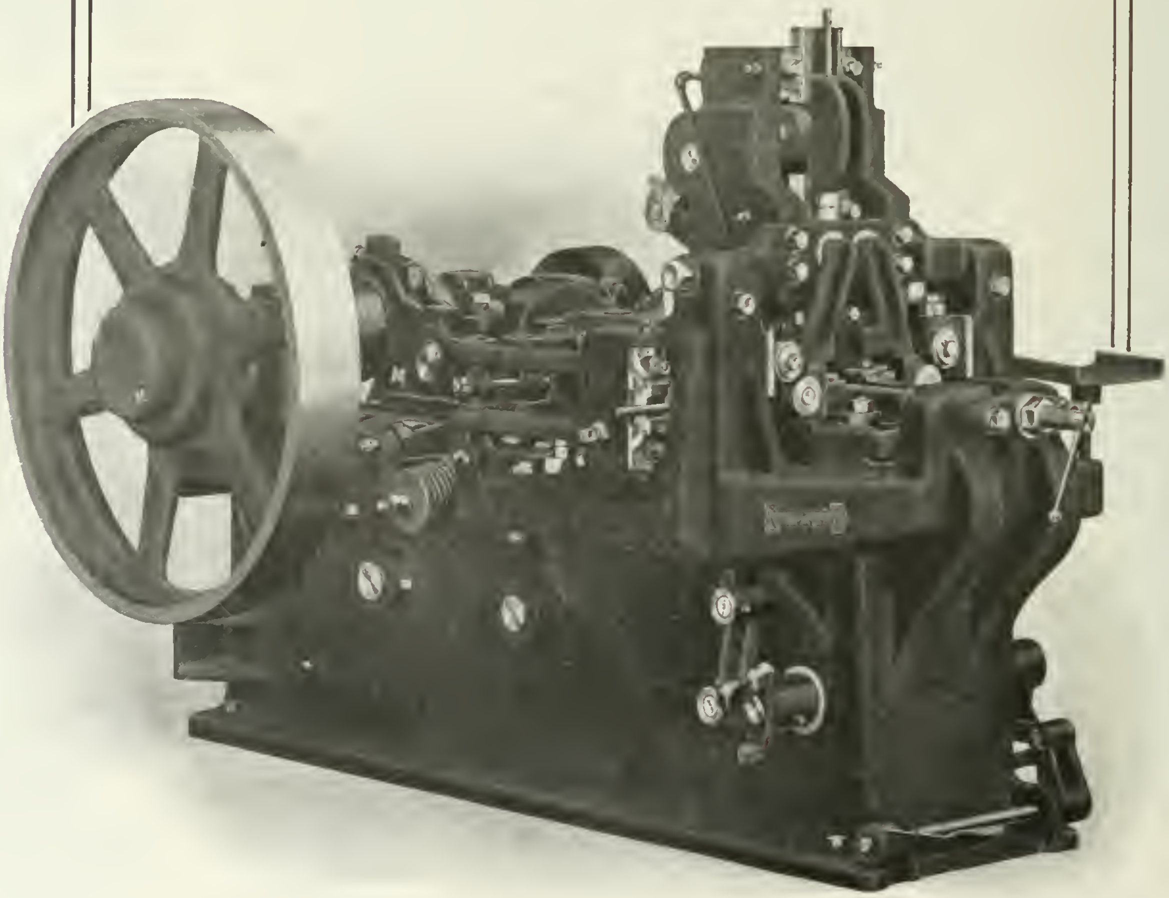
This machine runs continuously and the movements are automatic. The operator devotes all his time to feeding; and, as the machine sets the pace for operation, outputs are greatly in excess of those secured from the old style machines.

As each bolt is given the same predetermined number of blows, work is very uniform. Due to the rigid construction of the bed and working parts, a better bolt is produced in four blows than can be secured in six blows from previous designs.

Investigate the National Semi-Automatic Hammer Header for making your square, hexagon and T-head bolts. It will pay you.

We'll be glad to send full details.

The National Machinery Co.
TIFFIN, OHIO, U.S.A.



contex
bakelite

silent, yet tough

ABOVE the roar of noisy machinery, engineers shouted for silent gears. Their answer is here—CONTEX. Gears made of CONTEX Gear Material are chatterless, rattleless and vibrationless—yet strong as iron. Absolutely unaffected by heat, cold, water, steam, solvents, many acids, rodents and weather conditions. Samples and descriptions ready for those really interested.

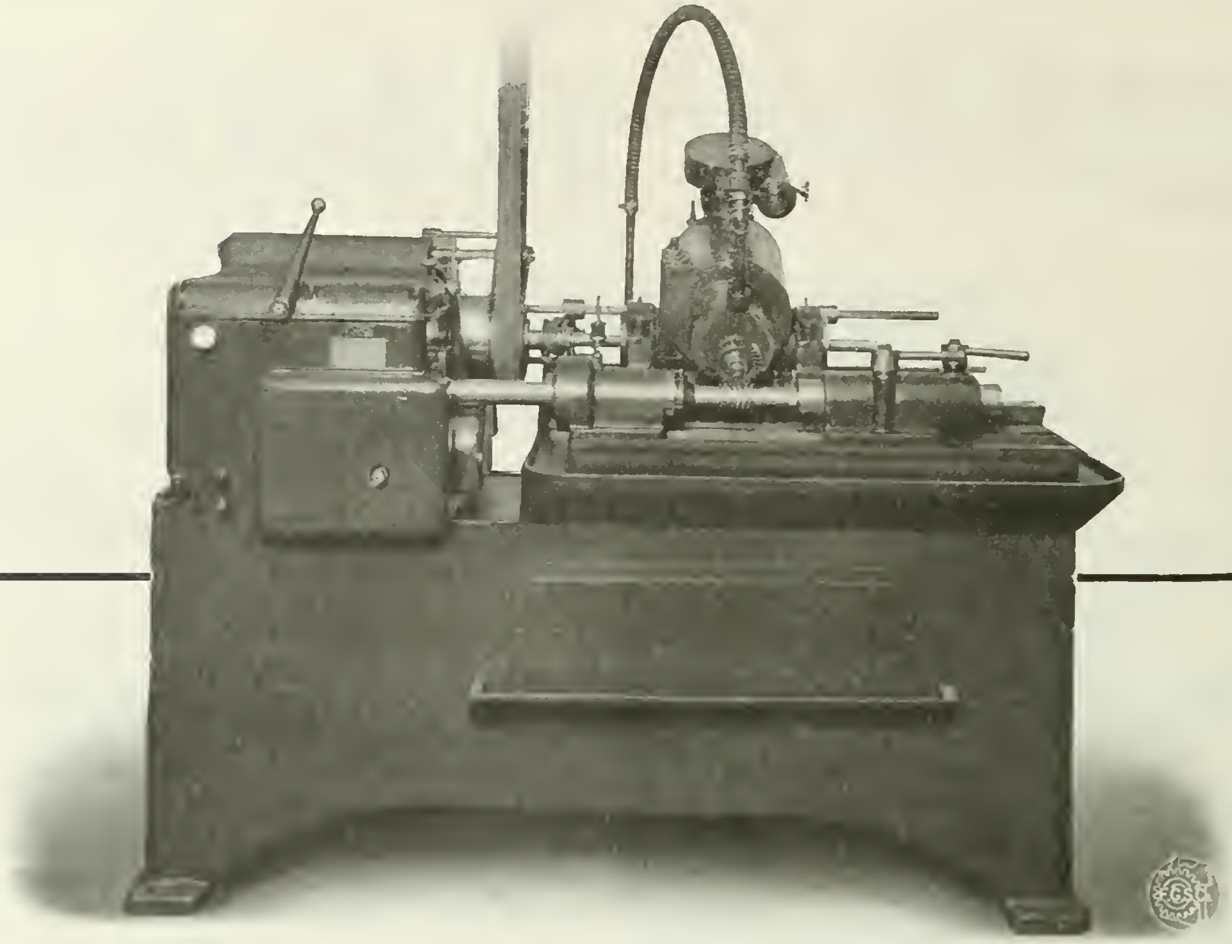
THE CONTINENTAL FIBRE COMPANY
(Licensed Manufacturers)
Factory: NEWARK, DELAWARE

Service on Contex, also Bakelite-Dilecto, Conite, Continental-Bakelite, and Vulcanized Fibre from:

New York......233 Broadway
Chicago...332 S. Michigan Ave.
Pittsburgh.....301 Fifth Ave.
San Francisco...75 Fremont St.
Seattle.....95 Connecticut St.
Los Angeles....411 S. Main St.

makes mute gears

A Laminated Phenolic Condensation Material



Here it is—
The Machine you have been waiting for

A Thread Generating Machine having remarkable production possibilities.

It uses a helical Gear Shaper cutter and produces worm threads with an ease and dispatch that is almost startling.

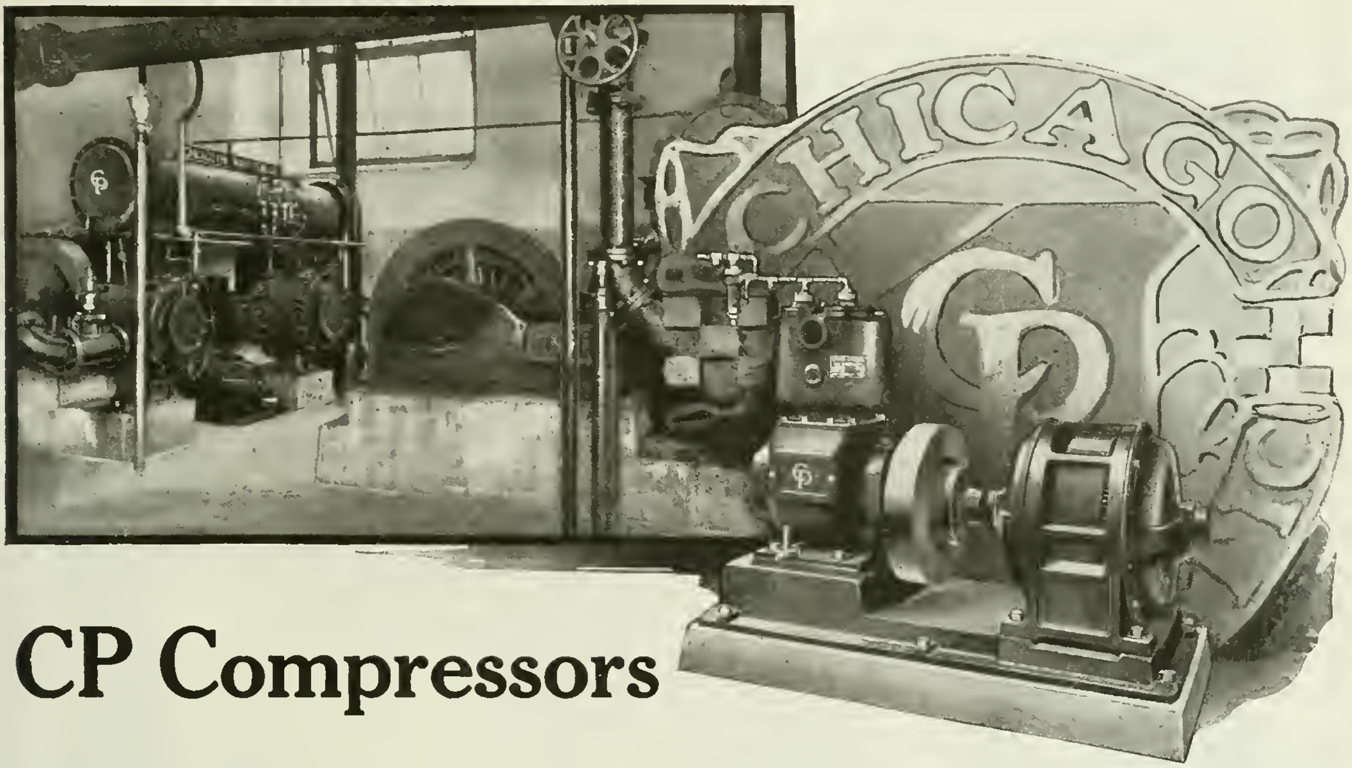
You can now generate worm threads anywhere from three to five times as rapidly as was ever possible before, and at the same time, get more accurate work.

A companion machine to the High-speed Gear Shaper, and another solution to the reduction of Labor Costs. If you cut threaded work in quantities, you will want one of these Thread Generators. Yes! We have a booklet that describes it completely. Do you want a copy?

The Fellows Gear Shaper Company

Springfield, Vermont, U. S. A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England; Societe Anonyme Alfred Herbert, Paris, France; Societa Anonima Italiana Alfred Herbert, Milan, Italy; Alfred Herbert, Ltd., Yokohama, Japan; Societe Anonyme Belge Alfred Herbert, Brussels, Belgium; Alfred Herbert (India), Ltd., Head Office, Calcutta, India; Bohm & Bormann, Berlin, Germany. PACIFIC COAST REPRESENTATIVES: Eccles & Smith Company, Portland, Oregon; Seattle, Washington; San Francisco and Los Angeles, California.



CP Compressors

CP DIRECT CONNECTED, motor driven air compressors of the types illustrated are used by the United Electric Light and Power Company in their Hell Gate station and in sub-station service.

Public Service equipment must be reliable. Where CP Air Compressors are installed, apologies for their performance are unnecessary, as attested by thousands of satisfied users.

The valves are the heart of an air compressor. CP Air Compressors are equipped with Simplate (meaning simple plate) Valves which is the original flat disc valve. Their straight lift without bending or twisting affords maximum valve area resulting in high volumetric efficiency and low power consumption per unit of air actually delivered. Simplates reduce valve maintenance costs to a minimum.

Men who know have placed their approval on CP Air Compressors as being mechanically correct. Wherever installed you will find them maintaining their reputation for satisfactory performance.

Made in over 500 sizes and types for every compressed air need. What is yours? Bulletins upon request.

After all what users say counts most!

After nine years service one user says: "Regarding the performance of our CP Air Compressor purchased in 1913, we are much pleased with same. It has been in almost continuous operation since purchased and is still in first class condition."

Chicago Pneumatic Tool Company

6 East 44th Street, NEW YORK, N. Y.

*Sales and *Service Branches all over the World*

*Birmingham
*Boston
*Chicago
*Cincinnati
Cleveland
Denver
*Detroit
El Paso
Houston
*Los Angeles
*Minneapolis
New Orleans
*New York
*Philadelphia
*Pittsburgh
Richmond
Salt Lake City
*San Francisco
Seattle
*St. Louis
Tulsa
Basle
Berlin
Bombay
Brussels
*Buenos Aires
Christiania
Dairen
Havana
Helsingfors
Honolulu
Johannesburg
London
Manila
Milan
*Montevideo
Montreal
Osaka
Paris
*Rio de Janeiro
Rotterdam
Santiago
*Sao Paulo
Seoul
Shanghai
Tampico
Tokyo
*Toronto
*Vancouver
*Winnipeg

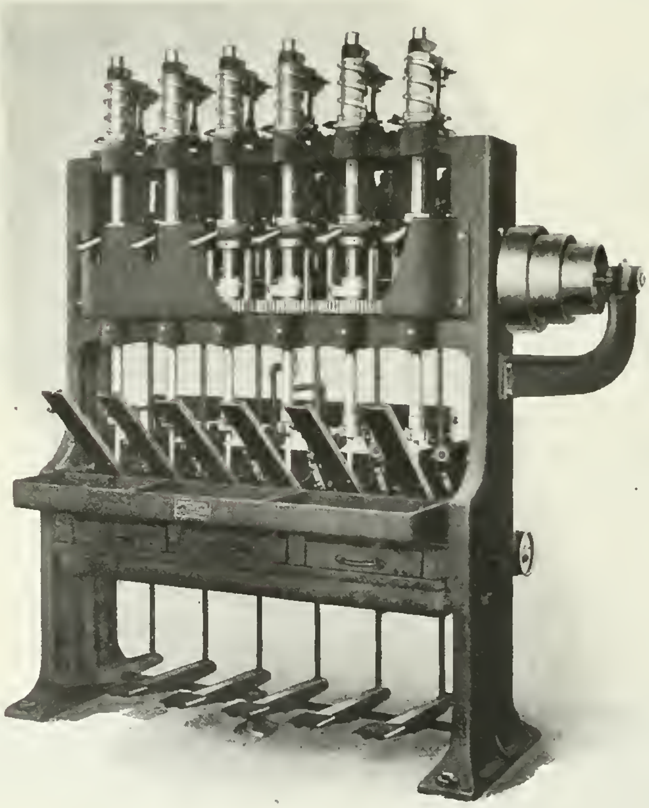
Canadian Pneumatic Tool Company, Montreal, manufacturers of Chicago Pneumatic products in Canada.

C-137

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES · · ROCK DRILLS · · COAL DRILLS

CHICAGO PNEUMATIC

The Compressor with the Simplate Valve



Acme Nut Tapping Machines

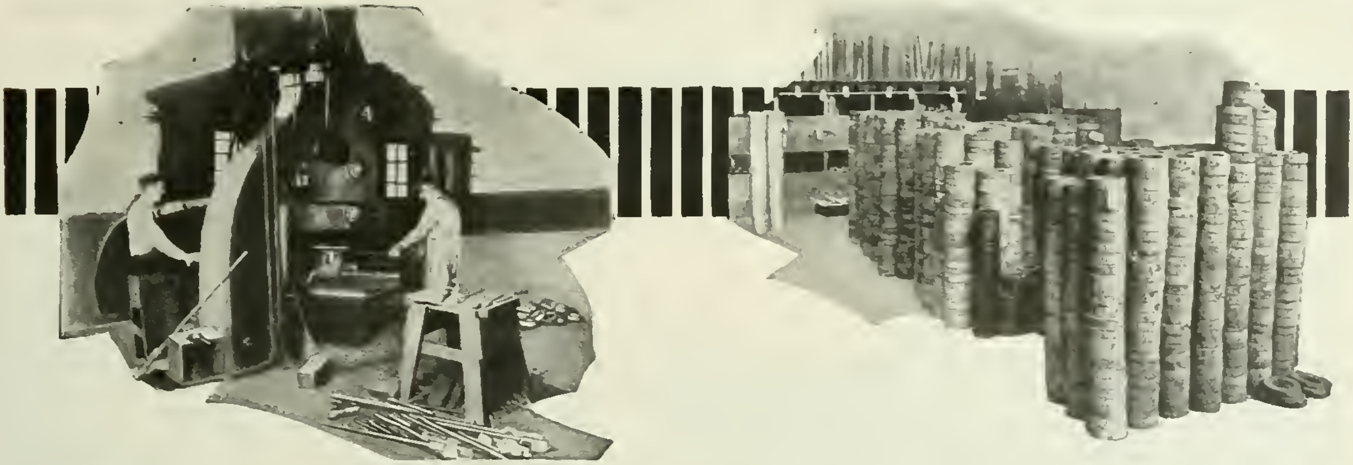
Above is shown a battery of three Acme Six-spindle, Semi-Automatic Machines tapping ⅝"-11-pitch and ¾"-10-pitch U. S. standard nuts—an average production of 12,000 being obtained per machine each 9-hour day.

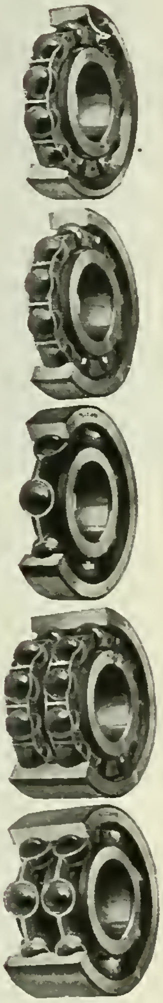
Acme Six-spindle, Semi-Automatic Nut Tappers are easily operated and speedy. Each spindle has automatic lifting device which permits automatic feed to place nut under cap.

Write for details

THE ACME MACHINERY COMPANY
CLEVELAND OHIO, U. S. A.

Foreign Agents: Burton, Griffiths & Co., Ltd., London. Glaenzer & Perreaud, Paris, France





Factors in Strom BALL BEARINGS Supremacy

No. 4—The Forge Shop

STROM ball-bearing-steel is hand forged—in our own forge shop—by a kneading process on steam hammers.

From the shearing of the slug to the finished forging blank absolute uniformity of weight and structure is efficiently achieved by the most modern forge shop equipment and practice. Fitting these exclusive devices and methods with certainty to our standard methods of heat treatment assures a finished STROM bearing of unified, wear-resisting quality.

Thus the STROM forge plant is another reason why STROM guaranteed ball bearings, for new or replacement work, leave wide open the gateway for Power—

"Wherever a Shaft Turns"

(1978)

Strom
BALL BEARINGS
U. S. Ball Bearing Mfg. Co.
4563 Palmer St., Chicago, Ill.

An Organization Built for Precision

Scientific in Principle and Practice

MULTI-DRILLERS NATCO **MULTI-TAPPERS**

THE HOLE STORY IN ONE WORD

Moline Plow Company
Poole Engineering Company
Brown-Lipe-Chapin Company

Find NATCOS give maximum production on gear work

The advantages of a patented two speeds in the head arrangement, for drilling and tapping several holes simultaneously, have converted many manufacturers to NATCOS. The above firms find NATCOS profitable on gear work.

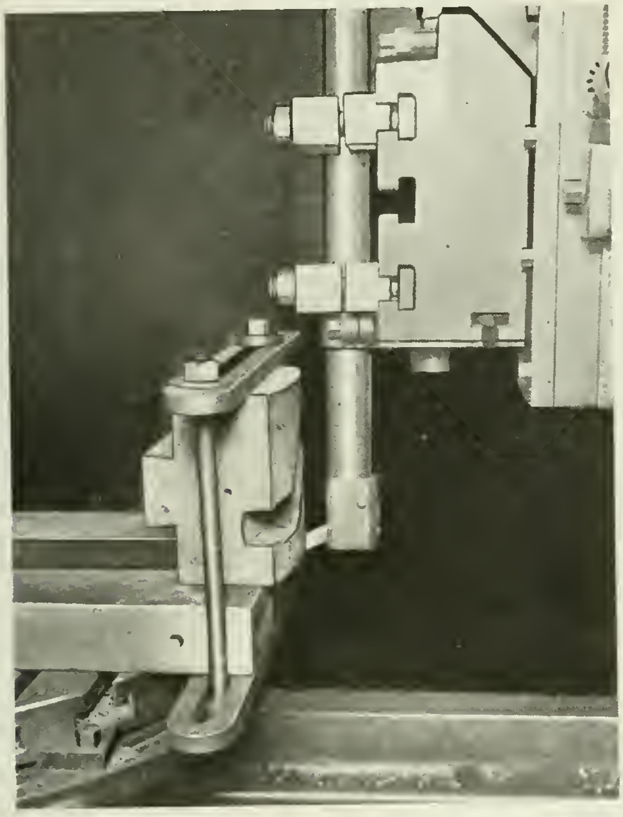
We will be pleased to show you how NATCO Multi-Drillers and Multi-Tappers can "gang the holes" on your work to your advantage. It costs nothing to find out. Send blueprints.

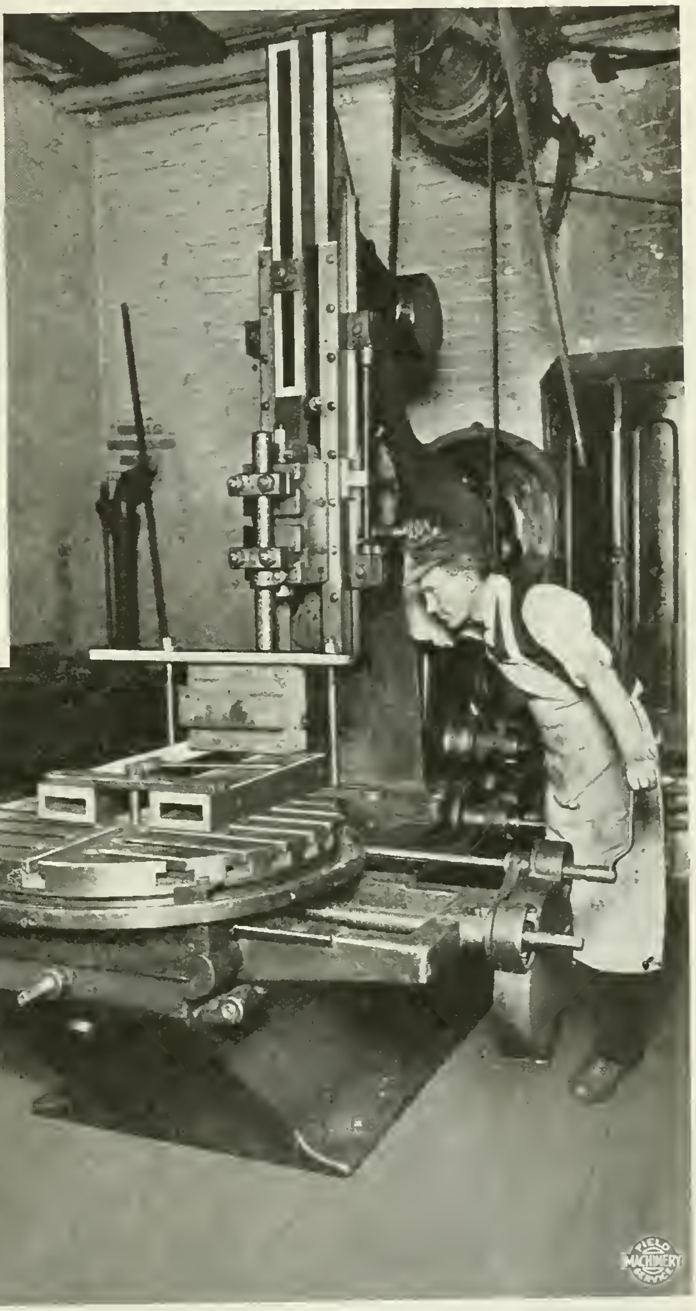
The National Automatic Tool Co.
RICHMOND, INDIANA

Largest Exclusive Manufacturers of Multi-Drillers and Multi-Tappers

"The Dill Slotter is Quicker"—

So They Use It for This Job





The Dill Slotter in the tool-room of a big industrial plant has a reputation as a time saver that brings it many unusual jobs. Take for instance, this drop hammer die: The operation now in progress (machining the working face to a 22″ radius) while a typical slotter job was preceded by the roughing and finishing of the dovetailed shank, which is 3¼″ wide by 1½″ deep, with sides cut on an angle of 5 degress. This is a legitimate shaper job, but as the foreman said, "the Dill Slotter is quicker" and speed is important when you count production costs.

Dill Slotter accuracy, speed and convenience enable it to handle a wide variety of work with unusual efficiency; make it a profitable installation in all kinds of shops. Interesting construction details and operation details in the Dill Slotter Booklet—yours for the asking.

T. C. DILL MACHINE CO., Inc.

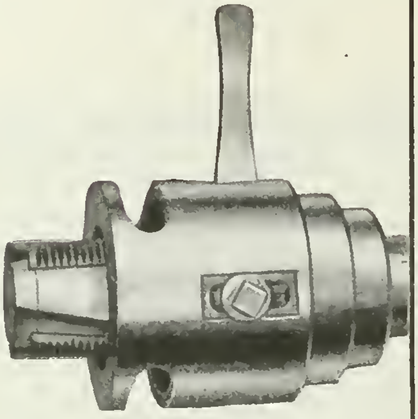
THE DILL SLOTTER PEOPLE

Philadelphia, Pa.

DOMESTIC AGENTS: Henry Prentiss & Co., New York City, Buffalo, Rochester, Syracuse, N. Y.; Boston, Mass.; Hartford, Conn. Motch & Merryweather Machinery Co., Cleveland, Detroit and Cincinnati. Marshall & Huschart Machinery Co., Chicago and Indianapolis. Brown & Zortman Machinery Co., Pittsburgh, Pa. W. E. Shipley Machinery Co., Philadelphia, Pa. Elliott & Stephens Machinery Co., St. Louis, Mo.

FOREIGN AGENTS. Alfred Herbert, Ltd., British Isles. Alfred Herbert, Ltd., Yokohama, Japan. Societe Anonyme Belge, Alfred Herbert, Brussels, Belgium. Societe Anonyme Alfred Herbert, Ltd., Paris, France. Societa Anonima Italiana, Alfred Herbert, Ltd., Milan, Italy.

Victor Collapsible Taps



If the threads you cut cause trouble, either in the cutting or in use, consult with us. No obligation. Ask for Catalog No. 10.

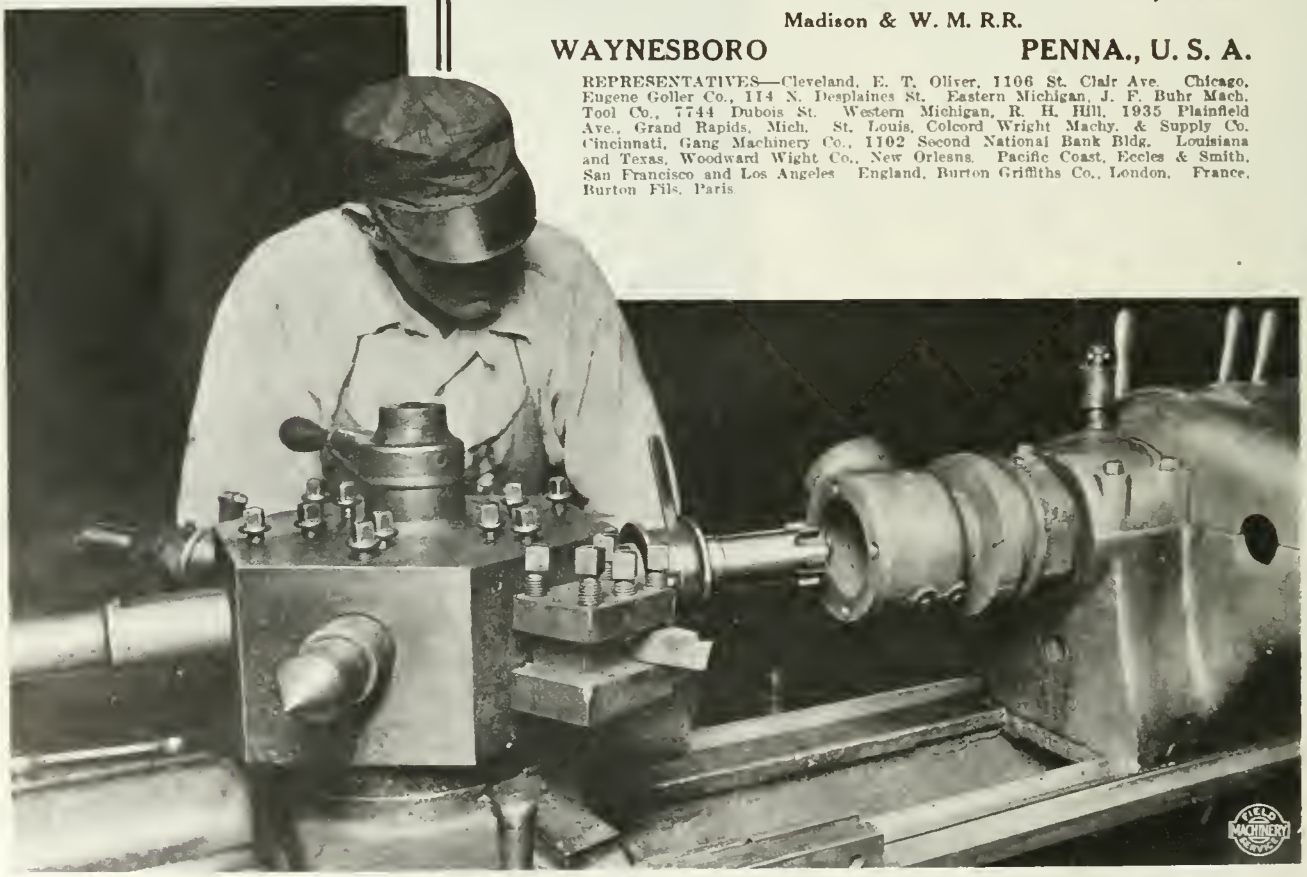
"Good Results"—Good Reason Why

For more than five years Victor Collapsible Taps have been used for tapping brass, iron and steel in the plant of the Ashcroft Manufacturing Company, Bridgeport. At the present time there are about a dozen of these taps in use, ranging from 1⅛" to 3½" pipe size.

The work consists of valve bodies, which are made in large quantities. A typical job is shown—a valve body made from a mixture of iron and steel, mounted on a turret lathe for a series of operations such as facing, boring and tapping. Threads are checked up by gages and are O. K'd by the inspector. Results are excellent—satisfactory in every way. Costs are "right."

VICTOR TOOL COMPANY, Inc.
Madison & W. M. R.R.
WAYNESBORO PENNA., U. S. A.

REPRESENTATIVES—Cleveland, E. T. Oliver, 1106 St. Clair Ave. Chicago, Eugene Goller Co., 114 N. Desplaines St. Eastern Michigan, J. F. Buhr Mach. Tool Co., 7744 Dubois St. Western Michigan, R. H. Hill, 1935 Plainfield Ave., Grand Rapids, Mich. St. Louis, Colcord Wright Machy. & Supply Co. Cincinnati, Gang Machinery Co., 1102 Second National Bank Bldg. Louisiana and Texas, Woodward Wight Co., New Orleans. Pacific Coast, Eccles & Smith, San Francisco and Los Angeles. England, Burton Griffiths Co., London. France, Burton Fils, Paris.



"NATIONAL FIRST"

Accuracy by Comparison

When our ancestors first fashioned their tools and implements from stones the standard of accuracy probably ended with the quarter inch.

From that time up to the present day accuracy has been gradually developed, thru comparison with existing standards, until we now are wont to measure tools not only in thousandths but in ten-thousandths of an inch.

To keep a step ahead of existing demands, and to be the pacemakers in this process of evolution of accuracy, that is the avowed aim of the National Twist Drill & Tool Company.

Whether it be a Twist Drill, Reamer, Milling Cutter or any of the Various Special Tools manufactured by us, we confidently invite your comparison of accuracy with other tools you are buying.

"NATIONAL FIRST"

MANUFACTURERS
of **PARABOLIC**
MILLING CUTTERS

TWIST DRILLS · REAMERS · MILLING CUTTERS · SPECIAL TOOLS

NATIONAL TWIST DRILL & TOOL COMPANY

DETROIT, U·S·A

BRANCHES

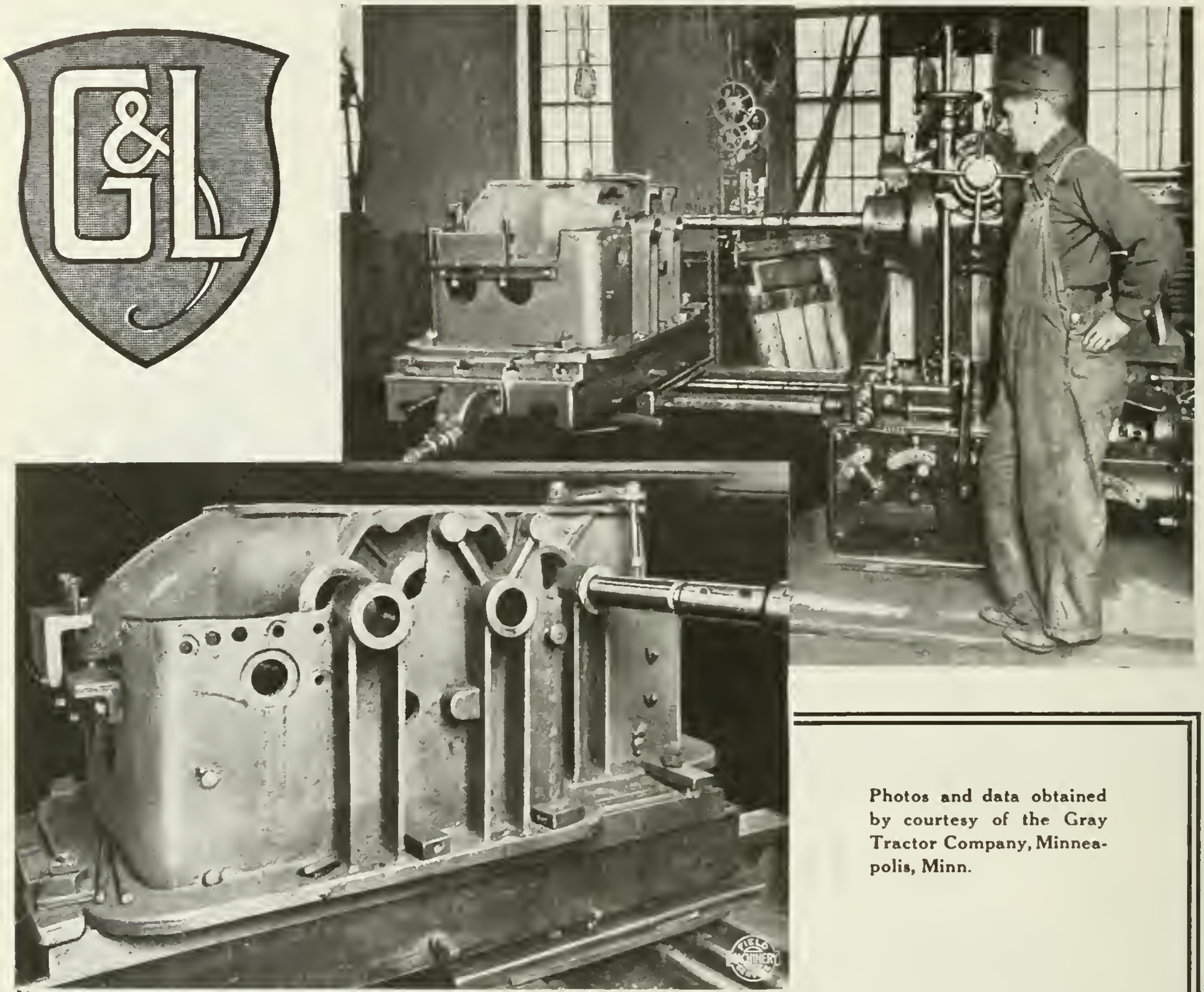
NEW YORK, N. Y.
73 Warren Street

PHILADELPHIA, PA
43 North Sixth Street

CHICAGO, ILL.
565 Washington Blvd

SYRACUSE, N. Y.
107 Gifford Street

BUFFALO, N. Y.
76 Pearl Street



Photos and data obtained by courtesy of the Gray Tractor Company, Minneapolis, Minn.

Boring Transmission Cases for Gray Tractors

Operations performed by the G & L Horizontal Boring Machine shown on cases for Model B 18-36 Tractors include:

1st, bore 4.750 diameter through two bosses, 6½″ diameter, 1 3/64″ thick, 3 5/16″ apart—facing both inside and out. Holes are cored to within ⅜″ of finish size and 3/16″ to ¼″ of stock is removed from the faces.

2nd, bore 3.375″ diameter through two bosses, 4⅞″ diameter, 2 31/64″ thick, 7 11/16″ apart, cored to 2⅞″, and face both sides of each.

3rd, bore 3.375″ through boss 4⅞″ diameter, 2 31/64″ thick, cored to 2⅞″; and 3.625″ through an opposite boss 5″ diameter, 1 15/16″ thick, cored to 3⅛″ diameter and face both sides of each.

4th, drill hole ¾″ diameter and counterbore 15/16″ to a depth of ⅝″.

Output on these cases, including all handling and machining, is 4 per 10 hour day. Accuracy and convenience are outstanding features of G & L machines. Let us tell you more about them.

GIDDINGS & LEWIS MACHINE TOOL COMPANY

FOND DU LAC *Designers and Builders of Special Boring Fixtures* **WISCONSIN**

Henry Prentiss & Company, Rochester, New York City, Syracuse, Boston, Buffalo, Hartford Motch & Merryweather Machinery Company, Pittsburgh, Cleveland, Detroit, Erie. E. A Kinsey Company, Cincinnati, Columbus, Indianapolis, Hamilton. Marshall & Huschart Machy. Company, Chicago, Milwaukee. Harron, Rickard & McCone, Los Angeles, San Francisco. Hallidie Machinery Co., Seattle. Southern Machinery Sales Company, Houston. Northern Machinery Co, Minneapolis. Smith-Courtney Co., Richmond. Salt Lake Hardware Co., Salt Lake City. Seeger Machine Tool Co., Atlanta. C. T. Patterson Company, New Orleans. Zimmerman-Wells-Brown Co, Portland. Swind Machinery Co., Philadelphia.

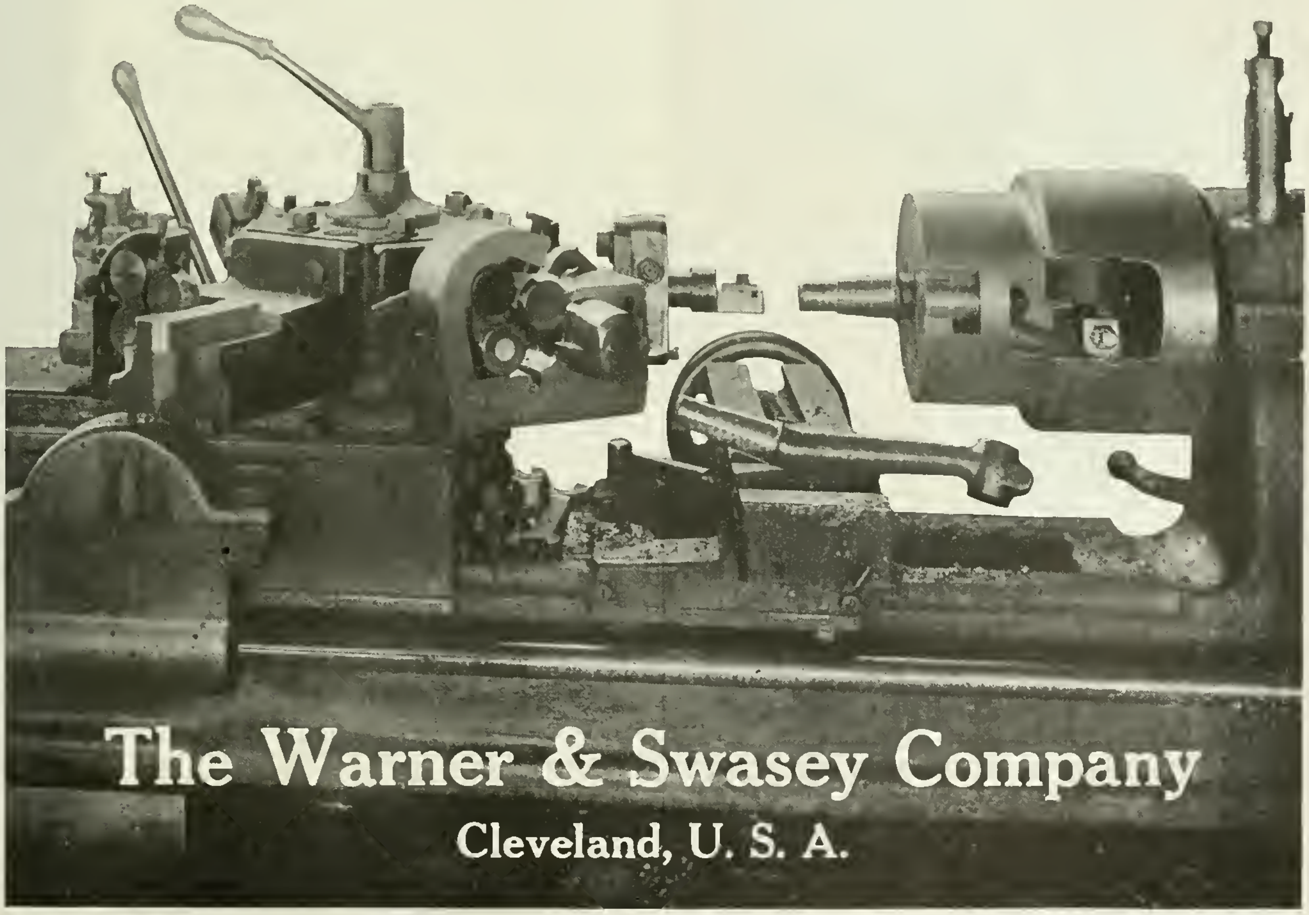
A Prominent Equipment Engineer

A prominent equipment engineer bought W & S Turret Lathes and Tools and paid more for them than was asked for competitive equipment he had investigated.

The Warner & Swasey Engineer, knowing of this investigation, asked if he would explain why his decision had been for W & S equipment.

And this is what he said:

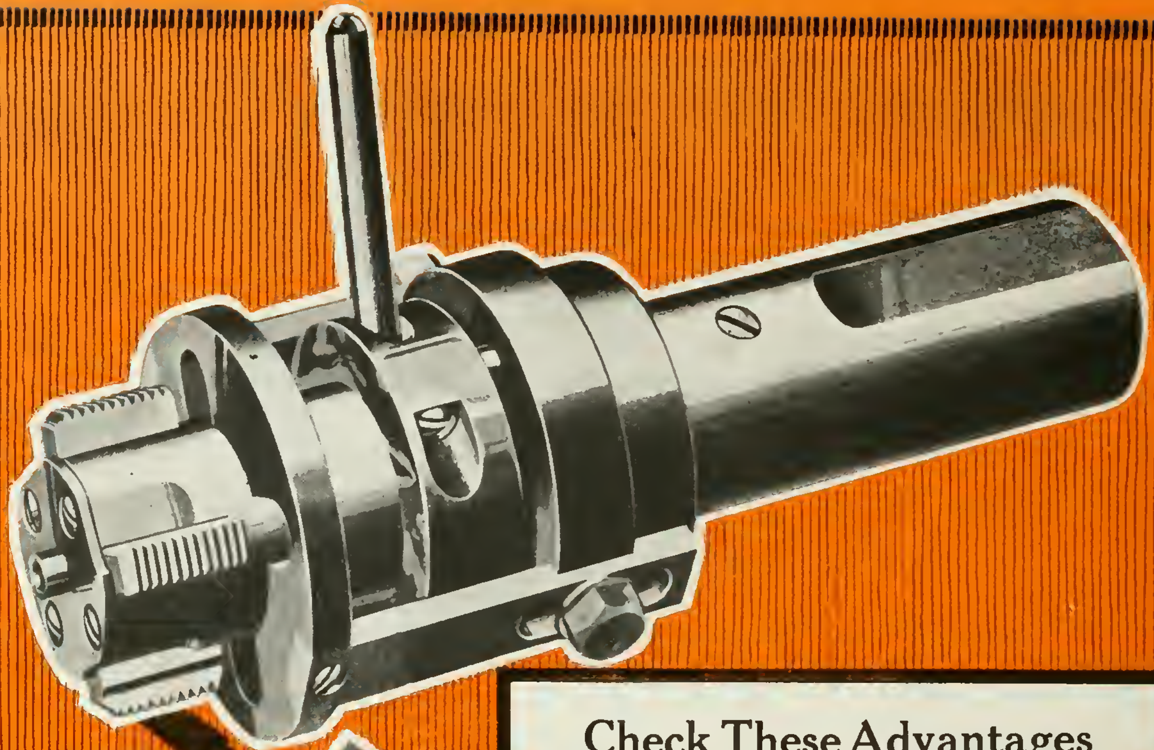
"I have bought a good many turret lathes in my time, of several different makes, but when I buy W & S, I know it will come well tooled, begin producing immediately and keep right on producing, and I can forget it. I am willing to pay quite a premium for whatever it is in your machine that gives me that kind of assurance."



The Warner & Swasey Company

Cleveland, U. S. A.

NEW YORK: Singer Building
CHICAGO: 618-622 Washington Boulevard
MILWAUKEE: 1143 Wells Building
BOSTON: Oliver Building
BUFFALO: Iroquois Building
DETROIT: 5928 Second Boulevard
DAYTON: 518 Mutual Home Building



Check These Advantages Against Your Experience

NAMCO positive Collapsing Taps have

—Chasers with rigid support—they bear full length on tool steel core—do not tilt, wabble or wear in slots.

—Collapsing action as simple as throwing a gear out of mesh, and just as positive.

—One piece core and shank, only three internal parts—rigid, compact and fewer parts than you will find in any other automatic tap.

Aren't these some of the factors that your experience says would help reduce your tapping costs?

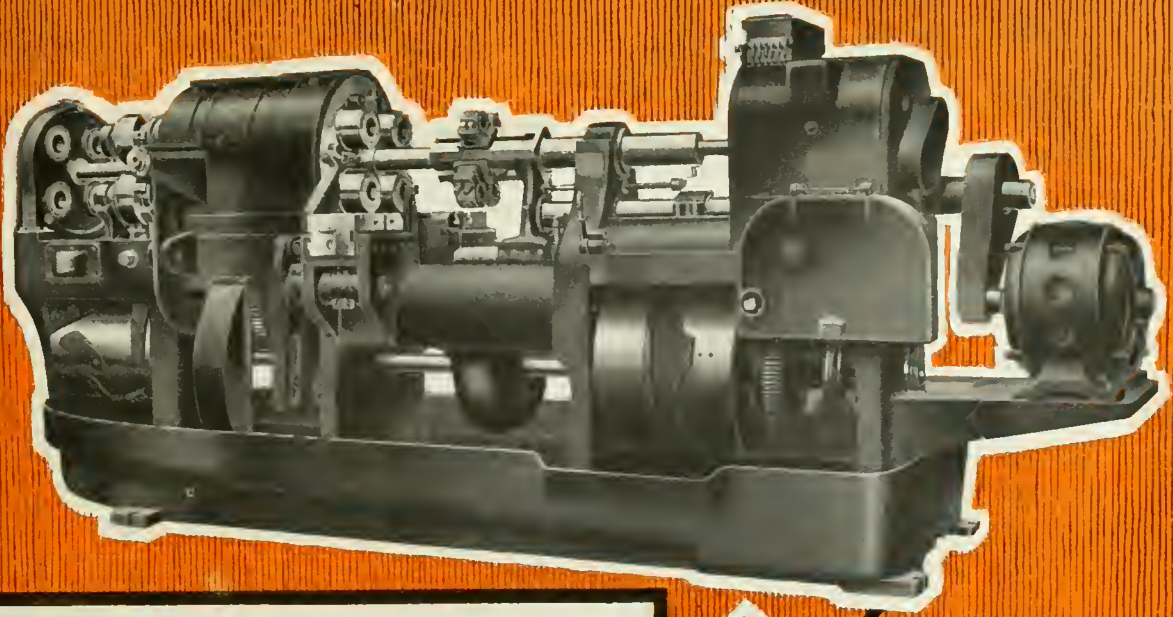
A full line of standard Outside Trip Taps for prompt delivery from stock. Capacities 1" and up. Also prompt service on special pilot or shank equipment for your special work.

Our T-D Catalog explains the details. Ask for it.

The National Acme Co.

Cleveland, Ohio

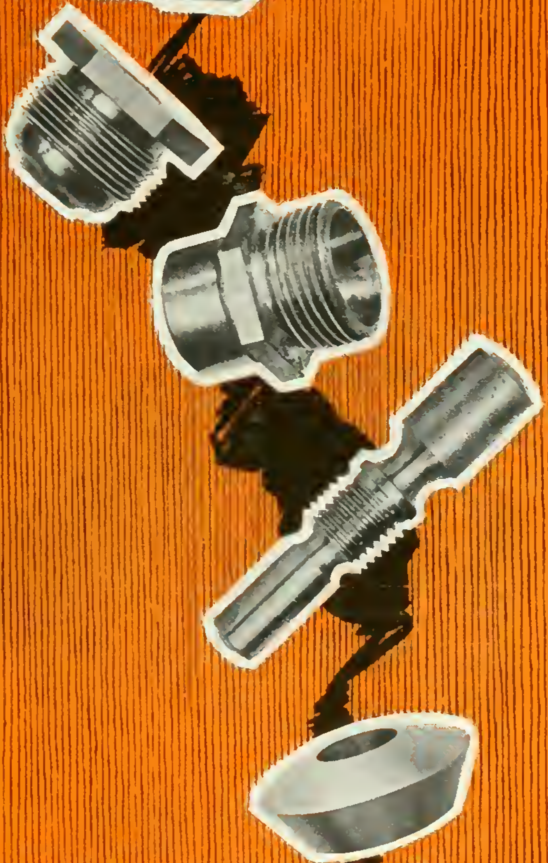
NEW YORK
CHICAGO
DETROIT
BUFFALO
BOSTON



Acme 4 Spindle Model "B" A Good Automatic Made Better

A good product, no matter how good, must be constantly improved, or it becomes a back number. Machines which met requirements for speed, finish and cost a few years ago, have kept in the foreground of today's rigid requirements only by constant engineering vigilance for faster speed, strain-resisting construction, simplicity, yet broader tooling adaptability for each machine tool investment.

Such is the development of the 2", 3" and 4" Model "B" Acme Automatics. Every detail of materials, design, operating convenience and tool design represents the vigilance of our engineers, backed up by our policy to make a good machine better. Today we believe that Acme Automatics are truly the "Acme" of screw machine efficiency in terms of greater output per hour and lower cost per piece.



The National Acme Co.

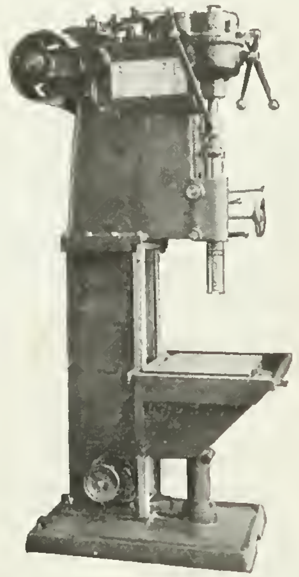
Cleveland, Ohio

NEW YORK
CHICAGO
DETROIT
BUFFALO
BOSTON

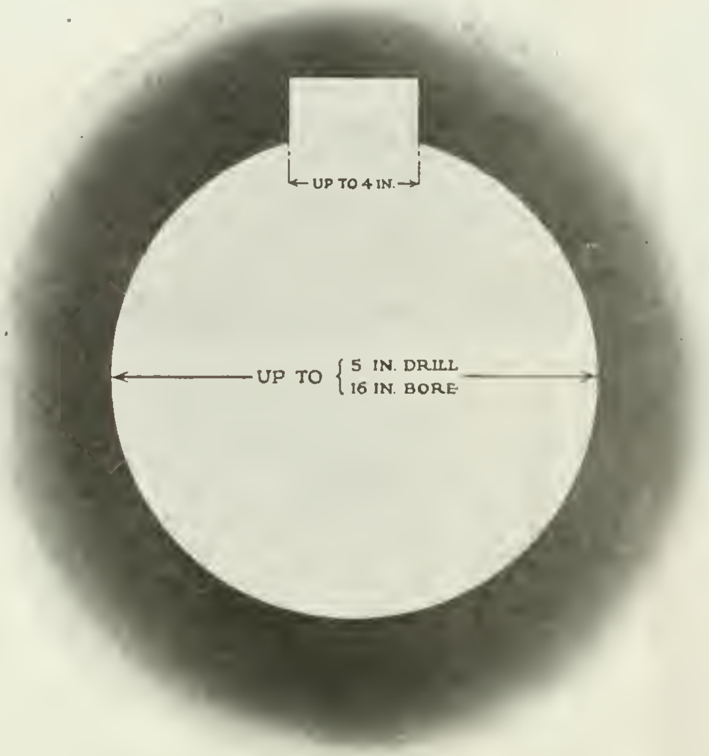
Continued Satisfaction and Economy with

BAKER EQUIPMENT

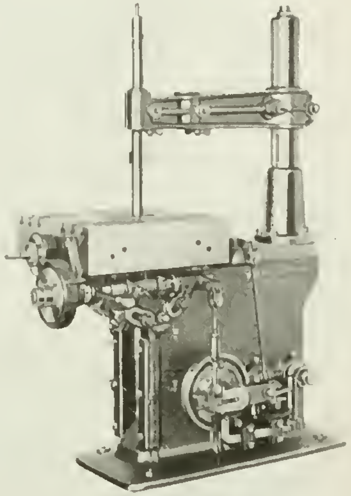
for DRILLING, BORING and KEYSEATING Operations



Baker Drills are simple, efficient, easy to operate, and require small floor space. Built in single purpose or quick change types.



Baker Keyseaters are made in five sizes. They are rugged, and insure accuracy with heavy cuts, because of their general construction and upper support for the cutter bar.

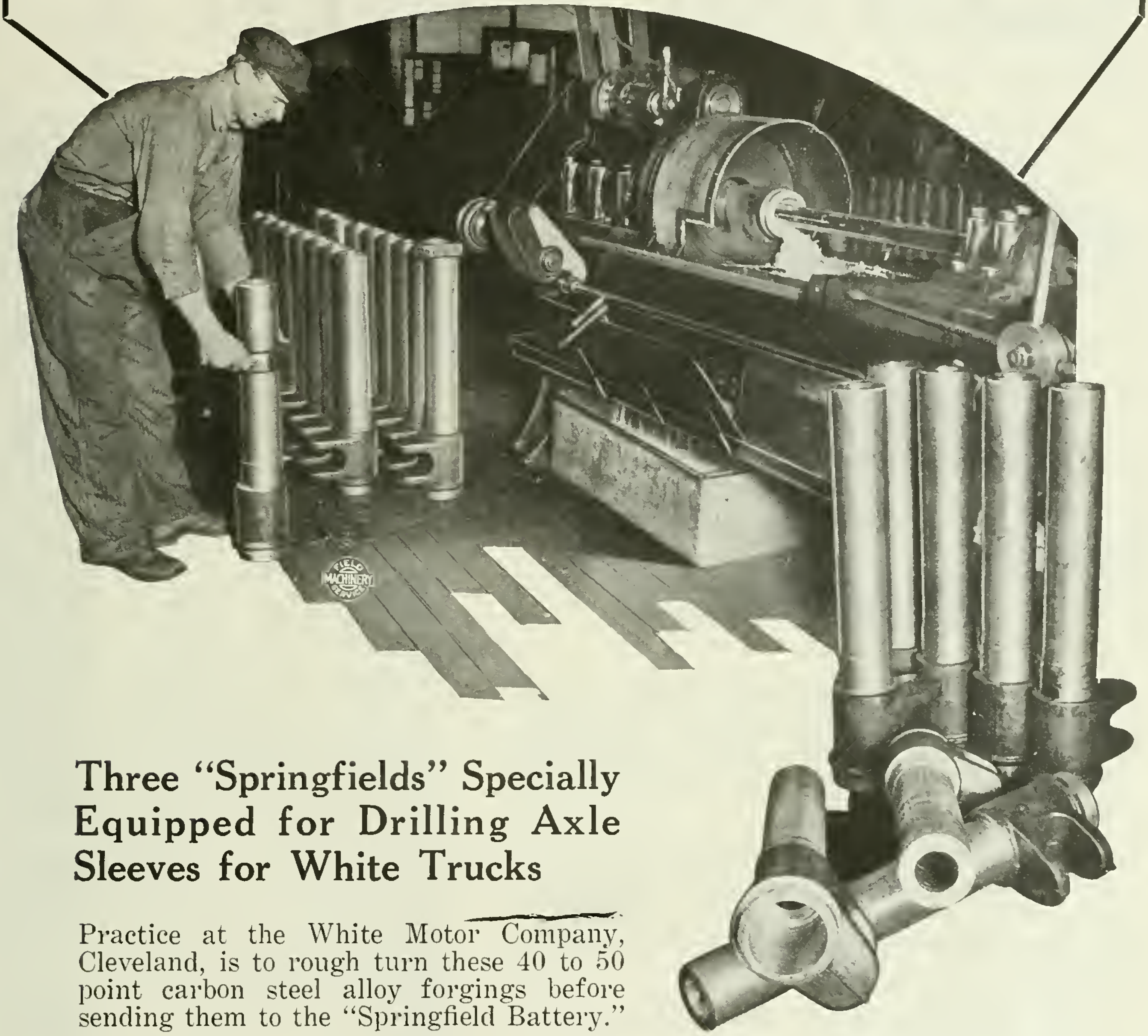


Pioneers in the development of Drilling, Boring and Keyseating Equipment, Baker Brothers have fostered this development to the point where they now offer a comprehensive line of machines which covers a very wide field.

Write for complete information.

BAKER BROTHERS, Toledo, Ohio, U.S.A.

SPRINGFIELD



Three "Springfields" Specially Equipped for Drilling Axle Sleeves for White Trucks

Practice at the White Motor Company, Cleveland, is to rough turn these 40 to 50 point carbon steel alloy forgings before sending them to the "Springfield Battery."

Here they are chucked with the heavy end projecting and machined as follows: 1st, drill hole 4¼″ diameter, 7″ deep—work revolving 72 R.P.M. and tool feeding ½″ per minute; 2nd, square up bottom of hole, leaving only the imprint of the drill point to guide the long drill 2½″ diameter, which is next inserted and 3rd, eats its way through the remaining 24″ of solid steel with a feed of 11/16″ per minute, while the work revolves at 96 R.P.M.

Springfield Lathes and Attachments are all interchangeable and can be assembled in whatever combination is best adapted to the operation to be performed. Catalog describes the whole line.

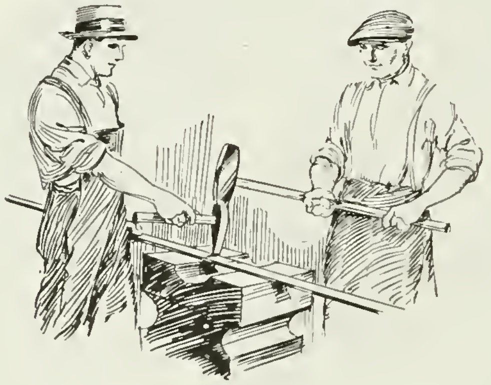
THE SPRINGFIELD MACHINE TOOL COMPANY

Manufacturers of Springfield Lathes and Shapers

631 Southern Ave. **SPRINGFIELD, OHIO**

AGENTS: Manning, Maxwell & Moore, Inc., New York, Boston, Philadelphia, Buffalo, Syracuse, New Haven, Pittsburgh, St. Louis, San Francisco, Seattle, Cincinnati. The E. L. Essley Machinery Co., Chicago, Ill. The Riverside Machinery Depot, Detroit, Mich. The Cleveland Duplex Machinery Co., Cleveland, O.

COLONIAL TOOL STEELS



Keeping It Clean

IN the Inspecting Department in the Colonial Mill it is the business, the sole business, of every man to prevent broken tools in your shop. They are the men behind the mill behind your Tool Steels.

Each bar of Colonial Tool Steel has cut from the end a piece long enough to readily reveal any interior flaws. Surface defects, such as slivers, or seams, are of course removed by filing or grinding machines.

This inspection is so rigid, that of the many tons shipped over a long period of years, **less than ½ per cent** has met with objection from **any** cause.

This same clean record of Tool Steel performance is what you may expect regularly in your shop when you standardize on the Colonial brands.

LIST OF TOOLS
and Grades of Colonial Steel
adapted for their use

Name of Tool	Grades of Steel
Arbors	Red Star
Augers, Wood & Bits	Red Star
Axe	Red Star
Ball Bearings	Superior
Bits, Channeling Machine	Red Star
Bits, Coal Mining	Anchor
Bits, Tong	Red Star
Bits, Well Stone Drilling	Standard Well Bit
Bush Hammer, Stone Tools	Red Star Sheets
Bunter, Heading	Red Star
Broaches, Machine	No. 7, High Speed
Bushings	Red Star
Center Punches	Red Star
Center, Lathe (see L)	Red Star
Chasers, Threading	H. S., No. 7, No. 14
Chain, Pipe, Links	Vanadium, Type A
Chisels, Pneumatic	No. 7
Chisels, Hand	Red Star
Chisels, Stone Cutters	Red Star
Chisels, Wood Working	Red Star
Cupping Tools	Red Star
Caulking Tools	Red Star
Claw Bars	Red Star
Creasers, Hot	H. S., No. 7 E
Counterbores	H. S., No. 14
Counterbores, Solid, Interchangeable	H. S., No. 7, No. 14
Collets, Bit Brace	Red Star
Collets, Spring	Red Star
Cutters, Fine Finishing	No. 5
Cutter, Pipe	H. S., No. 14
Cutters, Flue	No. 7, High Speed
Cutters, Flue Hole	No. 7
Cutters, Nail	High Speed
Cutters, Corn Stalk	Alto Sheets
Cutters, File	High Speed
Cutters, Milling, Plain	High Speed
Cutters, Form	High Speed
Cutters, Inserted Blade	High Speed
Cutters, Profile	High Speed
Cutters, Metal Slitting	High Speed
Cutters, Screw Slotting	No. 5
Cutters, Wood Forming	High Speed, No. 5
Cutting off Tools	High Speed
Dies, Bolt Threading	H. S., No. 7, No. 14
Dies, Blanking	H. S., No. 7, No. 14
Dies, Forming & Bending	No. 7, No. 14
Dies, Sub-Press	No. 7, No. 14
Dies, Drawing	H. S., No. 7, No. 14
Dies, Cartridge Shell	High Speed, No. 7
Dies, Hammer Dies, Power	Red Star
Flat Jack Jewelers' Dies	High Speed No. 7
Dies, Drop Forging	Red Star, Alto
Dies, Nail	High Speed
Dies, for Paper	H. S., No. 14
Dies, Pipe Threading	H. S., No. 7, No. 14
Dies, Solid & Adjustable Threading	H. S., No. 7, No. 14
Dies, Glove	No. 7, No. 14
Dies, Rivet	No. 7, Red Star
Dies, Shoe Knife	Red Star
Dies, Spring Screw, Threading	H. S., No. 7, No. 14
Dies, Solid Bolt	No. 7, No. 14
Dies, Adjustable, Round	
Dies, Split Threading	H. S., No. 7, No. 14
Dies, Spoon, Silver	No. 14
Dies, Silversmith	No. 7
Dies, Domino Screw Cold Heading	No. 7, Red Star
Dies, Cold Heading	No. 7, Red Star
Dies, Hot Heading	H. S. or No. 35
Dies, Wire Drawing	No. 14
Dies, Plates	No. 7, No. 14
Digging Bars	Red Star
Drills for Boring	Red Star
Drills, Tool Steel	H. S., Superior
Drills for Stone	Red Star
Drills, Twist	High Speed
Drills, Flat	High Speed
Engraver Tools	No. 14
Furnace Bars	Anchor
Flatters, Blacksmiths	Red Star
Fullers, Blacksmiths	Red Star
Forming Tools for Metals	H. S., No. 5, No. 14
Flange Tire Forming Tools	High Speed
Gear Cutters	High Speed
Gauges	Oil Hardening No. 6
Grip Dies for Rivets, Hot	No. 35
Hatchets	Red Star
Hammers, Blacksmiths	Red Star
Hammers for Crushing Machines	Red Star
Hammers, Pneumatic	No. 7
Hammers, Nail Machines	No. 7
Hammers, Riveting Pneumatic	No. 7
Hobs, Gear	H. S., No. 7, No. 14
Header Dies, Cold	No. 7, Red Star
Header Dies, Hot	No. 36
Jaw Chuck	Anchor
Jaw Vise	Anchor
Keys for Drop Hammers	Red Star
Knives, Pocket	Red Star Sheets
Knives, Carver	Red Star Sheets
Knives, Butcher	Red Star Sheets
Knives, Cleavers	Red Star Sheets
Knives, Back Spring	Alto Sheets
Knives, Heel Forming Shoe	No. 14
Knives, Shoe Makers	Red Star Sheets
Knives, Shoe Sole	Red Star
Knives, Surgical	No. 14
Knives, Table	Alto Sheets
Knives, Potato	Alto Sheets
Knives, Corn Knife	Alto Sheets
Knives, Drawing	No. 14, Red Star
Knives, Hog	No. 14
Knives, Machete	H. S., Red Star
Knives, Paper	H. S., or No. 14
Knives, Shear	No. 7, Red Star
Knives, Wood Working	H. S., Red Star
Knurling Tools	No. 7, No. 14
Lathe Centers, Dead	Red Star
Lathe Center, Live	Red Star
Lathe Tools for Metal Turning	High Speed
Lathe Tools for Woodworking	High Speed
Liners for Brick Dies	Imperial
Letter Stamps, Hand	No. 7, No. 14
Letter Stamps, Roll	No. 7, No. 14
Mandrels	Red Star
Mills, End	High Speed
Mills, Hollow	High Speed
Mills, Shell End	High Speed
Piercers, Hot	High Speed
Pick Steel	Alto
Pinion Bars	Red Star
Pins, Drift	Red Star
Pinch Bars	Red Star
Planer for Metal Tools	High Speed
Planer for Stone	High Speed
Planer for Wood	Red Star
Point Steel for Stone Cutters	Red Star
Punches, Cartridge Shell	No. 7
Punches, Hand—Hot or Cold Work	H. S., or No. 7
Punches, Drawing	No. 7, No. 14
Plug Gauges	No. 6, Oil Hard'ng
Pneumatic Tools	No. 7E or F
Rings, Tong	Red Star
Rods, Piston	Red Star
Reamers, Hand, Solid	H. S., or No. 5
Reamers, Shell	High Speed
Reamers, Taper	High Speed
Reamers, Rose, Chucking	High Speed
Reamers, Locomotive, Taper	No. 14, H. S.
Reamers, Bridge	High Speed
Reamers, Expansion, Hand	High Speed
Reamers, Drill & Center	No. 5
Rolls, Flue Expanding	No. 7
Ring Gauges	No. 6, Oil Hard'ng
Rivet Sets	No. 7, Red Star
Shear Blades—Hot Work	H. S., No. 7
Shear Blades—Cold Work	No. 7, Red Star
Saws, Circular Metal	H. S., Nikro
Saws, Circular Wood	Nikro
Scrapers for Scraping Machine Parts	No. 5
Scrapers, Tube	Red Star
Screw Drivers	Red Star
Sets—Rivet	No. 7, Red Star
Sets—Button	No. 7, Red Star
Sets—Nail	Red Star
Spinning Tool	High Speed
Shaper Tool	High Speed
Stamping Tools	No. 7, No. 14
Sledges, Blacksmith & Stone	Red Star
Snaps, Rivet	No. 7, Red Star
Springs	Red Star
Swages, Blacksmith	Red Star
Swaging Metal	No. 7
Taps, Tapper	No. 14, Red Star
Taps, Hand	Red Star Tap, Extra No. 14
Taps, Machine	H. S., Red Star
Taps, Automatic Machine Screw	High Speed, No. 5
Taps, Staybolt	No. 14
Taps, Pipe Taps	Red Star
Taps, Pipe Tap Chasers	High Speed, No. 5
Tire Turning	High Speed
Tool Holder Bits	High Speed
Wedge, Stone	Red Star
Wedges	Red Star
Wrenches, Track	Red Star

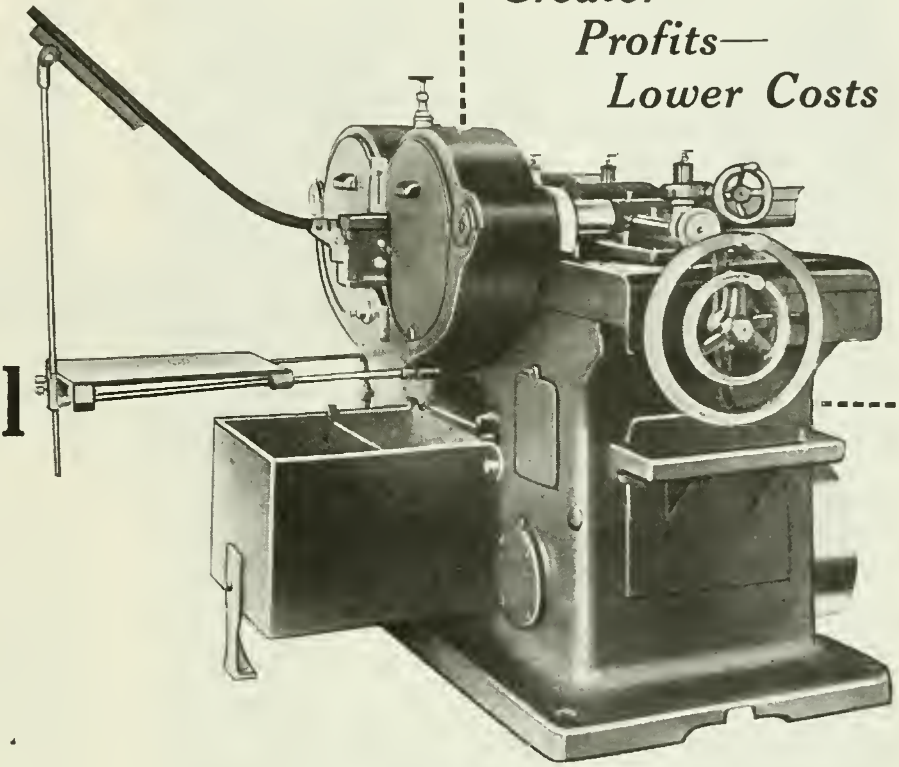
Full instructions for hardening and tempering all Colonial Tool Steels will be found in the *Colonial Heat Treating Book.*
MAILED FREE.

Colonial Steel Company

PITTSBURGH BOSTON NEW HAVEN NEW YORK CLEVELAND
CINCINNATI DETROIT CHICAGO ST. LOUIS

The Heim Centerless Cylindrical Grinder

*Greater Profits—
Lower Costs*



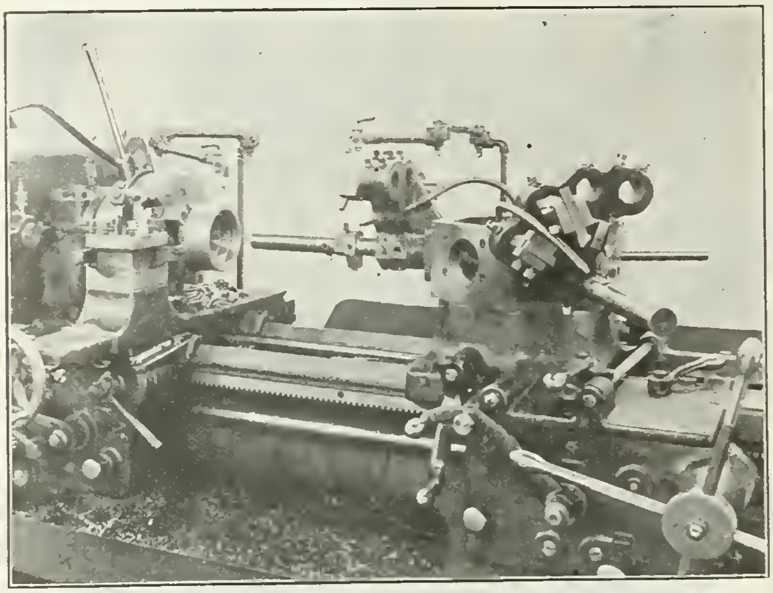
It all depends on your work. If your products are in the class served by this machine the increase in profits will be tremendous. We have records of production increases higher than six times the best figure obtainable by other grinding methods. We have records of successful application on work that is usually considered beyond the range of the centerless grinder.

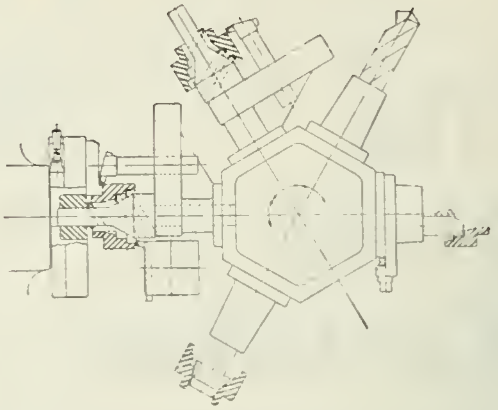
So, if you do straight, taper or shoulder grinding on any class of work we can show you how to greatly increase your profits.

Tell us about your cylindrical grinding problems. Send us samples of work to be ground—we'll give you production and cost estimates that will astonish you.

The Ball & Roller Bearing Company

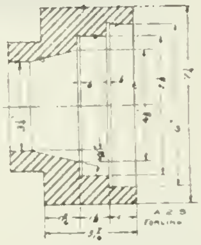
DANBURY, CONN., U. S. A.





Steel gear forgings machined internal and external in 24 minutes on the

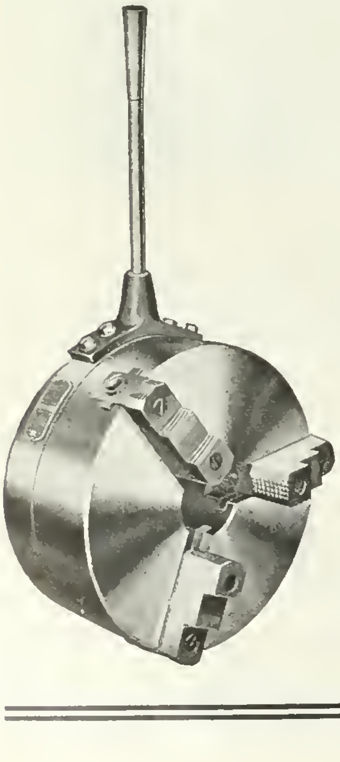
FOSTER 3-B Universal Turret Lathe equipped with an 18" Foster-Barker Chuck



The Machined Forging

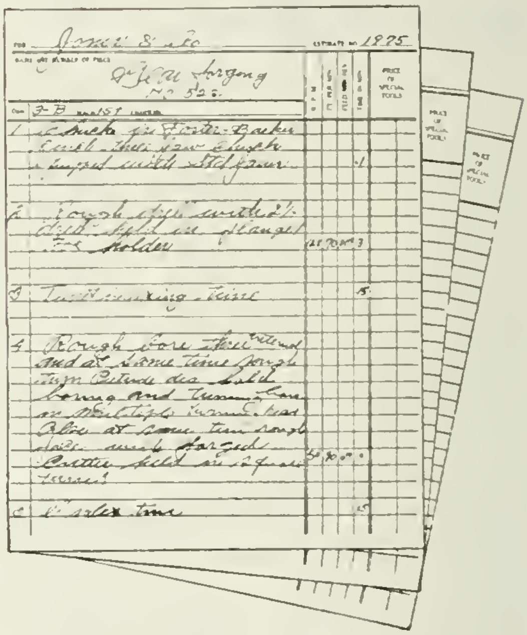
Here's another job on the Foster giving tangible evidence of its power, its rigidity and accuracy.

Taking four heavy hogging cuts and standing up under this continuous heavy duty is an ample demonstration of its stability and quality.



The developments of the machines of the Foster line have kept pace with the developments of modern high speed tool steels and they will meet to the fullest extent all industrial requirements coming within their range.

Our machinery catalog describes all machines of the Foster line; also the Foster-Barker wrenchless chuck.



Foster Production Estimates

FOSTER Methods are

methods of accuracy and speed. Our estimates on your work will give you definite and accurate information covering Foster advantages.

Send us your blueprints.

FOSTER MACHINE CO., Elkhart, Ind.

CHICAGO OFFICE: 549 W. WASHINGTON BLVD.
NEW YORK OFFICE: 30 CHURCH STREET

"SHELBY"

"SHELBY" SEAMLESS STEEL TUBING is regularly furnished in high-grade, uniform steels of suitable alloy for

BALL AND ROLLER BEARINGS

The material case-carbonizes or case-hardens uniformly, is highly accurate in diameter and wall-thickness, and machines readily with little waste stock.

When used in place of solid or forged stock, tubular material permits increased and intensive production in the manufacture of ball and roller bearings and many other products.

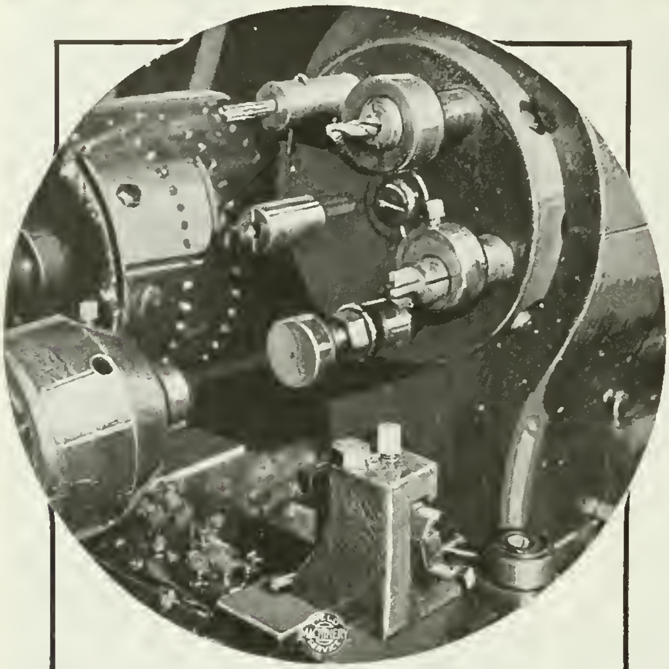
Ask for Bulletin No. 17—
The Mechanical Uses of "SHELBY" SEAMLESS STEEL TUBING

NATIONAL TUBE COMPANY
Frick Building Pittsburgh, Pa.
District Sales Offices in The Larger Cities

MACHINING TUBING FOR BALL BEARING RACES

THE RECOGNIZED STANDARD OF SEAMLESS STEEL TUBING

CLEVELAND AUTOMATICS



A Typical Installation Getting the Usual Profitable Results

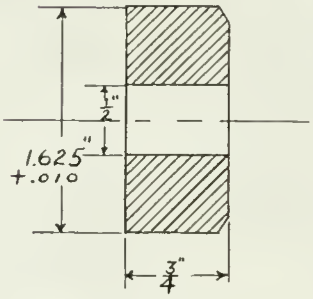
There's nothing unusual about this battery of six Cleveland Automatics at the Standard Motor Construction Company, Jersey City, N. J. Kept busy on all kinds of work in the construction of Standard Marine Engines, they deliver the goods with the usual wide margin of profit that makes them so consistently popular.

The sketch gives the details of a typical series of operations in the manufacture of valve lifter rolls. Four of the five turret holes on this machine are used to produce this part and the operations are as follows: first, feed stock to gauge stop; second, center—the outside diameter and chamfer are formed at the same time by a tool mounted on the front cross slide; third, reamer drill for ½″ hole; fourth, ½″ ream, after which the cutting tool on the rear cross slide cuts off the roll. Production figures—not available—are declared to be "mighty satisfactory."

We'll be glad to quote production on other operations or give you estimates on work that interests you.

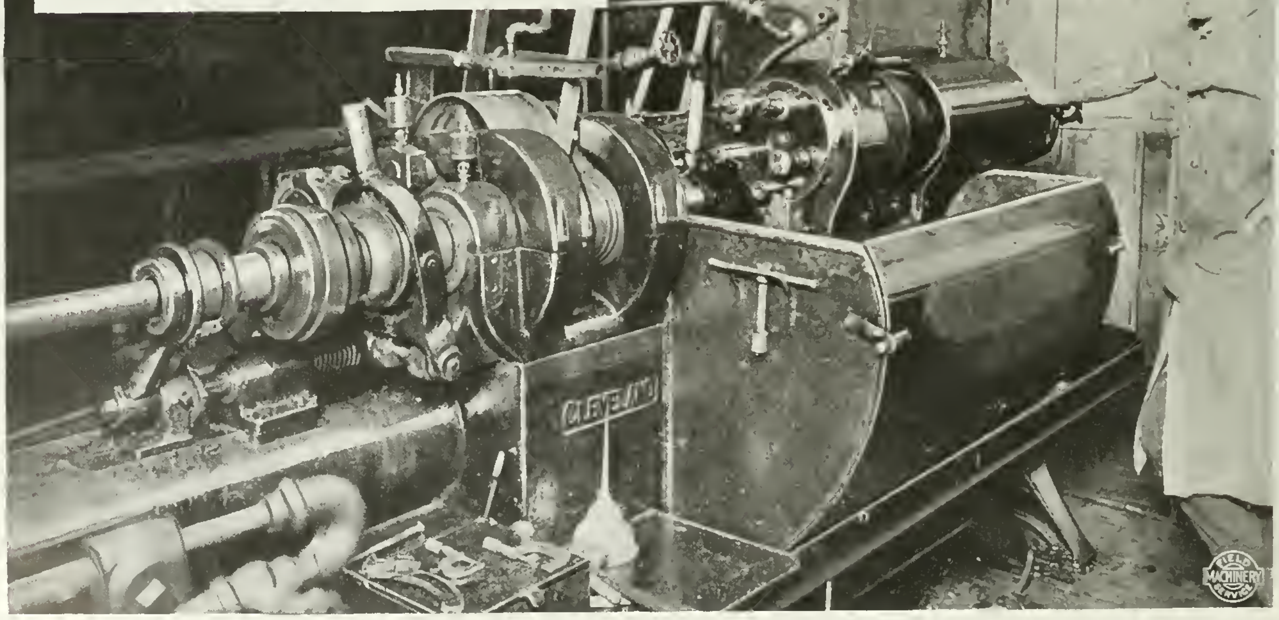
THE CLEVELAND AUTOMATIC MACHINE COMPANY

CLEVELAND OHIO, U. S. A.



$\frac{5}{32}$″ TO 8″ 18″ FEED

CLEVELAND'S CAPACITY UNEQUALED



to clean
RIGHT
ask
JOHN
BRIGHT

JOHN BRIGHT introduces International 84 —the cleaner DE LUXE—at 11¾c. a pound

HERE'S the newest addition to my large family of cleaners. It is the best compound that has ever been perfected—regardless of price—for fine cleaning, especially on highly oxidizable metals, and it can handle a large variety of work. That's why we call it De Luxe.

International 84 is entirely soluble and dry. Works wonders for either still or electric cleaning. It removes buffing composition as well as vegetable, mineral and animal oils. It will not tarnish oxidizable metals nor injure the hands and clothing of workmen.

Three to four ounces of 84 to the gallon of water makes a cracker-jack solution that both emulsifies and saponifies. And say, it's a regular Methuselah when it comes to long life in the cleaning tank.

I want you to meet our new cleaner face to face. Although it is comparatively new, hundreds of tests have proved its merits. I'll stand responsible for its performance and behavior, as usual. Trial lot won't cost you a cent unless it meets your fullest expectations.

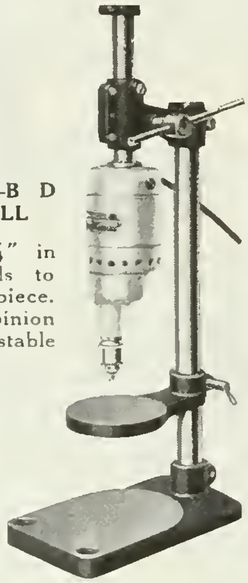
Internationally yours,
John Bright

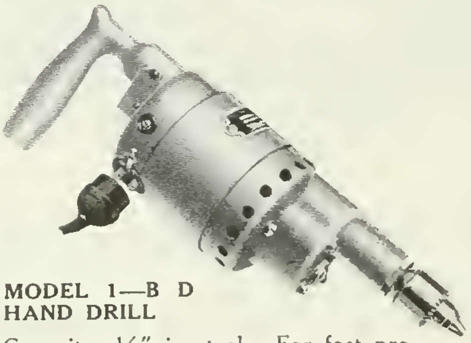
International Products
I.C.C.
International Chemical Co.

INTERNATIONAL CHEMICAL CO.
PHILADELPHIA —————— PENNA.

**MODEL 2—B D
BENCH DRILL**

Capacity, ¼" in steel. Drills to center of 8" piece. Rack and pinion feed. Adjustable table.



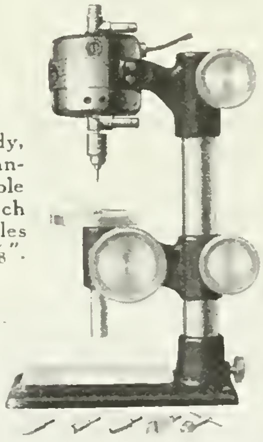


**MODEL 1—B D
HAND DRILL**

Capacity, ¼" in steel. For fast production drilling in steel, alloys and wood.

**PRECISION
DRILL**

Sensitive, speedy, accurate. A handy, dependable tool for bench work. Drills holes from .004" to ⅛".



For Those Who Like to Do a Good Job Quick

WORKMEN on piecework, factory superintendents, production managers—all find the dependability of Dumore Drills an important factor in their work.

Great savers of time and labor—easy to handle—convenient to operate, these light weight tools can easily be carried about from place to place. They eliminate expensive tear-downs and do away with slow tiresome hand work. Dumore Drills will meet your drilling requirements as satisfactorily as they have met the needs of thousands of others. If you are not already equipped with motor driven drills or if you are contemplating a change from the type you are now using—you will do well to consider the Dumore. They're always ready to work—each a sturdy, efficient, labor-saving tool.

A request from you will bring our Folder, No. 113, showing the many ways in which Dumore Drills can be used and how they will save you money. Your copy is ready—send for it today.

WISCONSIN ELECTRIC CO.

2562 Sixteenth Street RACINE, WISCONSIN

TYPE A MOTOR STRIPPED

A complete line of Dumore F. H. motors, ranging from 1/40 to ¼ h. p. is now available to those who desire small motors for special applications.

DUMORE

GEARED ELECTRIC DRILLS

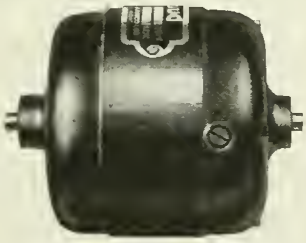
These Tools Reduce the Cost of Extreme Accuracy

AMERICA'S leading metal working industries, desiring to obtain exacting limits at least possible cost, have equipped their plants with Dumore High Speed Grinders. Experience has shown that these precision tools are almost invaluable because of their ability to economically perform a wide variety of close grinding operations in tool-room and shop. In many instances these handy tools are used exclusively for production work where extreme accuracy is required.

Perfect running balance eliminating vibration; speed ranges of 10,000 to 50,000 r.p.m., assuring absence of taper and bell-mouth—these are but a few of the advantages gained by those who use Dumore Grinders. If you are interested—if you would learn complete details of the many ways in which Dumore Grinders can increase production at lower operating costs, write for Booklet No. 40. Full particulars of actual job records are yours for the asking.

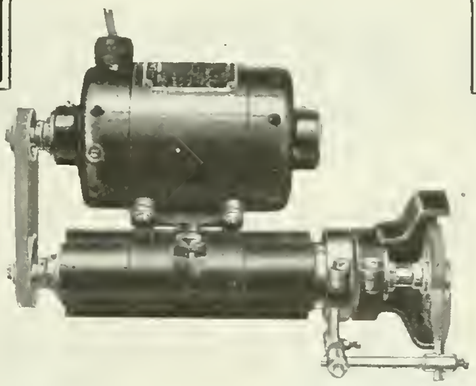
Your name and address, please!

WISCONSIN ELECTRIC CO.
2562 Sixteenth Street RACINE, WISCONSIN



TYPE A MOTOR STRIPPED

A complete line of Dumore F. H. motors, ranging from 1/40 to ¼ h. p. is now available to those who desire small motors for special applications.

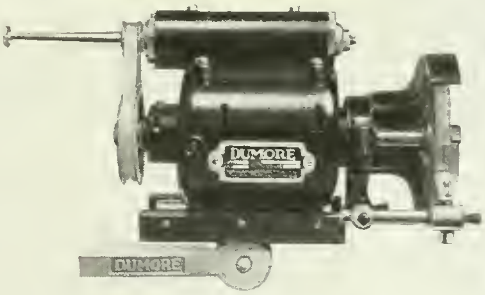


NO. 3—MULTI-SPEED GRINDER

Rated at ¼ h. p. Compact enough to use on any size lathe down to and including 8".

NO. 1—J G GRINDER

Speed 15,000 R.P.M. An ideal tool for repair shop or tool-room.



NO. 2—A G GRINDER

For general tool-room use. Spindle speeds 10,000 and 30,000 R.P.M.

DUMORE
HIGH SPEED GRINDERS

BARBER-COLMAN

HEAVY DUTY

Staggered
Tooth
Alternate
Gashed

MILLING CUTTERS

In designing this series of Cutters we have incorporated almost every known detail of construction to make these cutters the last word in production ability.

For straddle milling and deep slot milling we believe them unbeatable.

Our customers who have used them tell us we have succeeded far beyond their expectations.

Should you have a particularly tough job of deep slotting or straddle milling, order this type. You will be surprised at the feed and speed possible with less power consumed and the smooth finished cut obtained.

Write for our pamphlet more fully describing these cutters.

BARBER-COLMAN COMPANY

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Slocomb Micrometers

Meet Every Test

Reg. U. S. Pat. Office

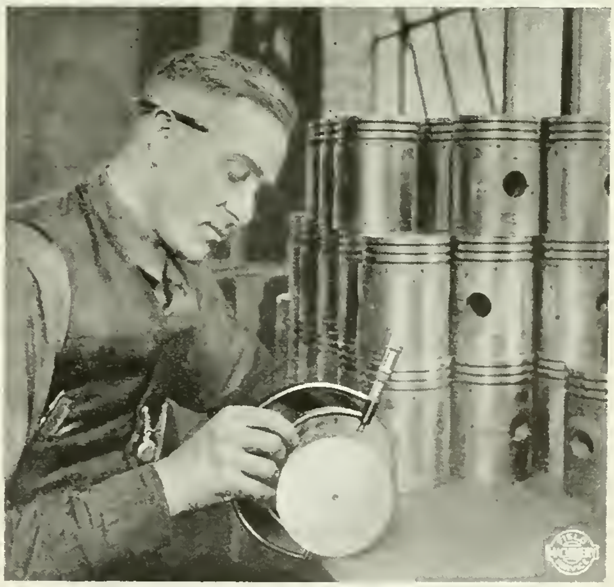
The name not the frame identifies the "Longest Lived Micrometer that can be bought"

Some folks just have to be shown!

It isn't enough for them that many leading automobile manufacturers, machine builders, contract shops and other discriminating "consumers" use *only* Slocomb Micrometers for gaging and inspecting important dimensions of their products—they must try for themselves—and we're glad to have them try—glad, too, when a skeptical prospect begins testing Slocomb Micrometers with Johansson Blocks. That means a speedy capitulation.

Slocomb Micrometers pass tests for convenience and durability with equal success, though time alone is able to show how fully they have earned their right to be called "the longest lived micrometers that can be bought." All styles and sizes, 0 to 48″ capacity, described in catalog 16.

Slocomb Catalog No. 16 describes our inside line as well as the famous Slocomb Combined Drills and Countersinks.



J. T. SLOCOMB COMPANY, PROVIDENCE, R.I.

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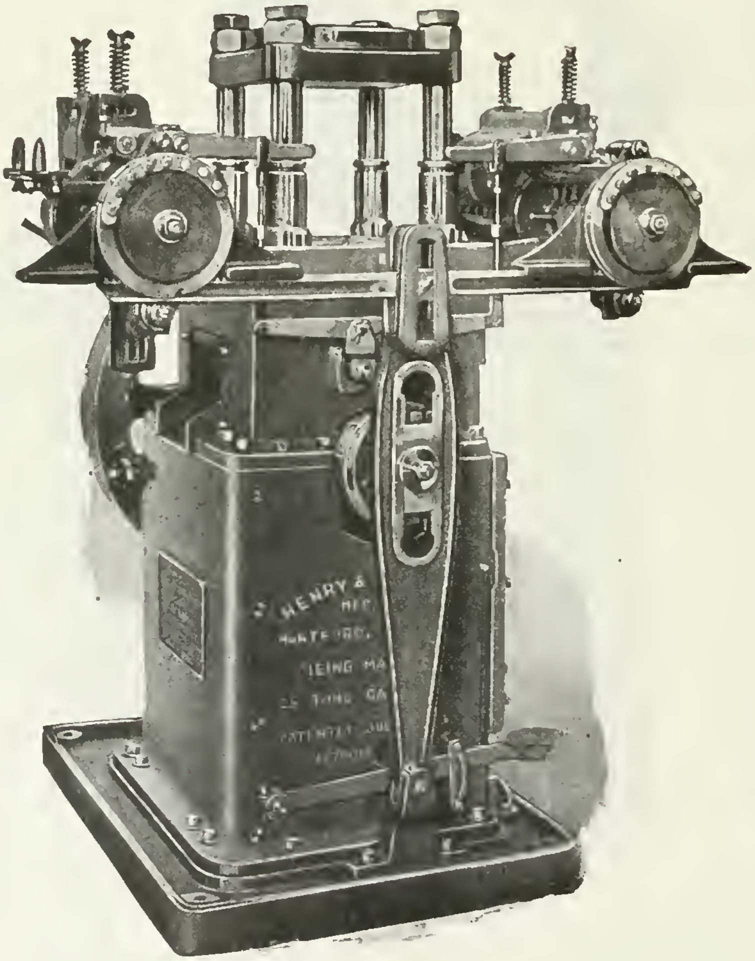
A NEED—

"A reduction in cost of manufacturing and the employment of every inch of floor space in every factory were never so much needed."

E. N. Hurley at National Foreign Trade Council, New Orleans.

Patented July 2, 1918
Other Patents Pending



10, 25 and 50
Ton Sizes

A REMEDY—

The Wright Dieing Machine

The Wright Dieing Machine takes the place of the familiar power press, turns out more and better work; saves and protects operators; occupies less floor space and needs no head room. By reason of its compact but powerful construction, tools are kept in perfect alignment, and need less frequent sharpening or renewal.

Operation is like a subpress; working parts except punch and die are concealed, but readily accessible from all sides, attachment of special feed, cut or carry fixtures is a simple matter.

Wright Roll Feed reduces the amount of labor and attention ordinarily required by punch presses. One man can keep a number of machines supplied with stock.

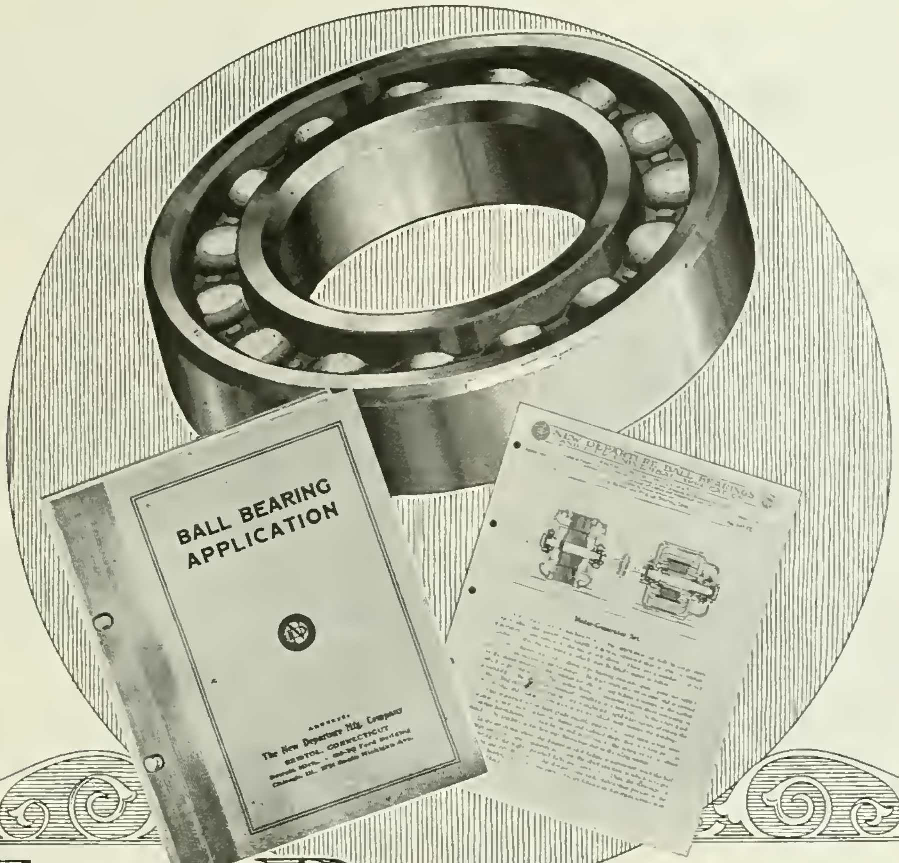
Users of Wright Dieing Machines report from fifty to two hundred per cent greater production; longer life of dies; general satisfaction with the equipment.

Let us send the details.

The Henry & Wright Manufacturing Company

Builders of Dieing and Drilling Machines

760 Windsor Street
HARTFORD, CONN., U.S.A.



New Departure Ball Bearings

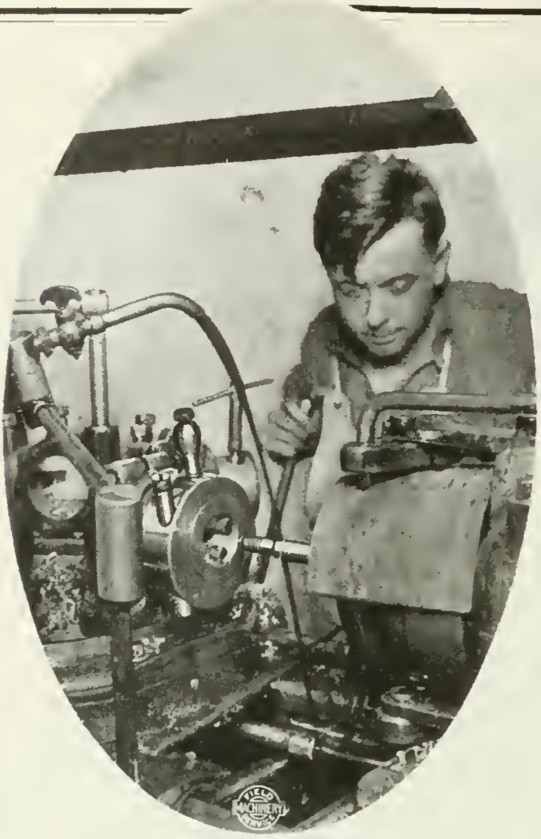
Engineers Depend on this Book

IT is considered just as important nowadays to know where to look for information as it is to have the head crammed with facts. We are told that more mechanical engineers use this New Departure volume of Engineering Data Bulletins as a manual and reference work than any other book.

Five thousand technical men keep it in their reference libraries and add to it each month the supplements which keep the book up-to-date and themselves conversant with every advance in engineering practice with reference to bearing design and application.

It contains over 200 pages of solid meat, yet the drawings are so profuse, the text so condensed and subject matter so carefully indexed that the information desired can be located without delay or difficulty. As the usefulness of this work is confined to technical men, we must ask that requests be made on your company letterhead.

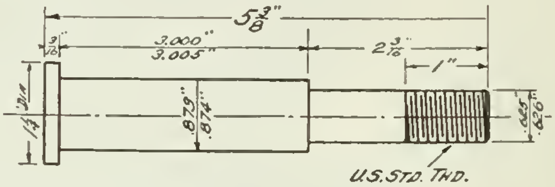
THE NEW DEPARTURE MANUFACTURING COMPANY,
Bristol, Conn.
Detroit
Chicago
56 Victoria St., London, S. W. 1



They're Using 7½ Year Old Chasers in this

HARTNESS DIE HEAD

The American Type Founders Company, Jersey City, N. J., finds the best way to insure belt tighteners against the inevitable vibration in service is to secure a close fit by using a Hartness Turret Lathe equipped with a Hartness Self-Opening Die Head, for the threading operation. Production averages 3½ minutes a piece, and though as noted above, the chasers have already seen 7½ years of service the threads are held to the same limits as the pins in which they are cut. Doesn't this record make you want to hear more about the Hartness Automatic Die Head?



JONES & LAMSON MACHINE CO., Die Division **Springfield, Vermont**

503 Market St., San Francisco, Cal. **9-10 Water Lane, Queen Victoria St., London, England**

Principles of Interchangeable Manufacturing

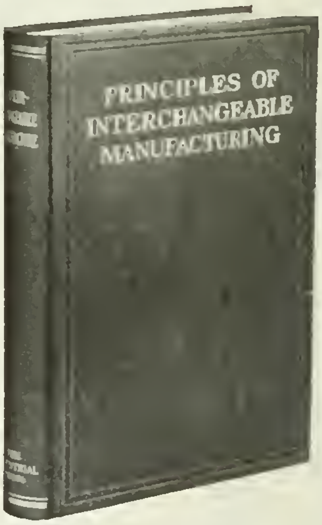
By Major Earle Buckingham, A.S.M.E., S.A.E.

Engineer, Pratt & Whitney Co.

A treatise on the Basic Principles involved in Successful Interchangeable Manufacturing Practice covering Design, Tolerances, Drawings, Manufacturing Equipment, Gaging and Inspection.

This is the first complete treatise on interchangeable manufacturing, as a whole, that has appeared and *it was written by an authority.* The book defines and emphasizes the underlying basic principles, using specific methods to illustrate their application. The information upon which this treatise is based was gathered from many manufacturing plants both large and small in this country and Canada. Every method discussed is in successful operation and for that reason the book is of great value to the industry.

In this book, as well as in every volume of MACHINERY'S Books on Machine Shop and Drafting-Room Practice, you will find a Self-Examination Sheet which enables the reader to get the utmost possible value out of the book. The Self-Examination Sheet makes home study easy and interesting.



254 Pages—6 x 9 inches—
Fully Illustrated

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You may send me, all delivery charges paid, for five days' examination, your book "Principles of Interchangeable Manufacturing" I will either return it in five days or send you $3.00 within 30 days, paying for it in full.

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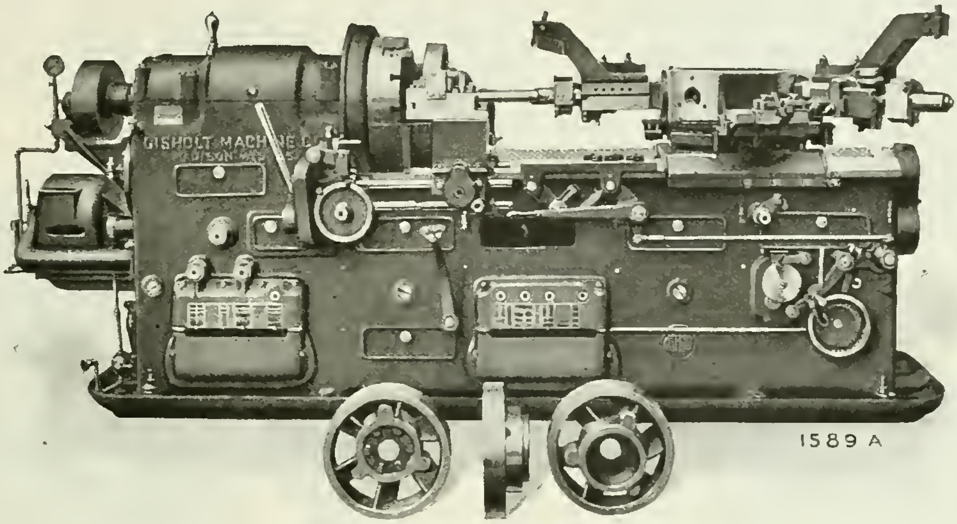
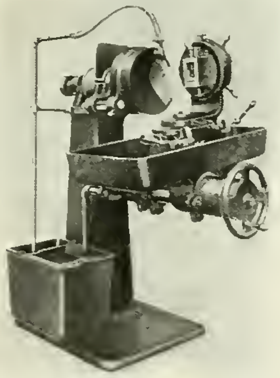
8-23



20-INCH AUTOMATIC TURRET LATHE

One of two Automatic Turret Lathes, operated by one man, which replaced two hand lathes, operated by two men. Besides saving labor, the automatics increased the production 10 wheels a day, and improved the accuracy of the product.

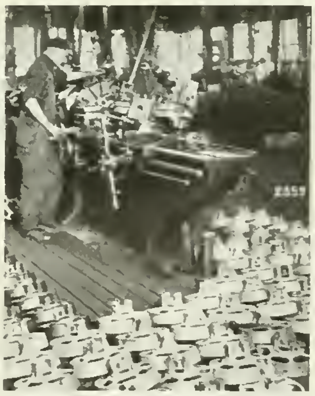


UNIVERSAL TOOL GRINDER
For sharpening single point cutting tools

In addition to heavy machine tools, we also manufacture small tools, such as Solid Adjustable Reamers, Boring Bars, Tool Holders, and Chucks.

To assist users of Gisholt machines in getting the greatest results from them we conduct an intensified course of training called the Gisholt School.

Don't you think it would be worth while to ask us for more information on any of these subjects—they are universally instrumental in cutting costs.



STANDARD TURRET LATHE
Made in six sizes, 13 inch to 41 inch.

GISHOLT MACHINE COMPANY

9 So. Baldwin Street **MADISON, WISCONSIN**

Eastern Office: Room 1725, 30 Church St., New York *Cleveland Office:* 1888 Page Avenue, Cleveland, Ohio

BARNES RADIAL DRILL

Spindle Travel 18 inches

No. 4 taper hole in spindle

Weight 3,300 lbs.

Table 24" x 65"

WE illustrate herewith a No. 3 Horizontal Radial Drill or End Drilling and Tapping Machine. The machine is back-geared, strong and well built, and all parts are within easy reach of the operator. The table is slotted for holding the work; the arm is of heavy box pattern, and the sliding head is gibbed strongly on the square ways of the arm. For operating the spindle, the operator has choice of three feeds; namely, the lever feed or the handwheel feed or power feed. Power feed has positive drive.

Dimensions No. 3 Horizontal Drill:

Distance from top of table to center of bearing, 8¾ inches.

Center of bearing to maximum height of spindle, 38¼ inches.

Bearing, 9 by 12 inches long.

Spindle arm moves through circle of 180 degrees.

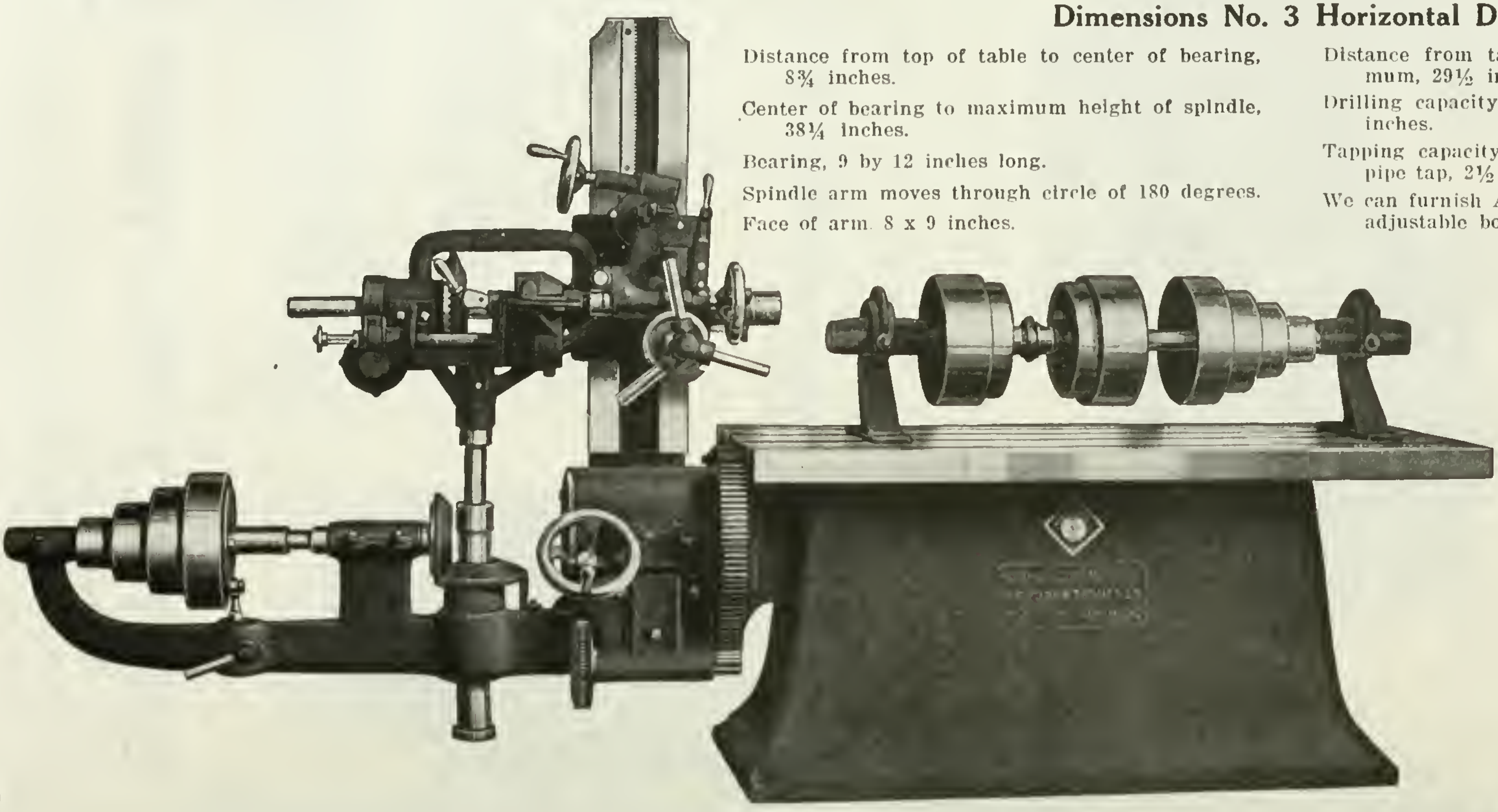
Face of arm 8 x 9 inches.

Distance from table to center of spindle, maximum, 29½ inches, minimum 2⅜ inches.

Drilling capacity in solid C-I., 3 inches; steel, 2 inches.

Tapping capacity in C. I., 3 inches; capacity of pipe tap, 2½ inches.

We can furnish Arbor Rest (extra cost) which is adjustable both vertically and horizontally.



W. F. and
John
Barnes
Co.

231 Ruby Street
Rockford
Illinois

SHIELD BRAND

REAMERS

HAND REAMERS IN SETS

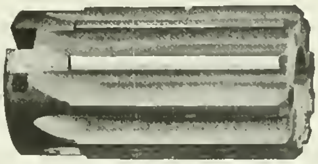
are distinguished by the better service they perform.

They are made with extreme accuracy and hold their edge longer than the average reamer.

They are backed-up by forty-two years' experience in small tool manufacture.

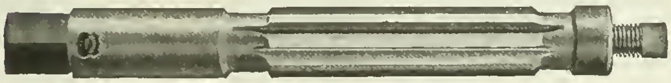
Order them for your drilling requirements.

The Shield Appears On All Our Reamers



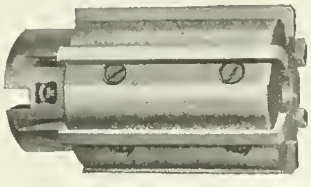
ROSE

SPIRAL FLUTES



EXPANSION REAMERS

HAND REAMERS



"STANAR" ADJUSTABLE

THE STANDARD TOOL CO.

CLEVELAND

Branch Offices

New York Store, 94 Reade St.
Chicago Store, 552 W. Washington Blvd.
Boston, 1101 Scollay Bldg.
Philadelphia, 401 Liberty Bldg.

London, England, Burton Griffiths & Co., Ltd. Paris, France, Burton Fils. Geneva, Switzerland, J. Lambercier & Co. Copenhagen, Denmark, Nienstaed & Co. Tokyo, Japan, The F. W. Horne Co.

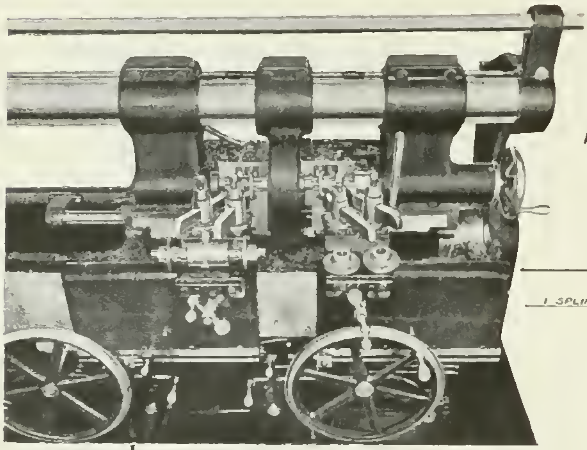
The New
DOUBLE END "SUNDSTRAND"

Sundstrand Double End Lathe is an efficient and accurate tool for turning simultaneously both ends of shafts, axle housings, etc., and manufacturing short pieces, as flanges, four-arm spiders, etc. It doubles output and halves production time on these classes of work.

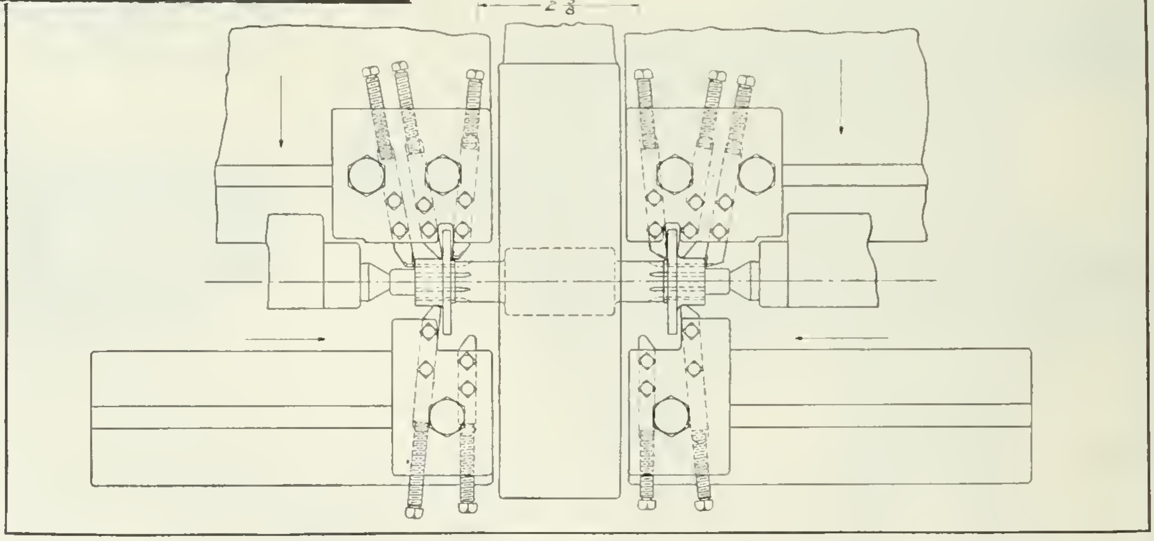
An example of duplicate manufacturing as performed by this machine is shown in diagram: Two universal joint flanges are held on a double-end arbor gripped in the center drive-chucking device. Two front and rear carriages carrying ten tools in this case, turn and face simultaneously. Carriages work toward each other and trip automatically. Two tailstocks and narrow center drive suspended from overhead arms slide along whole length of bed and account for Sundstrand's capacity for varying lengths of work.

Work is easily inserted and removed. Chips and lubricant fall freely into pan. Starting lever extends whole length of bed. Belt or motor drive—many other features we'd like to tell you about.

Send for Catalog and Full Particulars



Turning and Facing Flanges —Two at a Time



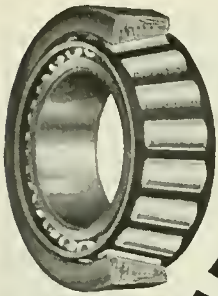
ROCKFORD MILLING MACHINE CO., Rockford, Ill., U.S.A.

DOMESTIC REPRESENTATIVES

Atlanta, Manning, Maxwell & Moore, Inc. Boston, Lynd & Farquhar Co. Buffalo, Homer, Strong & Co., Inc. Chicago, Manning, Maxwell & Moore, Inc. Cleveland, Co-operative Machinery Co. Cincinnati, Manning, Maxwell & Moore, Inc. Davenport, Mid-West Machine Tool & Supply Co. Dayton, M. D. Larkin Supply Co. Detroit, Manning, Maxwell & Moore, Inc. Grand Rapids, McMullen Machinery Co. Greensboro, N. C., Greensboro Supply Co. Houston, Texas, Manning, Maxwell & Moore, Inc. Kansas City, English Tool & Supply Co. Los Angeles, Herberts Machinery & Supply Co. Milwaukee, Western Iron Stores Co. Minneapolis, F. E. Satterlee Co. Montreal, Yeates Machinery & Supply Co. New York, Manning, Maxwell & Moore, Inc. New Orleans, The Fairbanks Co. Omaha, Interstate Machinery & Supply Co. Philadelphia, Manning, Maxwell & Moore, Inc. Pittsburgh, Manning, Maxwell & Moore, Inc. Rochester, Homer, Strong & Co., Inc. San Francisco, Herberts Machinery & Supply Co. Seattle, Wash., West Coast Mchy. Co. St. Louis, Manning, Maxwell & Moore, Inc. Syracuse, Manning, Maxwell & Moore, Inc. Toronto, Garlock Machinery Co., A. A. Jones & Shipman, Ltd., Alfred Herbert, Ltd. Windsor, Chas. A. Strelinger Co. of Canada, Ltd.

FOREIGN REPRESENTATIVES

Australia: Selson Engineering Co., London. England: A. A. Jones & Shipman, Ltd., New Century Works, Leicester. France: Louis Besse, 89 Rue de Lappe, Paris. Holland: Wynmalen & Hausman, Rotterdam. Japan: Roku-Roku-Shoten, Tokyo. Mexico: Annes & Sessums, Ave. F. I. Madero No. 1, Senna, Mexico D. F. Russia: M. Mett Engineering Co., Petrograd. Spain: Casamitjana Hermanos, Barcelona. Sweden: Aktiebolaget, Rylander & Asplund, Stockholm.



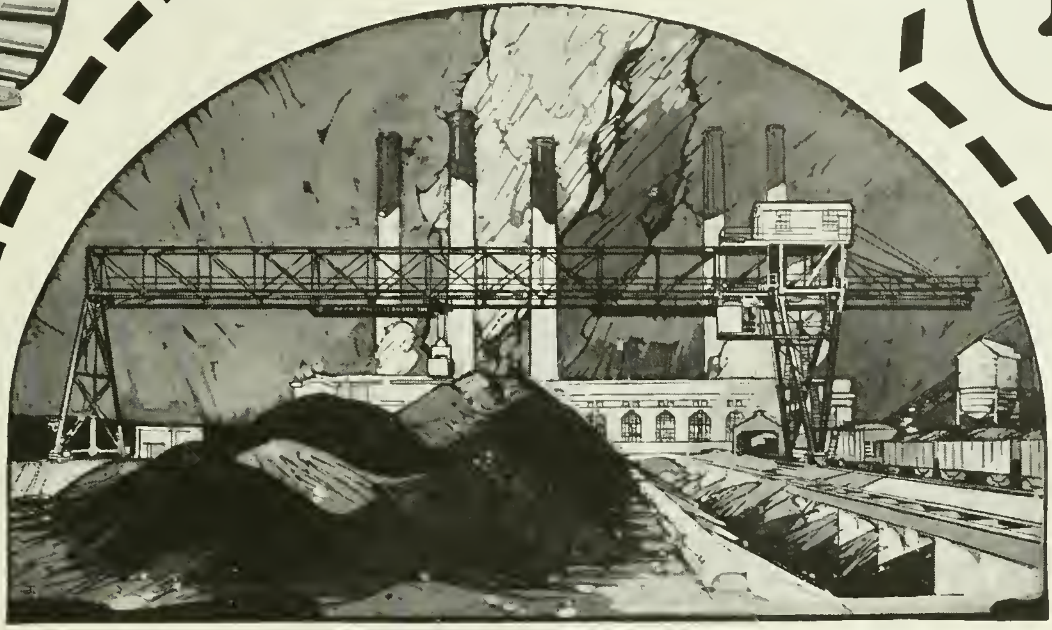


Illustration reproduced through the courtesy of the Brown Hoisting Machinery Co.

Material Handling with Timkens

In conveyors, Timken Tapered Roller Bearings save power, permit the use of a lighter weight and less expensive belt or chain, and prolong the life of the belt or chain.

In hoists and cranes, as in conveyors, the ability of Timken Bearings to carry radial loads, *and* thrust loads, *and* resultant loads provides for the sudden changes from one load to the other, when the hoisting operation is completed and the conveying operation begins.

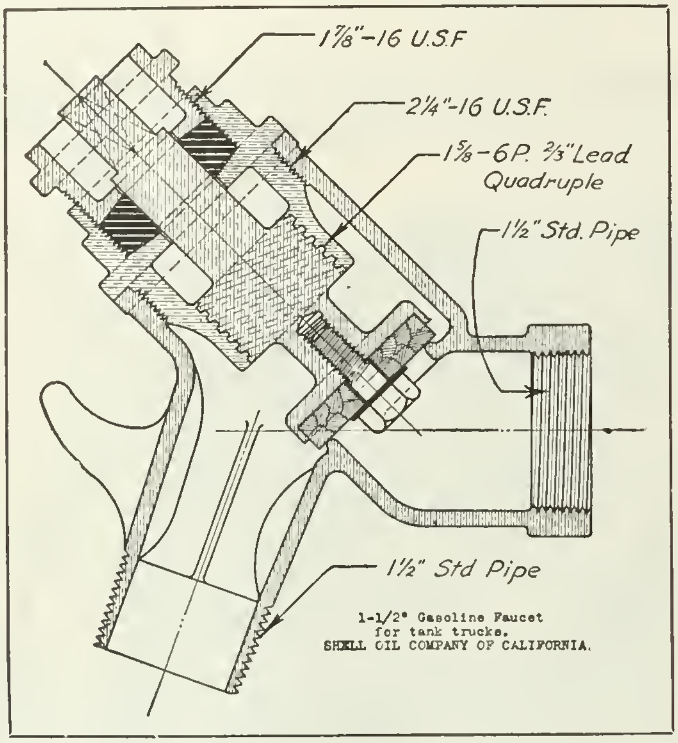
In all types of material handling machinery, Timken Bearings do away with the bugbear of frequent lubrication; wear in the running gears, idlers, etc., is confined to the bearings themselves; and when inevitable wear does eventually occur in the bearings, a simple, quick adjustment corrects it.

Naturally Timken-equipped material handling machinery includes such well known names as Robins, Brownhoist, Wellman-Seaver-Morgan, Godfrey, Chisholm & Moore, and others. For Timken Tapered Roller Bearings in material handling equipment, as in practically every other type of industrial machinery, are saving power, and trouble, and dollars.

The Timken Roller Bearing Co
CANTON, OHIO

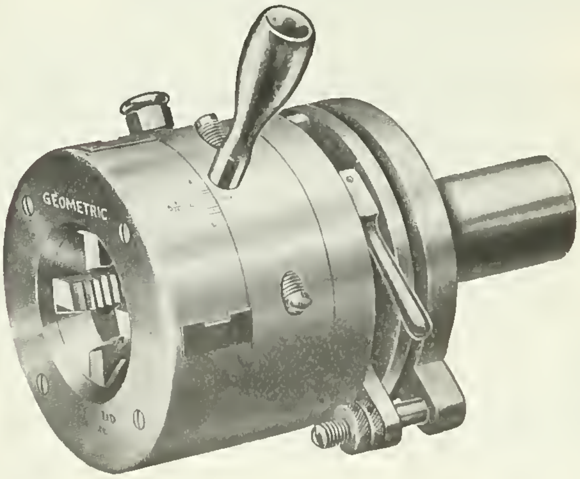
© 1923, The T R B Co, Canton, Ohio

TIMKEN
Tapered
ROLLER BEARINGS

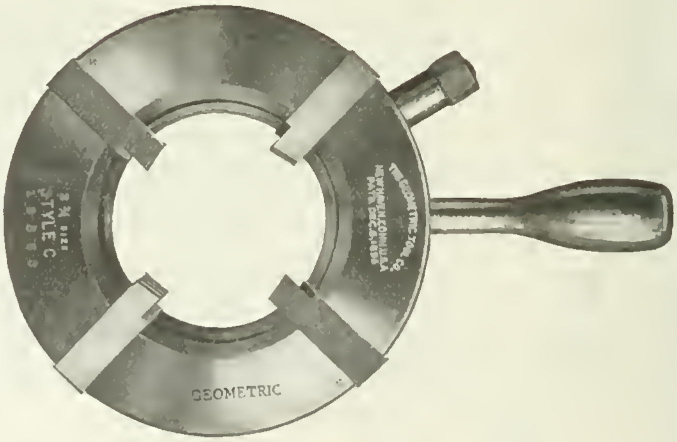


Five Threading Operations in Less than Two Minutes with Geometric Die Heads and Geometric Collapsing Taps

The Threaded Products Co., Oakland, California, manufacturers of specialties for oil producers, refiners, etc., declare that "Simplicity is the secret of practicality" and apply this dictum to the tools they use as well as the products they manufacture. Geometric Threading Tools—simple, practical, durable—profitably meet their needs. Study this drawing: five threads in two minutes is a fair sample of the work done here by Geometric Tools.



Get the details of Geometric Production on other work. Try a Geometric Tool at our expense.



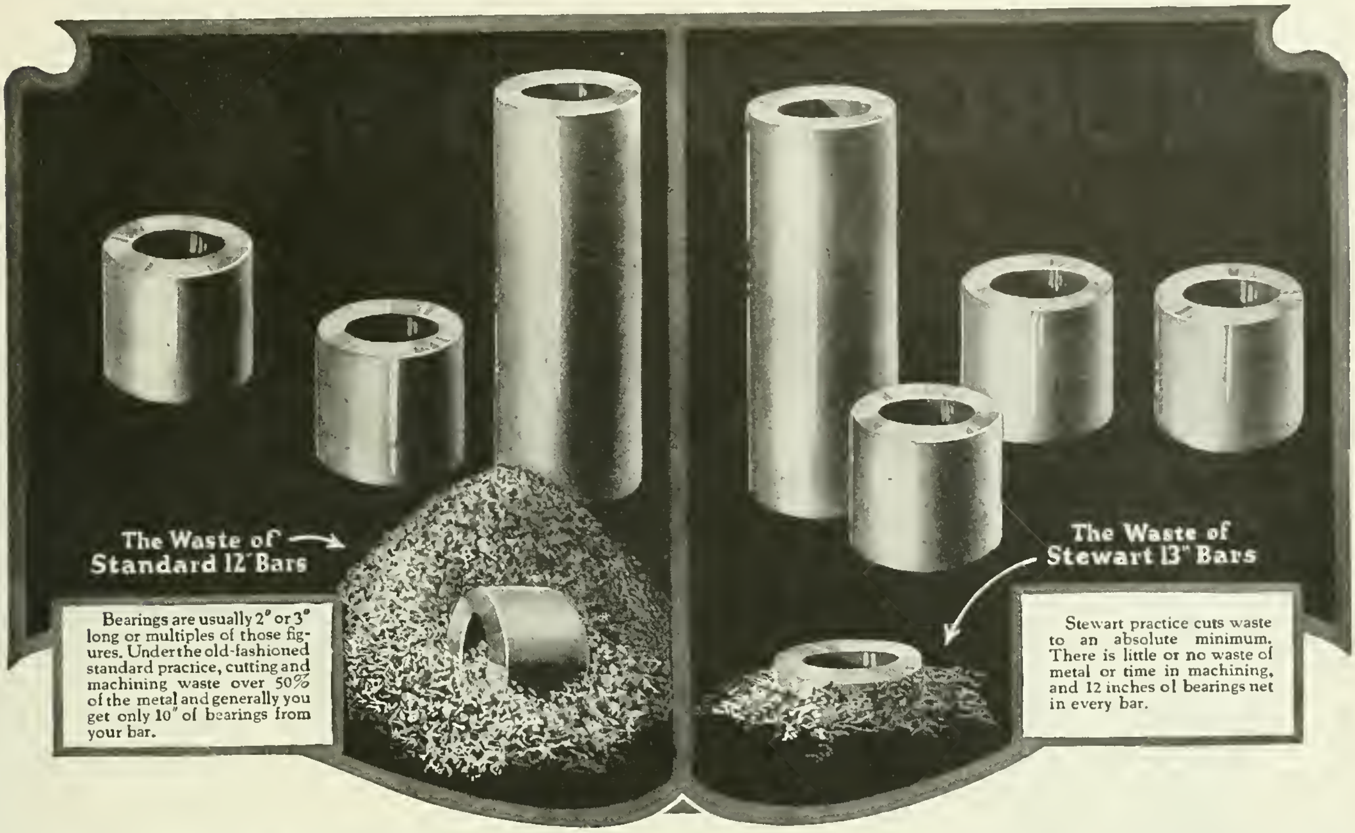
THE GEOMETRIC TOOL CO., New Haven, Conn.

General Distributors for Michigan, The Charles A. Strelinger Co., Detroit

WESTERN SALES AGENTS. The Tool Equipment Co., San Francisco. AGENCIES: Blackman-Hill-McKee Mchy. Co., St. Louis, Mo.; Federal Mchy. Sales Co., Chicago; Hill, Clarke & Co., Inc., Boston, Mass.; Kemp Mchy. Co., Baltimore, Md.; The National Supply Co., Toledo, O.; The W. M. Pattison Supply Co., Cleveland, O.; Root, Neal & Co., Buffalo, N. Y.; F. E. Satterlee Co., Minneapolis, Minn.; Somers, Fitler & Tood Co., Pittsburgh, Pa.; Vandyck Churchill Co., New York and Philadelphia; Vonnegut Mchy. Co., Indianapolis, Ind.; The C. H. Wood Co., Syracuse, N. Y.; The Western Iron Stores Co., Milwaukee, Wis. CANADA: The A. R. Williams Mchy. Co., Ltd., Toronto, Vancouver (B. C.), Halifax (N. S.), and St. John (N. B.); Williams & Wilson, Ltd., Montreal. FOREIGN: Allied Machinery Co. of America, France, Italy, Switzerland, Spain, Portugal; Andrews & George, Tokyo, Japan; Bevan & Edwards, Melbourne. Buck & Hickman, Ltd., London, Birmingham, Manchester, Glasgow. Etablissements Horstmann, Paris; V. Lowener, Copenhagen, Christiania, Stockholm; Trading Co., R. S. Stokvis & Zonen, Rotterdam, Holland, and Brussels, Belgium; White & Rae, Sydney.

GEO MET RIC

Right in the Lead



Bearings are usually 2" or 3" long or multiples of those figures. Under the old-fashioned standard practice, cutting and machining waste over 50% of the metal and generally you get only 10" of bearings from your bar.

Stewart practice cuts waste to an absolute minimum. There is little or no waste of metal or time in machining, and 12 inches of bearings net in every bar.

Why Waste 50% of Your Bearing Metal?

Our factory representatives below will give you complete information

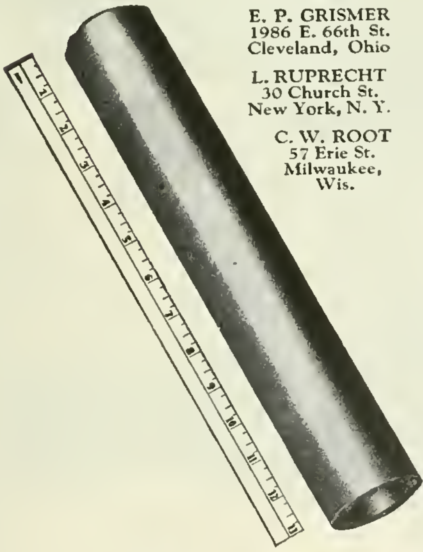
J. FRANK LANNING & CO.
327 First Ave., Pittsburgh, Pa.

A. C. OLFS
7321 Woodward Ave.
Detroit, Mich.

E. P. GRISMER
1986 E. 66th St.
Cleveland, Ohio

L. RUPRECHT
30 Church St.
New York, N. Y.

C. W. ROOT
57 Erie St.
Milwaukee,
Wis.



THE picture above tells the story of the greatest improvement in bearing metal practice in years, originated by Stewart Manufacturing Corporation in conjunction with the development of Stewart Brons Bearing Metal.

You have always bought rough 12" bars. WHY? Generally you get only 10 inches of bearings from them. You lose over half your metal in machining and cutting. And you lose your machining time.

Buy a Stewart 13" bar and you get 12 inches of bearings. Stewart Bars are "FINISHED ALL OVER." We do your machining on a quantity basis, save all the metal, cut down your costs and give you more bearings for less money.

Pure Copper-Lead Bearings

More than that — when you buy Stewart Brons you have the most perfect bearing metal ever developed. We have learned how to mix copper and lead in any desired proportions, make the mixture uniform and proof against segregation.

It is a remarkable development — the perfect bearing metal. Absolutely will not score shafts. Functions perfectly at all low temperatures, and will not burn out. At 600° it sweats a little lead and lubricates itself. Even at 1000° we have never seen it score a shaft. Its melting point is 1700°. We carry 258 sizes of bars and bushings in stock in four grades of Brinell hardness to meet any requirements.

The success which Stewart Brons Bearing Metal has had since its announcement is remarkable. Every engineer should investigate its possibilities. We maintain an Engineering Department to co-operate with you. Our Service Department is at your disposal.

Jobbers! There is a wonderful market for Stewart 13" bars. Write for our proposition

STEWART MANUFACTURING CORPORATION
4503-88 Fullerton Avenue
Chicago, Illinois

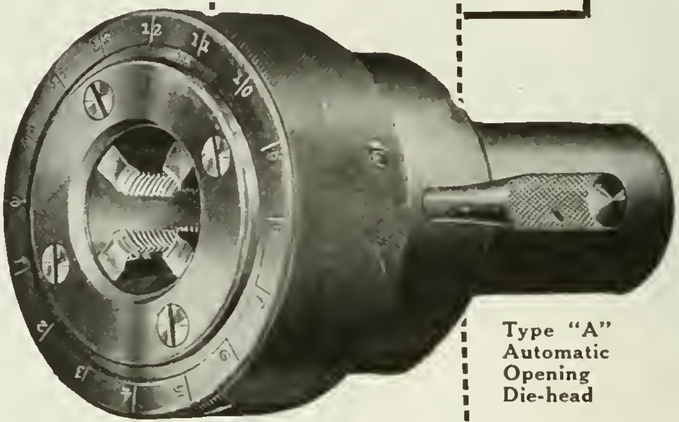
For detailed information write the factory direct or communicate with our nearest factory representative

Stewart Brons Bearing Metal

The Perfect Metal for Bearings

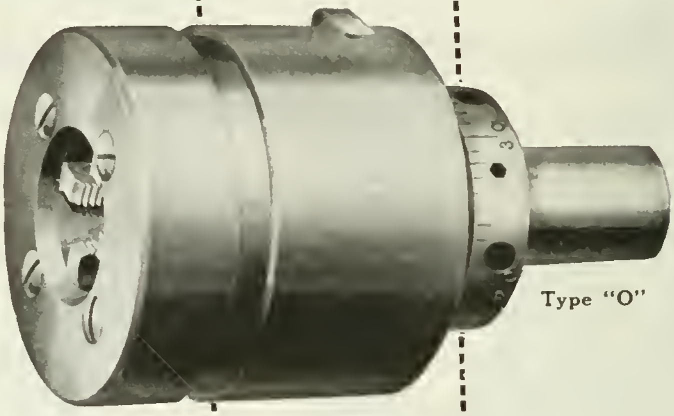
MURCHEY TOOLS

For speedy, economical threading use Murchey Die-heads. Long satisfactory service. They save time and money and cut manufacturing costs.



Type "A" Automatic Opening Die-head

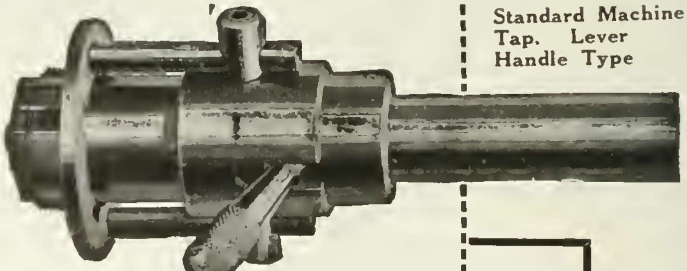
They are extremely accurate and require little attention. All parts are specially heat-treated, hardened and ground.



Type "O"

Self Opening Die-heads can be adjusted to .00025″ by means of a knurled index ring. Sizes from 3/32″ to 12″ capacity.

Murchey Standard Machine Taps range in size from 1¼″ to 12″, come in styles for both stationary and revolving spindle machines and thread all materials.



Standard Machine Tap. Lever Handle Type

Murchey Tools are sent on approval. Try one on your work and in your own shop.

Or if you need special threading tools, we'll submit an estimate on receipt of drawings. Complete catalog on request.

Murchey Machine & Tool Company

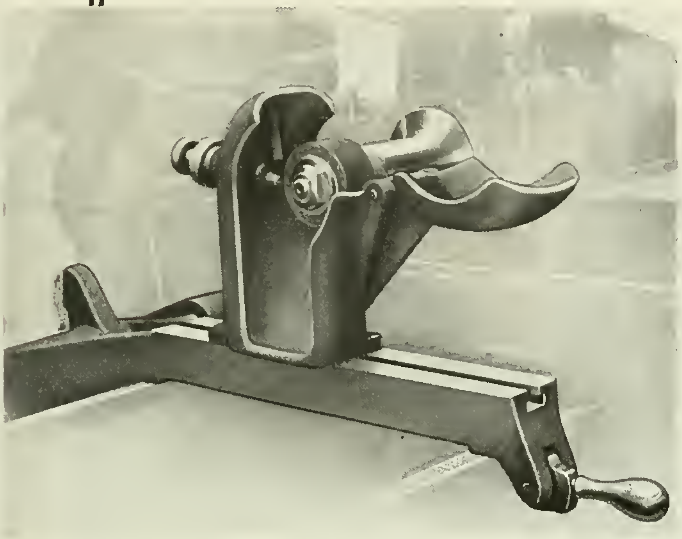
34 Porter Street, DETROIT, MICH.

Cleveland Office, 6523 Euclid Ave. Pittsburgh Representative, Laughlin & Barney, 483 Union Trust Bldg. Chicago Representative, R. E. Ellis Engineering Co., 621 Washington Blvd. Smith-Booth-Usher, 50-60 Fremont St., San Francisco. Smith-Booth-Usher, 228 Central Ave., Los Angeles. Fenwick Freres & Company, 8 Rue de Rocroy, Paris. Coats Machine Tool Company, 14 Palmer Street, Westminster, London. S. W., England.

Truing the Wheel is a Simple Matter

We've built a wheel truing device into the "Hydroil" Grinder which for simplicity and effectiveness can't be beaten. The diamond bridge is attached to a shaft mounted on the base of the machine at its back. When not in use, it swings back out of the way as in the lower illustration. When required, it is swung forward and down and instantly clamped to the work table by a cam. The diamond does its dressing upon the *back* of the wheel so that all dust is thrown *down* rather than up into the air. A water connection is provided for cooling the diamond and carrying away dust.

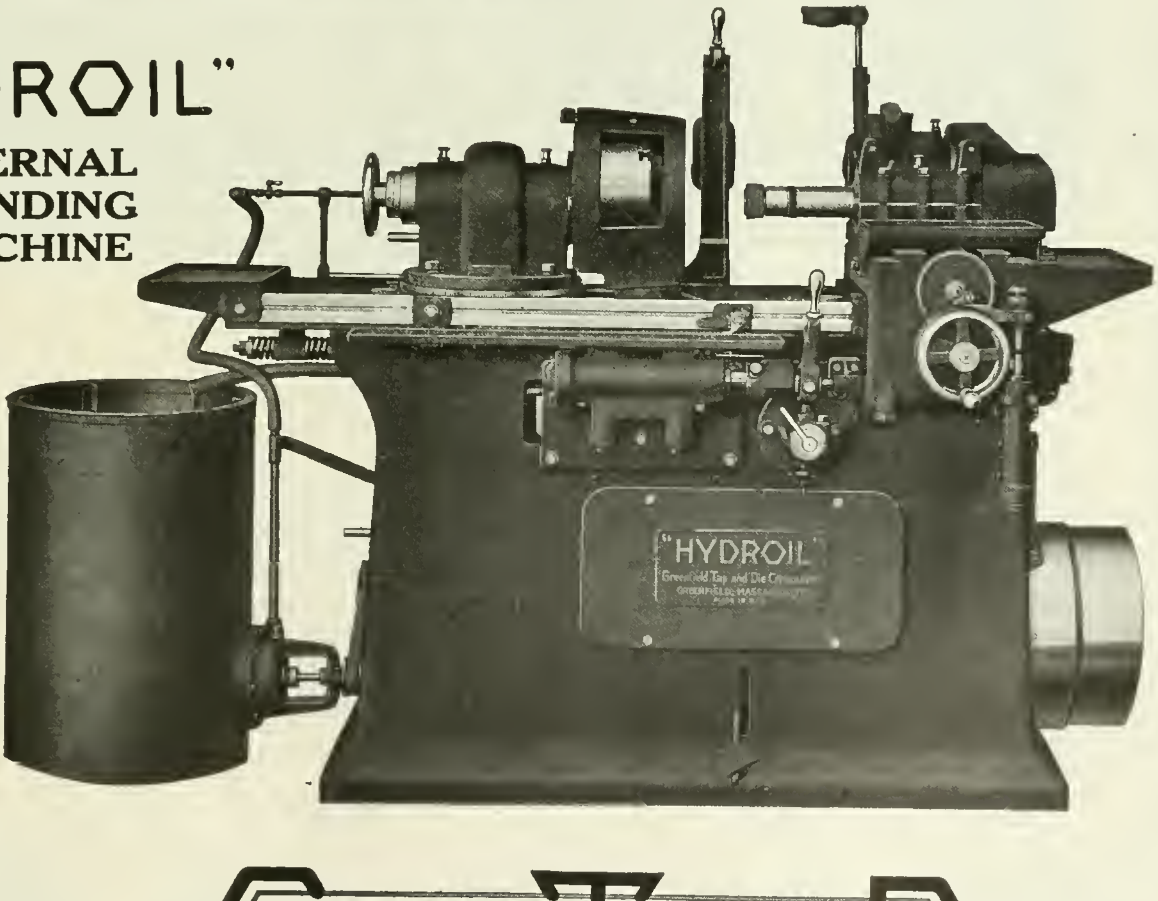
There are many other features in the "Hydroil" that combine to make it a most profitable machine on a wide range of internal grinding. Read about them in our new Grinding Machine Catalog No. 101. Send for it today.



Diamond Bridge in Position

"HYDROIL"

INTERNAL GRINDING MACHINE

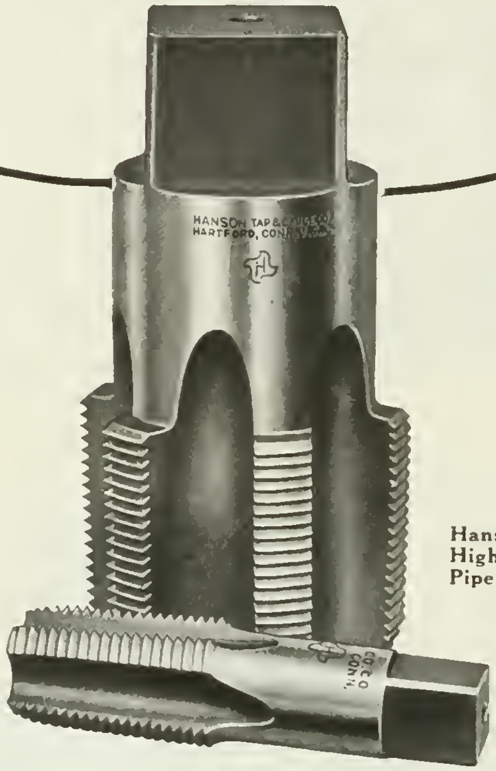


GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASSACHUSETTS

AGENTS—MANNING, MAXWELL & MOORE, INC.—New York, Philadelphia, Pittsburgh, St. Louis, Chicago, Milwaukee. STRONG, CARLISLE & HAMMOND CO.—Cleveland, Toledo, Detroit. SYRACUSE SUPPLY CO.—Syracuse, Rochester, Buffalo. E. A. KINSEY CO.—Cincinnati, Dayton, Indianapolis.

How great is your loss due to poor Pipe Threads?

It is easier and cheaper to make perfect pipe threads than it is to make poor ones if you have the right tap.



Hanson Process
High Speed
Pipe Taps

"Hanson Process" Pipe Taps are made either straight or taper type.

"Hanson Process" Pipe Taps are furnished correct in lead, correct in form of thread and correct in design. Lead correct to within .0001" per inch. Taps as accurate as finest pipe thread gauges.

Do you figure the cost of tapped holes or the cost of taps? We design taps for the material you are tapping. Let us know what work you are doing.

"HANSON" PROCESS

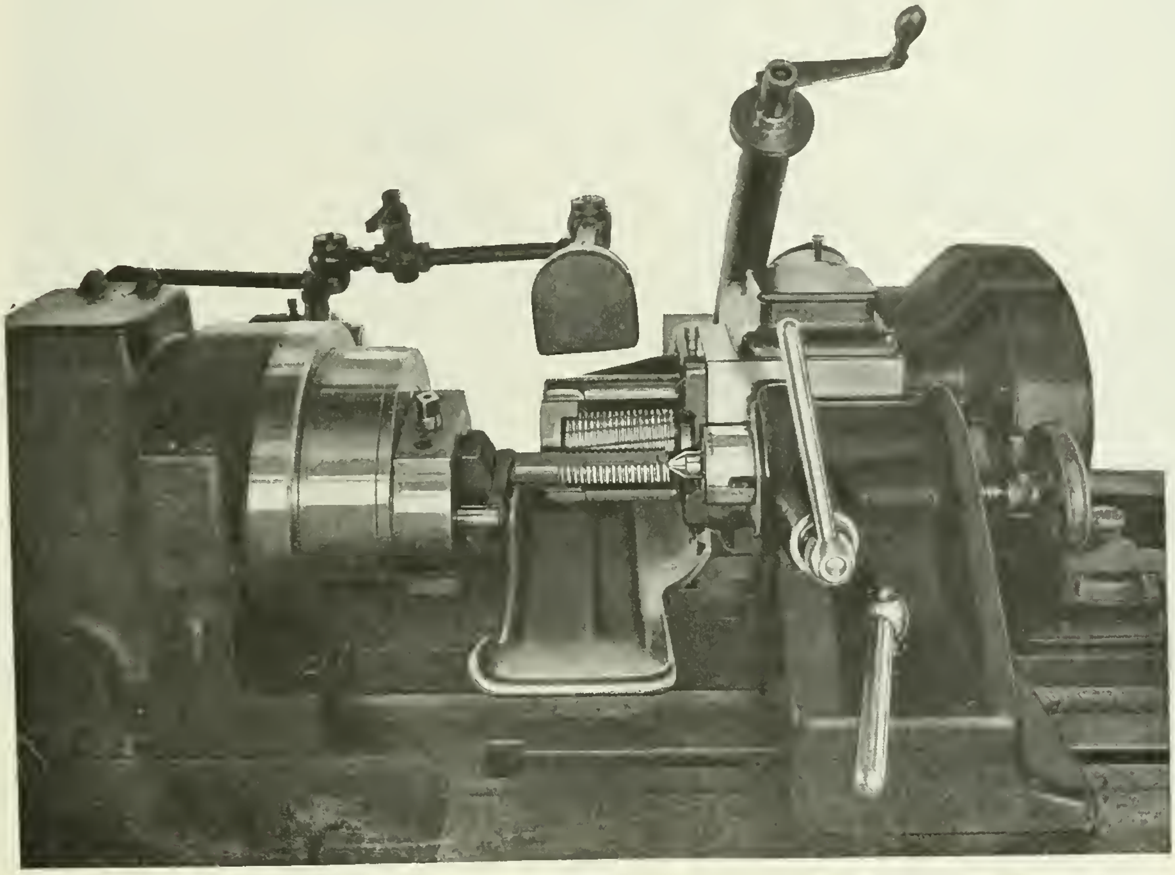
The Hanson Tap and Gauge Co.

169 Bartholomew Avenue
HARTFORD, CONN.

REPRESENTATIVES

New York, N. Y.	L. C. Biglow & Co.
Philadelphia, Pa.	D. J. Normoyle
Pittsburgh, Pa.	William K. Stamets
Cleveland, Ohio	William K. Stamets
Cincinnati, Ohio	Seifreat-Woodruff Co.
Dayton, Ohio	Seifreat-Woodruff Co.
Detroit, Mich.	English & Miller Mchy. Co.
San Francisco, Cal	A. H. Coates Co.

Universal Semi-automatic Thread Milling Machine



18" STILLSON WRENCH JAWS THREADED AT THE RATE OF 100 PER HOUR, FROM FLOOR TO FLOOR

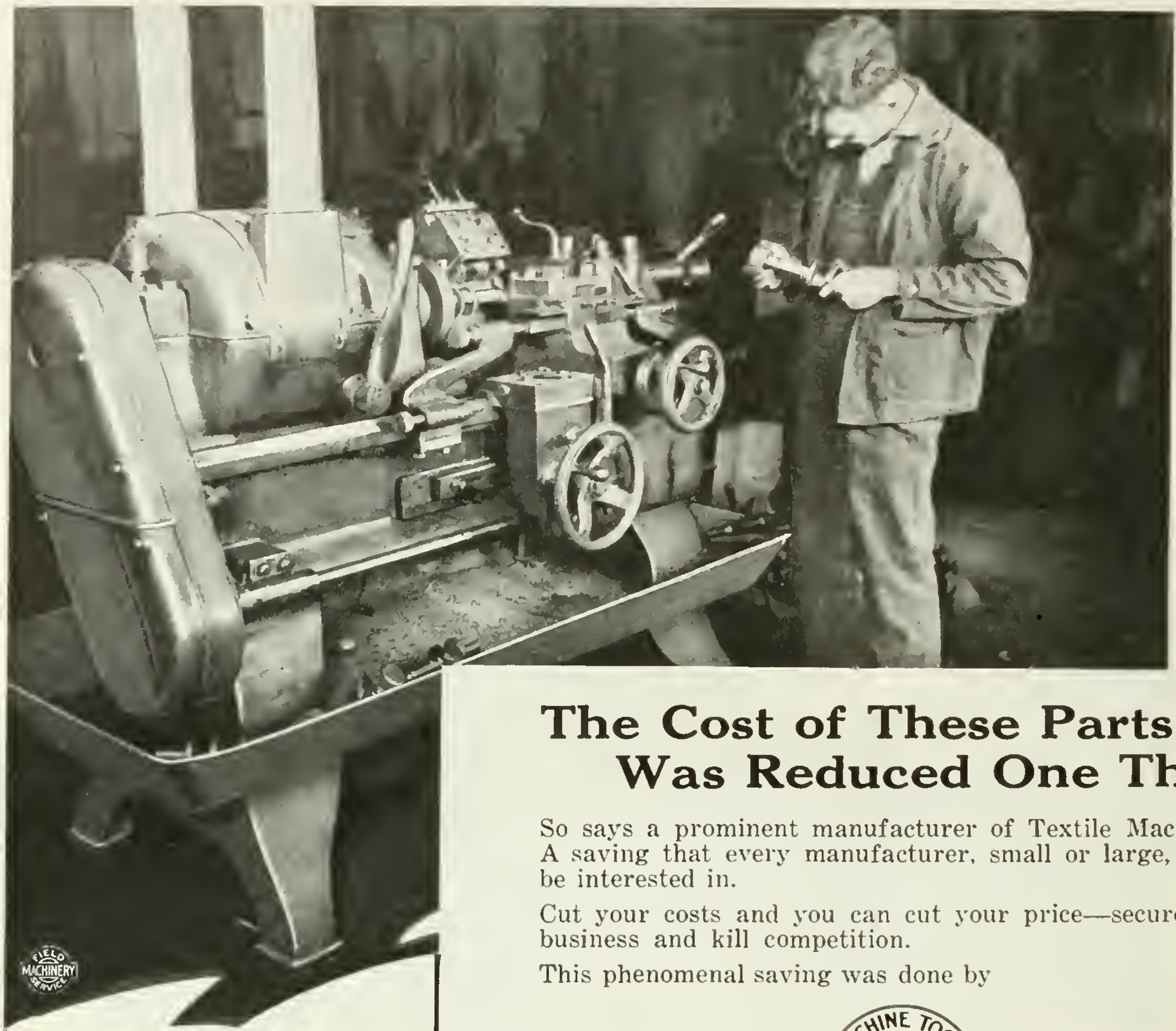
This is one of many operations where the advantage of the "hurry-up" motion is apparent. After the thread is milled on one edge the work is instantly revolved to the position for threading the opposite edge.

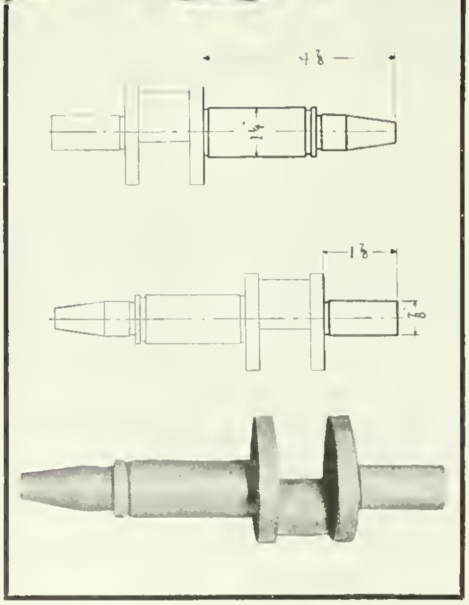
With this design it is possible to use small diameter hobs, thereby keeping down cost of cutting tools and obtaining a fine finish on the work.

The Hanson-Whitney Machine Co.

Hartford, Conn.

DOMESTIC REPRESENTATIVES: Seifreat-Woodruff Co., Cincinnati and Dayton, O.; English & Miller Machinery Co., Detroit, Mich. Wm. K. Stamets, Pittsburgh, Pa. and Cleveland, O.; D. J. Normoyle, Philadelphia, Pa.; L. C. Biglow & Co., Inc., New York City; George McPherson, Syracuse, N. Y. FOREIGN REPRESENTATIVES: Leo C. Steinle, London, England; R. S. Stokvis & Zonen, Rotterdam, Holland; Aktiebolaget Rylander & Asplund, Stockholm, Sweden; Fenwick Freres & Co., Paris, France; Brussels, Belgium; Turin, Italy; Barcelona, Spain, Rio de Janeiro, Brazil; Zurich, Switzerland. Andrews & George, Tokyo, Japan.





The Cost of These Parts Was Reduced One Third

So says a prominent manufacturer of Textile Machinery. A saving that every manufacturer, small or large, should be interested in.

Cut your costs and you can cut your price—secure more business and kill competition.

This phenomenal saving was done by

MACHINE TOOLS
REED-PRENTICE
WORCESTER, MASS. U.S.A.

PRODUCTION LATHES

The work was cast-iron eccentric shafts for "Comb Boxes."

The former cost was 16 cents each.

The present cost (Reed-Prentice equipment) is 10 cents each.

The fact that while the ends of the shaft (tapering, grooving, etc.), are completed on the Reed-Prentice, the eccentric itself and the flanges are still turned on a fixture on the engine lathe gives even greater significance to the difference in production cost.

Reed-Prentice Production Lathes lower manufacturing costs on all kinds of lathe work. If you are interested in *increasing profits* we can give you interesting data on a wide variety of parts produced on these machines.

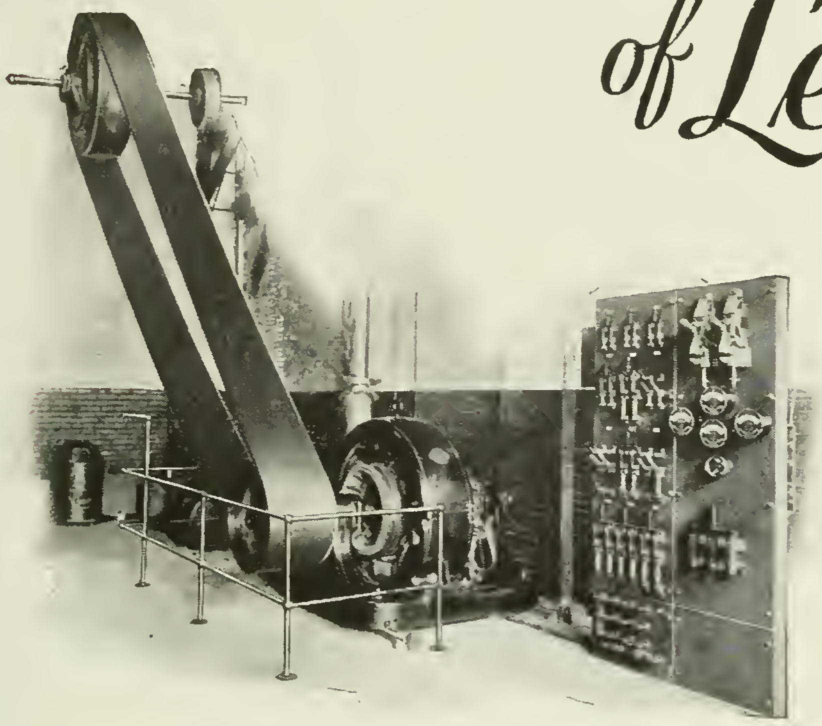
REED-PRENTICE Co.

LATHES-RADIAL DRILLS
BECKER MILLING MACHINES
MILLING CUTTERS

RAPID PRODUCTION LATHES
WHITCOMB PLANERS
SPECIAL MACHINERY

WORCESTER, MASS.
677 CAMBRIDGE ST.,
Branch Offices and Agents Throughout the World

Nothing takes the place of Leather



$5000.00 in PRIZES for Letters about Leather

THE sole and belting leather tanners of America jointly plan to tell the truth about leather to the public.

People, in general, need to know the facts about this basic industry, and ought to realize the conditions under which it exists. So the tanners intend that their product, and their policies, shall now be frankly and fully explained.

For such a purpose, the principal producers of leather have provided funds to carry out a broad publicity campaign, in various forceful, informing ways. Through advertising space, in the principal popular periodicals, the tanning industry will make its position plain.

Among other vital facts which affect everybody, this one in particular shall be made evident:

"Nothing takes the place of leather" for machinery belting.

You are concerned in having this assertion substantiated. You are urged to consider the evidence the tanners will submit. You will then be able to give a verdict on the proved facts.

During this August

over 29,000,000 copies of America's favorite weekly and monthly magazines will publish the details of a Contest, open to anyone, anywhere, offering

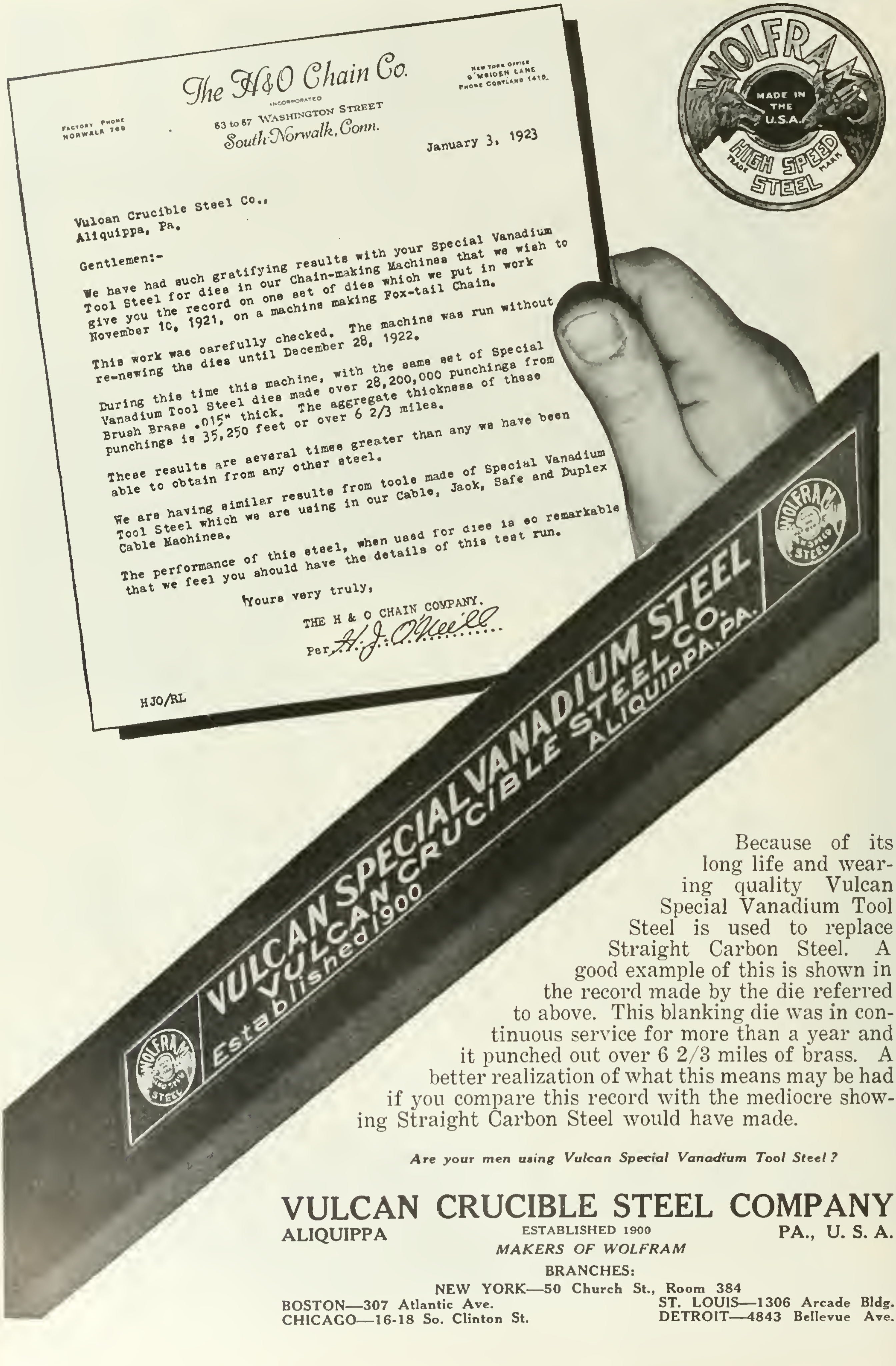
$5000.00 in Cash Prizes for Letters about Leather

First prize $2,000.00 in cash—one hundred seventeen other cash prizes

Help somebody you know to win!

AMERICAN SOLE AND BELTING LEATHER TANNERS
17 Battery Place, New York City

Representing a group of independent, competing makers of leather, who buy their raw material in open market against the bidding of all the world; who do business unaided by any subsidy, and with no advantage through any tariff; whose hazards are abnormally great, but whose margin of profit is abnormally small.



The H&O Chain Co.
INCORPORATED
83 to 87 Washington Street
South Norwalk, Conn.

Factory Phone
Norwalk 789

New York Office
9 Maiden Lane
Phone Cortland 1419.

January 3, 1923

Vulcan Crucible Steel Co.,
Aliquippa, Pa.

Gentlemen:-

We have had such gratifying results with your Special Vanadium Tool Steel for dies in our Chain-making Machines that we wish to give you the record on one set of dies which we put in work November 10, 1921, on a machine making Fox-tail Chain.

This work was carefully checked. The machine was run without re-newing the dies until December 28, 1922.

During this time this machine, with the same set of Special Vanadium Tool Steel dies made over 28,200,000 punchings from Brush Brass .015" thick. The aggregate thickness of these punchings is 35,250 feet or over 6 2/3 miles.

These results are several times greater than any we have been able to obtain from any other steel.

We are having similar results from tools made of Special Vanadium Tool Steel which we are using in our Cable, Jack, Safe and Duplex Cable Machines.

The performance of this steel, when used for dies is so remarkable that we feel you should have the details of this test run.

Yours very truly,

THE H & O CHAIN COMPANY.

Per H. J. O'Neill

HJO/RL

Because of its long life and wearing quality Vulcan Special Vanadium Tool Steel is used to replace Straight Carbon Steel. A good example of this is shown in the record made by the die referred to above. This blanking die was in continuous service for more than a year and it punched out over 6 2/3 miles of brass. A better realization of what this means may be had if you compare this record with the mediocre showing Straight Carbon Steel would have made.

Are your men using Vulcan Special Vanadium Tool Steel?

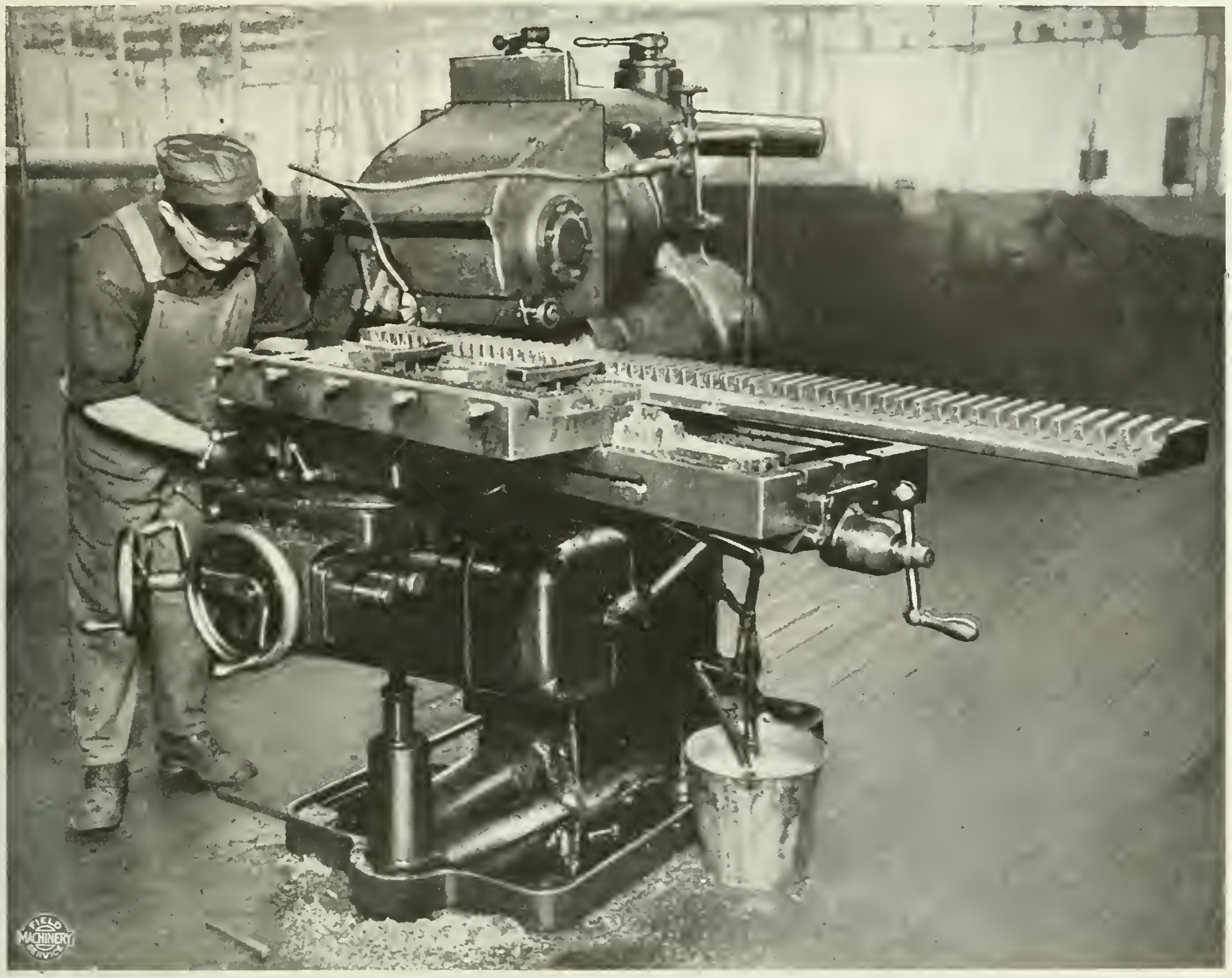
VULCAN CRUCIBLE STEEL COMPANY

ALIQUIPPA ESTABLISHED 1900 **PA., U. S. A.**

MAKERS OF WOLFRAM

BRANCHES:

NEW YORK—50 Church St., Room 384
BOSTON—307 Atlantic Ave.
CHICAGO—16-18 So. Clinton St.
ST. LOUIS—1306 Arcade Bldg.
DETROIT—4843 Bellevue Ave.



For Accurate Heavy Cuts

This shows a No. 2 Ryerson-Conradson Universal Milling Machine cutting a section of a special herringbone rack for a planer. The teeth are .720″ deep and are finished to a close degree of accuracy in a single cut. The modern design, wide range, extremely accurate construction and operating efficiency of this Ryerson-Conradson Miller are characteristic of all our machine tools. "Ryerson Machinery" means high grade production tools that meet the best standards for modern metal working equipment, in a range that covers the needs of practically every class of work.

We would be glad to send you complete information on any machines which are of interest to you.

JOSEPH T RYERSON & SON INC.
Established 1842

Plants: CHICAGO ST. LOUIS CINCINNATI DETROIT BUFFALO NEW YORK
Branch Offices: Minneapolis Milwaukee Denver Tulsa Houston San Francisco

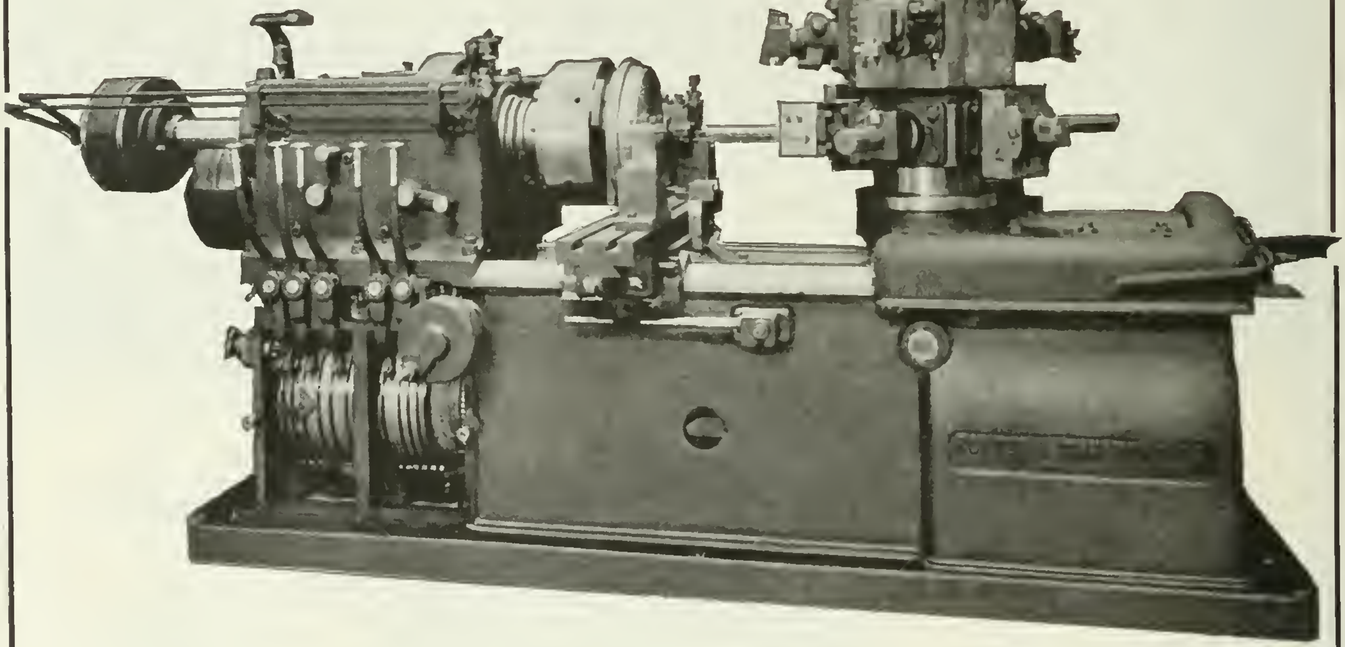
RYERSON MACHINERY

Announcement

of the

Potter & Johnston
New Model Machine

6-C AUTOMATIC



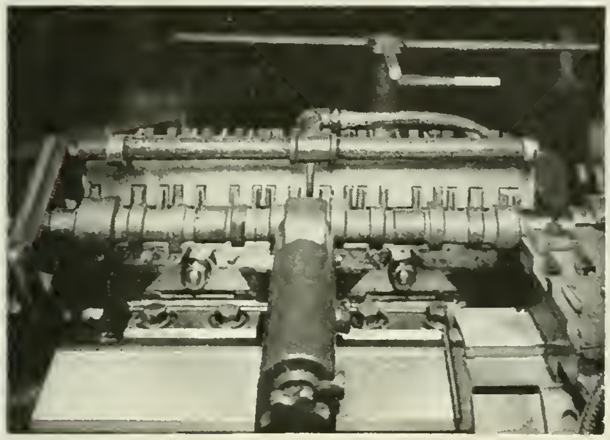
The Potter & Johnston 6-C Manufacturing Automatic Chucking and Turning Machine is the latest development in the P. & J. Automatic line and has been designed especially for the **Economical Production** of Flywheels, Hubs, Electric Motor Parts, etc., within its capacity where accuracy and power are required.

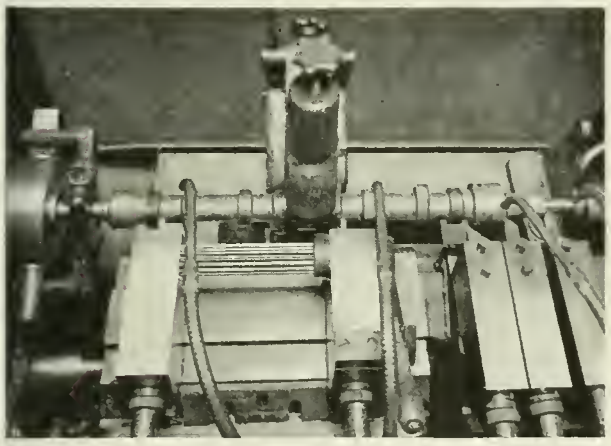
Send for your copy of bulletin No. 57.

POTTER & JOHNSTON, Pawtucket, R.I., U.S.A.

DOMESTIC OFFICES: New York Office—Hudson Terminal Building, 50 Church St. Walter H. Foster, Manager. Detroit Office—The Potter & Johnston Agency Co., 535 Bates St. Chicago Office—3057 Eastwood Ave. Leslie J. Orr, Manager. Pacific Coast Office—Rosslyn Hotel Los Angeles, Cal. Charles H. Shaw, Manager. FOREIGN REPRESENTATIVES: L. J. Colomb, 68 Avenue de la Grande Armee, Paris, France. Representative for France, Belgium, Switzerland, Spain and Portugal. Charles Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland, Ercole Vaghi, Corso Porta Nuova, 34 Milan, Italy. Rylander & Asplund, Stockholm, Sweden. Yamatake Company, No. 1 Yuracucho, Ichone, Kojimachiku, Tokyo, Japan.

Lo-swing
Beats Its Own Record





They thought they knew what production meant at the Jackson Motor Shaft Company, Jackson, Michigan, with 13 Lo-swing Lathes (3½" model) in constant operation, but the installment of these two new 4" models showed them that even the best machines may advance with the times.

Cam shafts 24 13/22" long of 3½% nickel steel come to the first of the two 4" Lo-swing Lathes with the center bearing turned and both ends faced and centered. Here they are faced between cams and turned on one main bearing and one end. Time, 1 minute 17 seconds floor to floor. The close up shows the 19 rear facing and 2 front turning tools.

The second operation (on the second new Lo-swing) is turning between the cams, one main bearing and the opposite end of the shaft. Time 1 minute, 45 seconds; close up shows the five turning tools.

This performance is better than the best estimates for competing machines; incidentally these two new model 4" Lo-swing Lathes are now handling the same amount of work that was formerly performed on three old 3½" Lo-swing and two engine lathes.

The new Lo-swing keeps "production up-to-date." Let us give you estimates

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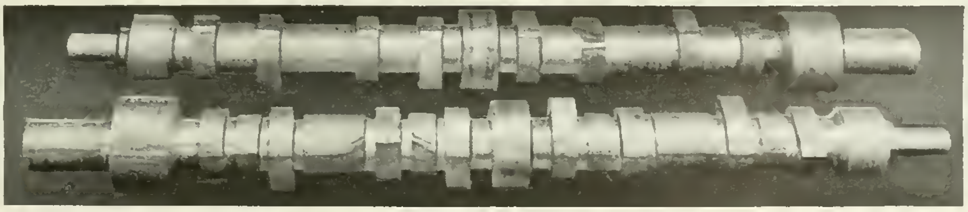

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LINDE OXYGEN

Studying Mechanisms in Motion

Application of an Optical-Mechanical Apparatus for Studying the Action of Rapidly Moving Parts

By PETER DAVEY

THE action of a mechanism operating at high speed often varies from the normal action due either to lack of balance or to some other defect. When such a condition exists, the effect of improper functioning usually is evident, but the cause is frequently unknown. The principal difficulty in detecting such mechanical defects has been due to the impracticability of observing the action of rapidly moving parts. An ingenious apparatus, known as the Elverson oscilloscope, provides a means of studying various forms of high-speed mechanisms under actual working conditions, by apparently slowing or entirely discontinuing the movements, even though the parts under observation are operating very rapidly. As this apparatus has been described previously in the technical press, the article to follow will deal principally with its practical application.

Briefly, the oscilloscope consists of an electrical interrupter which is driven direct from a shaft of the mechanism under examination for the purpose of synchronizing the flashes of a special type of lamp with the moving part, so that when this part is seen under the rays of the lamp, its motion appears to be either greatly retarded or entirely discontinued. In Fig. 1 the electrical interrupter is shown attached to the rear end of a milling machine spindle. If the switch plate of the electrical interrupter is in the "stationary position," the lamp flashes are accurately synchronized with the moving part, which is illuminated instantaneously and repeatedly at the same point in its travel; consequently, it appears to be stationary, because it is only illuminated at the instant of passing this given position. If the observer desires to see the motion reproduced slowly, the switch plate is turned to the "creeping position." Then the successive lamp flashes are not quite in synchronism with the moving part, which is illuminated at points varying slightly and progressively. The result is that the part appears to be moving slowly.

This article describes the practical application of a device known as the "Oscilloscope," by means of which it is possible to observe the action of high-speed mechanisms under actual working conditions. With this device, the action of the mechanism, moving at high speed, may be studied as if it were moving very slowly or actually standing still. This is accomplished by the use of a special type of electrical lamp, the flashes of which are synchronized with the movements of the revolving mechanism. If the lamp flashes illuminate the moving part repeatedly at the same point in its travel, it will appear stationary, because it is illuminated only at the instant when it passes a given position. If the successive flashes of the lamp illuminate the moving part at points slightly in advance of each other, the result will be that the part will appear to be moving slowly.

The rapid succession of the lamp flashes causes what is known as "persistence of image" in the eye, with the result that a continuous picture is produced of the slowed down or arrested motion in the same way that the "movie" projector throws a series of rapidly succeeding pictures on the screen, which appear continuous to the eye. In the case of the oscilloscope, however, the actual mechanism is examined and not a picture of it. In order to produce a sharply defined image, it was necessary to evolve a lamp giving a flash of extremely short duration, and this has been achieved to such an extent that, when a machine running at high speed is viewed in the "stationary" position, it is difficult to imagine that it is not at rest.

When the action of a machine is to be observed, the only preparation necessary is to make a simple adapter to act as a coupling between the shaft of the machine and that of the oscilloscope gear-box. This gear-box, which is encircled by a special clip having provision for anchorage to prevent rotation, is attached to the adapter so that its primary shaft rotates with the shaft of the machine. Electrical connection is then made between the gear-box and lamp, and the case that contains the electrical equipment, including a storage battery which supplies the necessary current for operating the lamp. These connections are effected by plugs and sockets, and long leads are provided so that the case may be moved out of the way, and the lamp carried around and used to illuminate any part of the machine. When not in use, the lamp and gear-box fit into the case, making a portable outfit. Given a rotary drive for the gear-box, the oscilloscope may be employed for the examination of any type of motion, either rotary or reciprocating, in cams, gears, chains, friction drives, slipping clutches, etc. This instrument has been developed by Herbert Kennedy & Co., Ltd., 233 Broadway, New York.

In addition to the "creeping" or "stationary" positions which are controlled by the gear-box switch, the action of a given part in different phases or positions may be observed by turning the complete gear-box around on the shaft. A protractor scale is mounted around the outer face of the box, from which accurate angular measurements of the degree of alteration of the phase may be read off. Thus, for instance, the period of operation of a cam may be measured under actual working conditions when lag is occurring due to the effects of inertia.

In this case, the oscilloscope is switched to the "stationary" position, and the cam mechanism illuminated by the lamp; the gear-box is then revolved slowly by hand, and at the point where the follower begins to rise, the angular measurement on the scale is noted. The gear-box is next revolved further, while the cam is seen to complete its cycle of operations, and at the point where the follower finally reaches the neutral section of the cam, the angular measurement shown on the scale is again noted. Now by taking the difference between the two readings, the true period of operation of the cam is determined under working conditions. At any point in the cycle, linear measurements also may be taken of the lift of the follower, and these linear measurements plotted against the angular measurements, thus giving a complete graphical record of the working of the cam. In some cases, curves taken in this way have shown astoundingly divergent results from the theoretical curves.

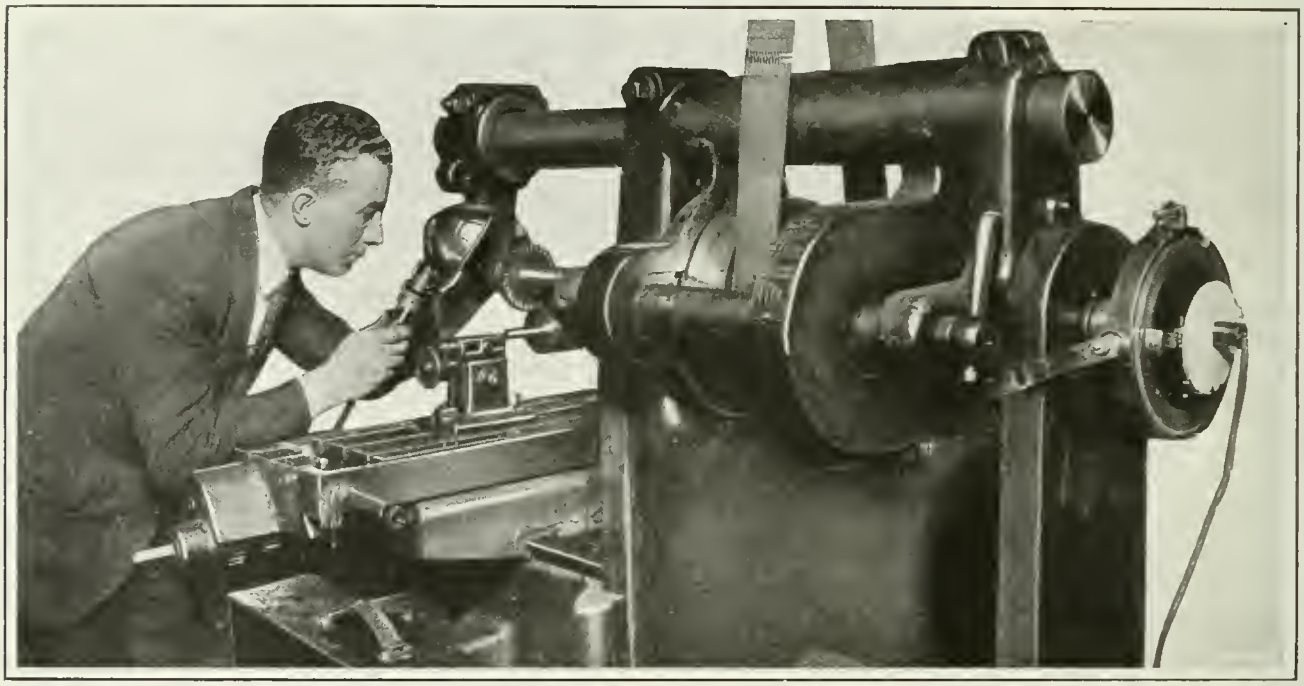


Fig. 1. Oscilloscope applied to a Milling Machine for observing Action of Milling Cutter

Observation of Gearing

Much valuable information has been gained about running gears, by studying the teeth meshing under actual working conditions in order to observe lost motion, lubrication, etc. A point that is often missed in this connection is the manner in which the gears are mounted, and there is no doubt that much time has been wasted in attempting to rectify the cutting of gears, when in reality the trouble has been that their mountings were not correct.

The oscilloscope may be successfully applied in many such cases, by making analyses of the vibrations around the bearing, and investigating the state of alignment when running, as well as the twist and whip in shafts. It can easily be seen whether or not the lubricant is doing its proper work, and in many cases it has been proved that oil, though supplied in quantities seemingly in excess of requirements, has been thrown off so that there was no oil at the essential point, namely, the point of contact of the teeth, although when viewed by the naked eye it seemed that correct lubrication was being effected. These statements also apply to chain drives, and chains often show vibrations that throw much light on the question of excessive wear and noise.

Action of Lubricants

The general subject of lubrication probably presents to the engineer more unexpected phenomena, when observed by the oscilloscope, than any other. This is explained by the fact that there are so many factors governing the behavior of the lubricant on high-speed moving parts as, for instance, the grade of lubricant; the nature of the surface on which it flows; the angle at which it strikes the moving parts; the nature of the oil supply, whether drip, splash, or continuous jet; and the surrounding temperature conditions. If we add to these the varying forces that act on the lubricant, such as surface pressure, centrifugal force, and supply pressure, it is not surprising that slight variations of any of these conditions should produce a great variation in the efficiency of lubrication.

Under the rays of the oscilloscope lamp it is a simple matter to observe exactly the formation of oil globules, their direction of flow, and the points from which they are thrown off the moving parts; and such observations have often led to improved economy in oil consumption, or by the slight alteration of small details, to the effecting of correct lubrication from conditions that otherwise produced practically no lubrication.

Studying Actions of Manufacturing Operations and Cutting Tools

Certain applications of the instrument have led to considerable speeding up of production operations, especially on high-speed automatic machinery, where it has shown the effect of running the machine in excess of normal speed, and by a close study of the defects that develop under these conditions has made clear the means of overcoming them, and thus making it possible to raise the normal speed. In many manufacturing operations, it is necessary either to run machines considerably below the maximum speed, or to stop them at regular intervals in order to inspect the progress of the work, and thus avoid the scrapping of a large batch of output through inability to check the setting of the machine while it is running. The oscilloscope provides a means of making the work appear as if it were creeping slowly through the machine, or else standing still at any particular point in the operation, and thus any fault developing under working conditions may be noted immediately, and it will never be necessary to stop or slow down the machine until such a fault does occur.

Study of the exact action of a cutting tool throws much light on the question of poor quality work or rapidly wearing tools (see Figs. 1, 2 and 3.) The cause and extent of chatter may be closely examined, and the point at which increased rigidity is desirable, to assist in its elimination, can be detected. In choosing the correct shaped cutter for a particular grade of material, it is of great value to be able to ascertain the form of shaving for different cutting depths and feeds; by watching the cutter, each stage of the cut of any individual tooth can be followed, and some very interesting results have been produced by the observation of a series of cutters, each ground in a slightly different way.

Determining the Periodicity of a Vibration

In the case of vibrations, special provision is made for their complete analysis, as regards direction, periodicity, and amplitude, and to attain this it is possible to produce either one, two, or four flashes per revolution of the shaft, in either the "creeping" or "stationary" position. Under ordinary circumstances the moving parts are illuminated by one flash per revolution of the shaft driving the oscilloscope.

Now suppose we consider a vibrating part viewed in the "creeping" position on one flash per revolution; we shall see the vibration slowed down, when it will appear as a slow swaying to and fro of the vibrating part. Assume that the vibration is occurring at shaft speed; then if we adjust the gear-box to cause the lamp to flash twice per revolution in the "creeping" position, two views of the vibrating part will be seen, 180 degrees apart, and this phenomenon will appear as two images of the part periodically approaching and receding from each other. Similarly, four flashes per revolution, in this case, would produce a quadruple image of the vibrating part, but should the vibration be at twice the shaft speed instead of at shaft speed, the four flashes per revolution would produce a double image. From the foregoing it will be seen that by working until a double image is produced, and knowing the ratio of the gear-box drive and the number of flashes per revolution that produces it, the periodicity of any vibration may be accurately ascertained without any calculation whatsoever.

As an example of a case in which it is necessary to drive the oscilloscope at a speed higher than that of the shaft, in order to find the vibration periodicity, suppose we consider a vibration occurring at eight times the shaft speed. Here it will be necessary to drive the oscilloscope at four times the shaft speed and employ four flashes per revolution before a double image will be produced.

Direction of a Vibration

In ascertaining the direction of a vibration, the double image phenomenon is again employed. The simplest mode of procedure is to make a light center-punch or similar mark on the vibrating part and to note the direction of the motion of this mark. Suppose, for instance, we are considering vibration on the top of an electric motor casing. If a mark is placed in the center of the casing top, we shall see two components of the vibration, namely, the axial and the transverse, and what we shall actually see by two flashes per revolution in the "creeping" position, will be two images of the mark following each other around in the form of an ellipse. The longest axis of the ellipse represents the predominant component, and the angular position of a line drawn through the longest axis, the resultant direction of the vibration.

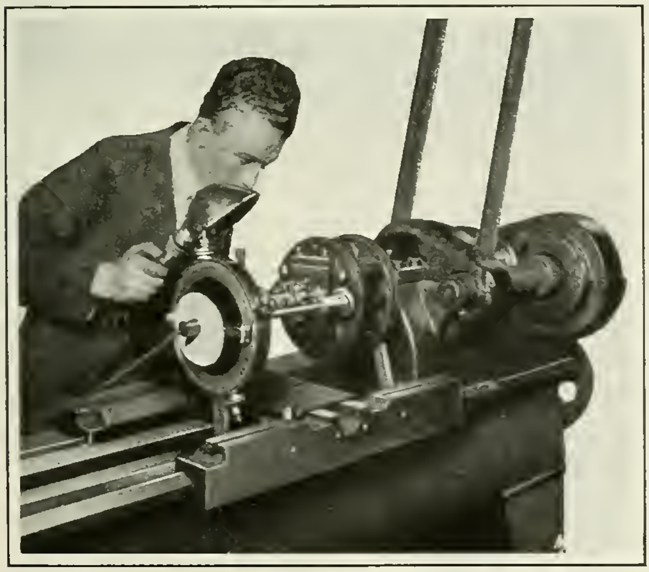


Fig. 2. Oscilloscope being used to observe the Action of a Formed Cutter Relieving Operation

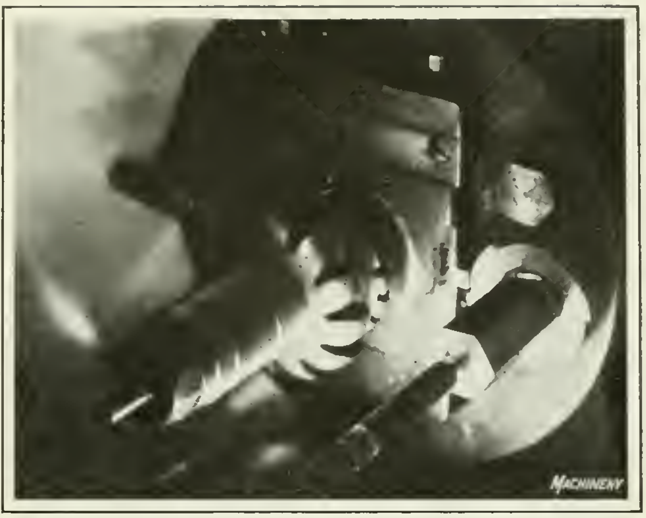


Fig. 3. Rapidly Rotating Cutter as photographed under the Rays of an Oscilloscope Lamp; Time of Exposure, Three Minutes

Amplitude of a Vibration

The third function of the double image phenomenon is in the determination of the amplitude of a vibration. It has been pointed out that two flashes per revolution in the "creeping" position produce two images of the vibrating part, periodically approaching and receding from each other. Now suppose two flashes per revolution are employed in the "stationary" position; then a stationary double image of the vibrating part will be produced, and the distance between the two images will increase or decrease as the oscilloscope gear-box is slowly turned around on the shaft. If the distance between the two images is measured when it is maximum, this distance will denote the maximum amplitude of the vibration at the point at which the measurement is taken. It has been found that in most cases where the vibration is at shaft speed, the most accurate method of obtaining maximum amplitude is by turning the box around until the node, or the point at which the two images exactly coincide, is reached; then the box is turned through exactly 90 degrees, and the maximum reading is obtained.

Typical Vibration Problems

The diagram Fig. 4 shows a typical enclosed piece of mechanism (containing an unbalanced shaft), as it would appear under the rays of the lamp, if illuminated by two flashes per revolution in the "stationary" position, with the box turned around until the maximum displacement appears. For the sake of illustration, the vibration, as shown by this diagram, is of larger amplitude than would ordinarily be met with in proportion to the size of the case, but it is intended to show exactly what is meant by a "double image." It will be noted that the vibration shown here has a pronounced horizontal component x and a vertical component y, the horizontal being of greater amplitude.

The diagram to the right shows an enlarged view of a portion of the bearing boss. A center-punch mark has been placed on the vertical center line just above the shaft, and the double image of this mark is shown at the point of maximum horizontal amplitude, while the dotted lines show the elliptical course taken by the two images of the mark as they follow each other around.

Above the center-punch marks are horizontal scribed lines, the distance between the images of which indicate the amplitude of the vertical component, and similarly if vertical lines were scribed, the amplitude of the horizontal component would be seen. Now suppose that two lines *A* and *B* have been scribed a known distance apart, say ¼ inch. Then if a double image appears exactly midway between the original positions of *A* and *B*, it shows that the amplitude of the vibration is exactly ⅛ inch, and similarly if the lines be scribed any known distance apart, the amplitude of the vibration may be arrived at.

The particular example here illustrated shows a vibration of large amplitude, but exactly the same thing may be done when amplitudes are very small, by employing suitable means for magnification, and successful measurements may be taken by the aid of a microscope with a micrometer attachment. If scribed lines appear too thick for accurate observations under the microscope, a glass disk having a hair line on it may be mounted on the vibrating part, and measurements of a high degree of accuracy may be taken in this manner.

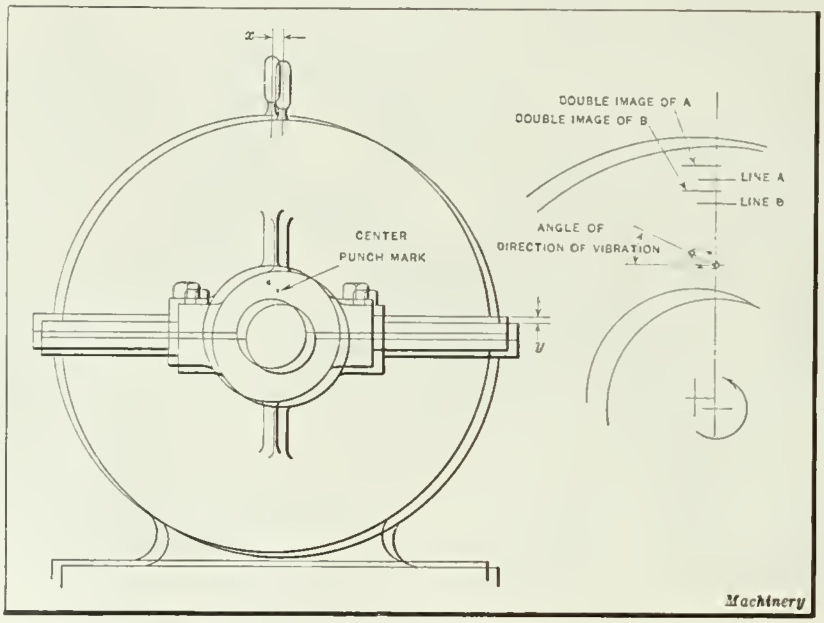


Fig. 4. Diagram illustrating "Double Image" Appearance of a Gear-case, which is subjected to Considerable Vibration; Enlarged View of Bearing Boss, showing Path followed by Punch Mark and Appearance of Lines for determining Vertical Amplitude

Having considered the means of analyzing vibrations, we will now turn our attention to the manner in which these analyses may be employed. In the first place, it can be determined at once if a vibration bears any definite relation to the speed of a given shaft, or whether its frequency is determined by the natural free period of the vibrating part. If the latter case holds, then instead of seeing the vibration as an even swaying motion or completely arrested, according to the position in which the oscilloscope is being operated, the motion will seem to be following a varying rule, the pulsations appearing of varying amplitude and at varying frequency.

Occasionally one sees the shaft speed gradually approaching the natural frequency of the vibrating part, and this makes itself apparent by the fact that the pulsations will become more and more regular, until they finally reach complete synchronism. Again, what is occasionally seen is a free vibration superimposed upon one synchronous with the shaft speed, and this gives the appearance of a "ghost" or phantom playing around the edge of the main vibration.

From the phenomena described, it is possible to ascertain if a troublesome vibration on a certain component of a machine is entirely the fault of the shaft, or whether the component itself is not sufficiently rigid and readily takes up a free vibratory period. By being enabled to ascertain the periodicity of vibrations, means are provided whereby they may, in many cases, be accurately traced to their sources. Suppose, for instance, a machine has a number of shafts running at different speeds, and it has been impossible to discover the shaft that is responsible for a certain vibration. If the oscilloscope gear-box be coupled, in turn, to the different shafts, or to one of them, and through gearing given the speeds of any of the others, then the gear-box speed that will produce a true double image of the vibrating parts on two flashes per revolution will at once indicate the periodicity of the vibration, and consequently the shaft responsible for it.

Another case frequently met with in which the analysis of periodicity is of great practical value is in connection with crankshaft vibrations on reciprocating engines. Here it is found that the periodicity is at twice crankshaft speed, which indicates lack of secondary balance, owing to the fact that connecting-rods, not being of infinite length, do not transmit true harmonic motion to the pistons. A serious vibration of this nature will show at once that the weights of the reciprocating parts are not correct.

On certain machining operations where vibrations are causing chatter or ripple, to be able to determine the periodicity will often point to the cause. To take a simple example of an eight-tooth milling cutter, the vibration was found to be at eight times shaft speed; while this showed that the vibration was caused by a jar on every tooth, the appearance of the work indicated that it was the result of one high tooth. This was due to the fact that the effect of vibration occurred only when a soft spot was encountered in the stock. Suppose, however, that it was caused by one high tooth; then the analysis would show the vibration to be at shaft speed, and the high tooth could be readily located by noting the tooth that was in operation at the time when the displacement appeared to be at a maximum. A case in which a high tooth or teeth would appear to be causing trouble, but would defy all efforts to trace the tooth unless the machine were in motion, would be in high-speed operations where the shaft of the machine is out of balance; and here the oscilloscope provides a ready means of locating the cause.

Direction analysis gives much useful information, not only in arriving at the cause of vibration, but also in indicating the structural rigidity of the machine concerned. The fact that a vibration has a distinct axial tendency in its direction, where an observation is taken over the shaft of a machine showing signs of lack of balance, indicates the presence of a dynamic couple in the shaft, its extent influencing largely this tendency to axial direction; that is, assuming that the construction of the machine is not such as to allow excessive movement in the axial direction.

This brings us to the point of structural rigidity, which is very important, since it often has to be based on a compromise, where causes of vibration that cannot be overcome are present in the machine. In a case like this, it is usually desirable to cut down the vibration of the machine as a whole, as much as possible, but at the same time, if the construction is too rigid, fracture is likely to occur at weak points. It is therefore desirable to be able to check the directions at various points, in order that as evenly proportional a compromise as possible may be arrived at. It may be mentioned here that in some cases it is surprising how vibration directions alter when running through various critical speeds, and this alteration will often show at once a lack of structural rigidity at a certain point.

Amplitude analysis is probably the most valuable function of the oscilloscope as applied to vibration problems, since the question foremost in the mind of the man dealing with them is: How much vibration is there? The opinions of people differ decidedly when it becomes a question of determining the amplitude of a high-speed vibration. An alteration made with a view to reducing the amplitude will often seem effective in the eyes of one man, whereas another will say that the trouble is worse than it was before the alteration was made. This particularly applies where vibrations are of very small amplitude, but if a thin line be scribed on the vibrating part, and the distance between the two images of this line, as observed under the rays of the oscilloscope lamp, is measured with a scaled microscope, both before and after the alteration is made, there is no point left for argument.

Means of accurate amplitude measurement permit of the investigation of critical speeds by observing the gradually increasing separation of the two images of a line until a maximum reading is attained, and noting the shaft speed at this point. The double image phenomenon may also be utilized in measuring the extent of movement in an oscillating motion of any amplitude, and occasionally will prove a useful method of determining the degree of overthrow in a motion of this kind. Although the latter may hardly be classed as a vibration analysis, it will have to be handled in exactly the same way.

Checking Balance of High-speed Rotors

Having described the means of carrying out analyses and the separate uses to which they may be put, we will now consider a case in which they are employed collectively, namely, in the balancing of high-speed rotors. This can be done with the rotor actually mounted in its permanent bearings, and with no preparation beyond providing means for driving the oscilloscope gear-box from one end of the shaft. The means employed is by analysis of the vibrations caused by the rotor around the bearings, and noting the position of the rotor with relation to the maximum displacement in a given direction. In carrying out this balancing operation, it will first be necessary to decide whether the vertical or the horizontal component of the vibration is to be considered.

In most cases it will be found that there is no choice between them in the matter of convenience, and therefore it is obvious that readings will be simpler to take and probably more accurate if the direction having the greatest amplitude is chosen. A mark is made on the bearing, from which the direction of greatest amplitude is ascertained; then a suitable line is scribed on the bearing, the line being vertical if the vibration be horizontal and vice versa. Let us suppose it has been decided to work from horizontal readings; then a vertical line having been scribed on the outer face of the bearing cap, a mark on the stationary part of the machine at a point along the horizontal center line is made, as shown in Fig. 5, which indicates diagrammatically a rotor set up in its bearings ready for balancing. Some means are then provided for identifying various points on the circumference of the rotor, such as a series of numbers chalked on different segments of the armature or spokes of a wheel, as shown in the illustration; if this is not convenient, the marks may be scribed on the shaft, but in this case, on account of the small diameter, the marks will have to be spaced with considerable accuracy.

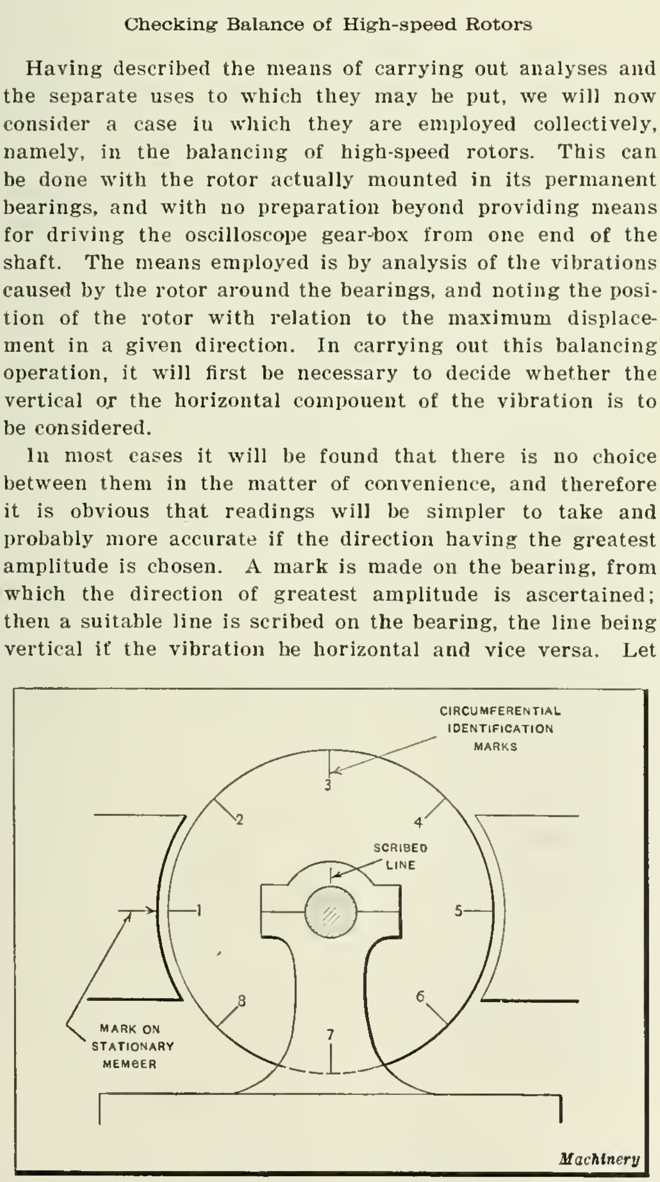

CIRCUMFERENTIAL IDENTIFICATION MARKS
SCRIBED LINE
MARK ON STATIONARY MEMBER
1
2
3
4
5
6
7
8
Machinery

Fig. 5. Diagram showing Marks used in Connection with Rotor Balancing

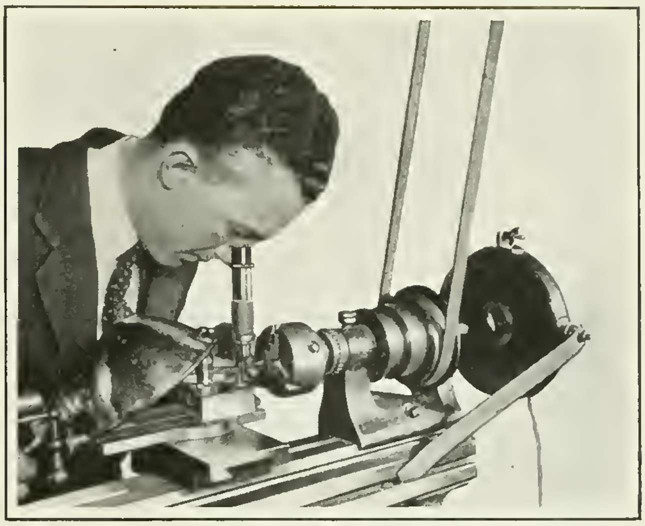


Fig. 6. If Necessary, a Microscope may be used in Conjunction with the Oscilloscope for examining Small Parts while in Motion

Having made the necessary marks, the oscilloscope gearbox is attached to the shaft, and the rotor set in motion, the speed of rotation being increased, when it will be noted that the vibration will steadily increase in amplitude up to a maximum, until the "critical" speed is reached, when it will, on further speeding up, register a minimum reading while the shaft runs through its critical range, after which the vibration will once more increase. It should be remembered that for speeds below the critical range a deflection of the bearing in a certain direction will locate the heavy side of the rotor, while above the critical speed range, the deflection will denote the light side. The critical speed in most cases will be quite low, and therefore balancing will usually be carried out above it. As already described, the actual reading will be taken on the double image of the scribed line, but it is not always possible to tell from this which way the displacement has taken place, since we shall see two exactly similar lines. Now it will be necessary to reduce the number of flashes to one per revolution, in order to ascertain the position the rotor has reached, and if at the same time it is noted whether the right- or left-hand image of the line has disappeared, it is shown at once which way the deflection has occurred. For instance, referring to Fig. 5, assume that the speed is above the critical range, and that the box has been turned around until the maximum vibratory amplitude is reached, as shown on two flashes per revolution; then, if the switch is changed to give one flash per revolution and it is observed that the number 1 on the rotor has reached a point opposite the arrow mark on the stationary part of the machine, and at the same time the right-hand image of the line has disappeared, we know at once that the deflection has taken place to the left, and that consequently the light spot is in the vicinity of the number 1.

Another point that has to be considered is that the maximum vibratory amplitude does not correspond exactly to the heavy or light spot on the rotor, but there is a definite lag in the reaction of the bearings. When taking readings below the critical range, the bearing deflection will lag behind the heavy spot, but above the critical range it will appear just in front of the light spot. The amount of this lag depends upon the speed of rotation, and its direction upon the direction of rotation, the amount being equal in either direction. Therefore, if the rotor be run first in one direction and then in the other, the mean position on the rotor between the two that correspond to maximum vibration will indicate the heavy or light spot, as the case may be.

Referring again to Fig. 5, suppose the point registering with the arrow is point 1 when vibration shows the maximum amplitude, and in the opposite direction of rotation, point 3 registers with the arrow; then the mean between these two points, namely point 2, indicates the heavy or light spot, as the case may be.

The broad principles underlying balancing operations with the oscilloscope have been dealt with in this article, but there are many variations from these principles that would require individual treatment. In all cases, however, the balancing can be carried out with the rotor mounted in position, and it is a comparatively simple operation, which permits of measurements being taken at intervals indicating exactly when the limit that represents a good commercial state of balance has been reached.

* * *

ASSEMBLING A GENEVA STOP-WHEEL MECHANISM

By W. OWEN

An important factor in the smooth working of a Geneva stop-wheel mechanism such as described on page 724 in May MACHINERY, which to the writer's mind is far more important than the locating of the driving roller on its arm is the accurate dividing or spacing of the slots in the driven plate and the positioning of these slots with respect to the cutaway portion of the plate. In the article referred to, it was assumed that a jig was not used to obtain the correct center distance between the two shafts. If there are many of the mechanisms to be made, the writer has found that a jig is indispensable.

The illustration that accompanies the article in May MACHINERY shows the mechanism designed to operate under ideal conditions; that is, the plate is revolved through an angle of 90 degrees by a corresponding movement of the arm, so that when the driving roller is entering or leaving the slot, the center line through the slot is at right angles to the center line of the driving arm. This, however, though advisable when possible, is by no means the condition always met with. The mechanism will work quite smoothly when the driving roller rotates through an angle of 70 degrees and imparts a 90-degree movement to the driven plate. An extremely accurate dividing head must be used in milling the slots in the driven plate of the mechanism. The same dividing head should also be used in conjunction with a circular table for milling out the curved portions of the plate. The writer knows of no smoother working mechanism for an intermittent non-reversing motion than the Geneva stop-wheel mechanism.

* * *

Water power is one of Canada's most basic and valuable natural resources. The capital invested in water power developments in that country is well over one-half billion dollars, making it one of Canada's greatest single industries. The known available water power in Canada is over 18,000,000 horsepower for conditions of minimum flow, and approximately 32,000,000 horsepower would be available for at least six months a year. These estimates are based on a 24-hour power basis. The total capacity of the water wheels and turbines so far installed in Canada is nearly 3,000,000 horsepower, or 338 horsepower per 1000 population. Canada's position is second only to that of Norway in the per capita utilization of water power. The present development represents an annual equivalent of nearly 27,000,000 tons of coal.

CASTING ALUMINUM MATCH PLATE PATTERNS

By JAMES F. HINES

The procedure followed in making double-faced metal match plate patterns was described on page 695 of May MACHINERY. Further information on the production and use of double-faced match plate patterns will be given in the following: The present article deals with the type of metal match plate pattern which is cast in aluminum, and which has an irregular parting line. This type of match plate can be rammed up and finished by hand on the bench or used in connection with the old style squeezer machine. It can also be used on a modern up-to-date power jolt squeezer, by jolting the drag and squeezing the cope and drag together at the same time. In this case, the cope is lifted off by hand, the plate being vibrated by either a pneumatic or an electric vibrator.

Until the last few years, it was generally believed that only certain types of patterns could be "plated" with good results. Today, by exercising proper care in making match plates, it is safe to say that over 90 per cent of the castings made in brass, iron, aluminum, malleable iron, and steel, weighing from one ounce to fifty pounds, can be successfully made from a match plate pattern. A properly made match plate will produce castings that are uniform in both weight and size.

Match Plates Reduce Production Costs

In some instances, the cost of production has been lowered three cents per mold through the use of match plates without reducing the molder's wages. Besides this saving, the number of pieces made in one mold has, in some cases, been increased 100 per cent, with very little increase in the size of the flask. For example, a manufacturer recently had a match plate pattern made for a coat and hat hook, which had been marketed by him for eighteen years. Brass gates with twelve pieces to a mold, in a 10- by 16-inch flask, had been used in producing the mold. At present, this manufacturer is producing twenty-four pieces in a flask, 12 by 16 inches in size, by employing a match plate.

In another case, a match plate was made up for producing a "pipe applier," an article which is sold at retail for ten cents. Naturally the margin of profit on this article is very small. In order to make the manufacture of the "pipe applier" profitable, a match plate pattern was made up; this enabled the operator to mold twenty pieces at a time, as against twelve pieces by the method previously employed. The labor cost also was reduced 2½ cents per mold. Such savings are made possible by carefully arranging the gating and the pieces in designing the match plate. Heavy or strong gating is not necessary when match plate patterns are used; in fact, the gating can be much lighter than that ordinarily used. Trouble is often experienced by the loosening of the pattern from the runner due to hand rapping and continual hard use. This trouble is avoided entirely when match plates are employed.

With the metal match plate type of pattern, the gates and runners are cast in one piece with the plate. As they are vibrated by air, which does not damage the plate, there is practically no expense for pattern upkeep. In constructing match plates, care should be taken to make them as nearly as possible 100 per cent efficient, as this costs but little more than to make them, say, only 50 per cent efficient. For example, a poorly arranged match plate may provide for the molding of ten pieces, whereas by a more careful arrangement it could be made to mold twenty pieces without any increase in size.

Production Requirements Determine Type of Pattern

The kind of match plate that should be used for any particular piece depends on the number of castings required. Match plates of the type here described are not the most efficient form where large production is involved, but are best adapted for use in producing parts ordered in lots of, say, 1000 to 10,000 pieces. An order for a certain automobile part, now in the process of being filled by several manufacturers of malleable castings, required seventy different match plates in order to furnish the castings on schedule time. This order was much too large to be handled by a double-faced match plate type of pattern, as this would have required the services of too many men. Orders of such magnitude require a different molding method and a different type of pattern. No attempt will be made here, however, to explain the method or patterns used in this case, as they have been developed along entirely different lines from those described in this article.

An ordinary gate can sometimes be employed in the production of a match plate. This is more frequently done where the pieces are so small that the shrinkage does not affect the size of the pieces to any appreciable extent, or where a shrinkage of 1/16 or 1/8 inch in the size of the casting is allowable. The aluminum plate casting shrinks approximately 5/32 inch to the foot. When any shrinkage is objectionable, the gate pattern cannot, of course, be used in producing the match plate, and it becomes necessary to make a master pattern with sufficient allowance for the plate shrinkage and the final shrinkage of the parts. In order to produce match plates that are free from shifts and excessive or detrimental shrinkage at the points where the pattern joins the match plate, it is necessary to watch many details very closely.

Casting a Match Plate

At least two drag and two cope flasks made of metal and machined on each joint so as to be true and parallel should be available for producing aluminum match plates. These flasks should each have at least three hardened pins to insure accurate alignment. Hardened bushings should be fitted into the cope, and the mating pins in the drag should fit the bushings closely, so that there will be no shifting of the cope on the drag. The bushings and the pins should be so located that the four flasks (two drag and two cope flasks) will be interchangeable. For general purposes, a flask 28 by 38 inches is about the right size. The drag should be 6 inches deep, and the cope the same depth. Excellent results are obtained by using Red Lock sand mixed with 00 Albany sand in about the proportions of two-thirds Red Lock sand to one-third Albany sand. Nothing but the best No. 12 aluminum bought in ingot form should be used. A perfect master plate, so far as neatness and accuracy is concerned, can be obtained by this combination. All points of the master pattern should have a liberal draft; in fact, the draft should be about double the amount that the average patternmaker is accustomed to put on ordinary patterns. The molder who is to handle the work must have had a broad experience, possess a good eye, and have lots of patience. An assortment of odd-sized and odd-shaped slicks should be available for smoothing up partings, pockets and joints.

The master pattern is either set up on a sand match or blocked up properly on a machined plate. The size of the flask used depends on the nature of the plate. A cope flask is then put over the master, and the flask rammed up with a green sand match, after which it is clamped up and rolled over. The sand bed or metal plate is next lifted off, and a temporary parting made. Then a drag flask is placed on the cope, and sand riddled on the mold through a very fine riddle to a depth of about an inch. Following this, another inch or so of sand is added, using a 1/8-inch riddle, and finishing with a ½-inch riddle. The sand is then rammed hard and uniformly, after which the cope and drag are clamped together and rolled over.

The false cope is next lifted off and shaken out. Then the final parting is made, and finished up by powdering heavily and brushing with a fine camel's hair brush. It is then blown off clean, after which a light coat of parting material is added and the cope flask put in place. The cope is then rammed up the same as the drag. When this is completed, two men carefully lift the cope off, taking care to draw it off evenly, while a third man vibrates the mold by hand, using a stick placed under the mold for this purpose. This stick should be about 3 inches wide and 18 inches long with a cleat nailed to it. If a perfect lift is not obtained, the mold should be shaken out and the work repeated.

After a perfect mold has been obtained, the plate size is laid off on the drag mold. Strips of the exact thickness of the required plate are laid on the mold so that their outer sides coincide with the lines laid off on the drag mold. Then sand is filled in and struck off level with the strips. The strips that cover the drag up to the lines that determine the size of the plate are now removed. After this is done, gates are cut at each end of the plate. The pattern is next drawn out, and cores or chills are used to support the heavy sections. The cope and drag are well sprayed with molasses water, and each half of the mold is thoroughly dried. The mold is then closed, and the cope and drag clamped together and poured off as soon as possible. Two men should pour at a time, one at each end, and the pouring should be done with the metal as cold as possible. The cooler the metal, the smoother will be the castings and the less the shrinkage.

* * *

MACHINERY EXPORTS TO THE FAR EAST

In 1921, the United States exported $246,000,000 worth of industrial machinery of all classes, as compared with industrial machinery valued at $96,000,000 in 1913. Considering that prices were practically double in 1921, as compared with 1913, there was an increase of approximately 25 per cent in the actual volume of machines exported. Of the total exports in 1921, fully 26 per cent went to Asia, as compared with less than 7 per cent in 1913. During the last four years, the United States has sent $242,000,000 worth of machinery to Asia, which is equivalent in value to the exports of forty years at the pre-war rate, and in volume to the exports of twenty years. This indicates the great importance of the Far East as a market for industrial machinery. The Bureau of Foreign and Domestic Commerce has made a special investigation of this market, the results of which are covered in a report entitled "Asiatic Markets for Industrial Machinery," which has been compiled by W. H. Rastall, formerly a trade commissioner and now chief of the Industrial Machinery Division of this bureau. The report has recently been made available for distribution, and can be secured from the Superintendent of Documents, Washington, D. C. The price is 60 cents. The book contains 344 pages, liberally provided with maps, charts, tables, diagrams and illustrations. Those interested in the export of machinery will find in this report a careful study of the Asiatic markets and of the position of American products in these markets.

* * *

Although business in the tractor industry and farm machinery field is still far from normal, the improved conditions in these fields are indicated by the price advances that have taken place. The orders received from dealers during the early part of the year exceeded the estimates to such an extent that manufacturers have found themselves compelled to increase their production schedules and to come actively into the market for raw materials. The price advances in the tractor and agricultural machinery field are justified by the increases in the prices of raw materials and the shortage of dependable labor, which have added to production costs. Farmers are in great need of new machinery, and there has been practically no buying during the last two years.

Design of Harmonic Cams

By C. O. RHYS

WHEN the motions of a cam-operated automatic machine have been decided upon, the timing determined, and the time chart prepared, the next step is to work out the actual sizes, throws, etc., of the cams themselves. In a machine that has many cam-actuated motions, it frequently becomes a long and tedious process to lay out the cams so as to have them meet the required conditions. They must be kept within the available space, the angle of climb must be kept within the proper limits, under-cut must be avoided in machining the cam tracks, and the throws must be calculated for each cam while passing through the angle of turn provided for by the time chart.

The accompanying table of formulas has been found by the writer and by many designers and draftsmen of his acquaintance, to facilitate the work of laying out cams to a considerable extent. All the factors mentioned can be rapidly and accurately calculated before a line need be drawn, slide-rule results being more than sufficiently accurate. Probably one or two examples will show the use of the table better than the most elaborate explanation.

TABLE OF FORMULAS FOR LAYING OUT HARMONIC CAMS

(Angles are in Degrees; Distances in Inches)

Symbol	Description	Formula
a	Angle of action of cam	
b	Angle corresponding to maximum steepness of cam track......................	$\frac{ad}{180}$
c	Maximum angle of climb..............	$\text{Tan } c = \frac{90t}{a\sqrt{R(R+t)}}$
d	Angle turned through by r corresponding to maximum steepness of cam track....	$\text{Cos } d = \frac{r}{R+r}$
a_1	Value of a when the distance of every successive point on the cam track from the camshaft constantly increases......	$180\sqrt{\frac{r}{R}}$
r	Half-throw of cam, or radius of cam-curve generating circle	
t	Travel or throw of cam	
R	Radius of base circle of cam curve......	$r\left[\sqrt{\left(\frac{180}{a \tan c}\right)^2+1}-1\right]$
C	Radius of curvature of cam curve at inner end.............................	$\frac{(R+t)^2}{R+t+r\,(180 \div a)^2}$
C_1	Radius of curvature of cam curve at outer end...........................	$\frac{R^2}{R-r\,(180 \div a)^2}$

Machinery

Suppose a cam is to be designed that will make a throw of 1½ inches while the camshaft is turning through an angle of 75 degrees. Suppose further that the angle of climb is not to exceed 30 degrees. Referring to the illustration Fig. 1, it is evident that if the radius R of the base circle can be calculated, and if the size of the cam-roll is known, the other dimensions of the cam may readily be determined.

From the table the formula for R is found to be

$$r\left[\sqrt{\left(\frac{180}{a \tan c}\right)^2+1}-1\right]$$

From the given conditions, r = one-half the cam throw, or ¾ inch; a = 75 degrees, and c = the angle of climb, or 30 degrees. Substituting these values in the formula, we have:

$$R=\frac{3}{4}\left[\sqrt{\left(\frac{180}{75 \times 0.5774}\right)^2+1}-1\right]=2.45 \text{ inches}$$

If the cam-roll is taken to be 1 inch in diameter and the cam track is not to approach nearer than ⅜ inch to the periphery, then by adding together the known values, the diameter of the cam can be quickly determined. Thus:

2.45 = radius of base circle;
1.50 = throw of cam;
0.50 = radius of cam-roll;
0.375 = thickness of metal beyond cam track;
4.825 = radius of cam.

Then the cam diameter is 9.65 inches.

If the radius of the base circle were increased slightly to obtain even figures, the climb angle would be slightly less abrupt than the specified 30 degrees. If we wish to check up this climb angle by laying it out, we must first find the point in the cam track where the maximum steepness occurs. This corresponds to a point on the cam track at which the radius of the circle generating the harmonic curve has passed through a certain angular turn, the magnitude of which is given in the table as

$$\text{Cos } d=\frac{r}{R+r}$$

Substituting known numerical values in this formula,

$$\text{Cos } d=\frac{0.75}{2.45+0.75} \qquad d = 76.5 \text{ degrees, nearly}$$

This angle, as the table of formulas shows, corresponds to the angle b turned through by the cam

$$b=\frac{ad}{180}=\frac{75 \times 76.5}{180}=31.8 \text{ degrees}$$

from the point where the throw begins.

We can now examine the cam curve to see whether it is free from under-cut. Under-cut will not occur provided the radius of curvature of the cam curve is more than the radius of the cam-roll. The points of least radius of curvature of the cam track are the two ends, so that if these be great enough, the rest of the cam curve will not give trouble. The radii of curvature at the ends can be found by applying the formulas for C and C_1, given in the table. Thus:

$$C=\frac{(2.45+1.5)^2}{2.45+1.5+0.75\,(180 \div 75)^2}=1.89 \text{ inches}$$

$$C_1=\frac{2.45^2}{2.45-0.75\,(180 \div 75)^2}=-3.21 \text{ inches}$$

Both these values are more than 0.5 inch, the radius of the cam-roll, so that the cam track will not be under-cut. The minus sign for value C_1 simply means that the center of curvature is outside of the cam track, which would naturally be true for one center when the track has the shape of a reverse curve.

In some cams, where the angle of action is large, every successive point on the cam track is farther removed from the center of the shaft, as shown in Fig. 2. The least angle of action, which is necessary for this condition, can be found by the formula for a_1 given in the table. Applying this formula to the cam under consideration,

$$a_1 = 180 \sqrt{\frac{0.75}{2.45}} = 100 \text{ degrees}$$

That is, if the angle of action had been equal to, or more than, 100 degrees (other dimensions being the same), the track would have been of the character shown in Fig. 2, with its curvature constantly going away from the shaft center. In cases of this kind, C_1 may be very large, and the question of possible under-cut then depends upon the value of C only.

Limitations in Available Space

Now suppose that questions of available space had prohibited the use of a cam as large as 9.65 inches in diameter and that the maximum outside diameter could not exceed 8.50 inches. This would mean that radius R would have to be reduced by half the difference between 9.65 and 8.50 inches, or 0.575 inch. Then the angle of climb of the cam would be given by the formula for c, R being 2.45 — 0.575, or 1.875 inches.

$$\text{Tan } c = \frac{90 \times 1.5}{75 \sqrt{1.875 \times 3.375}}$$

and

$$c = 35 \text{ degrees } 30 \text{ minutes}$$

This is by no means a severe angle for ordinary work.

We must now find the least radius of curvature for this cam curve, which is

$$C = \frac{3.375^2}{3.375 + 0.75\,(180 \div 75)^2} = 1.48 \text{ inches}$$

This is still a good deal in excess of the 0.5 inch radius of the cam-roll, so that there will be no under-cut of the cam track.

Conditions Causing Under-cut

Under-cut is usually caused by the combination of a small angle of action, a high climb angle, and a large-diameter cam-roll. For instance, if we take an angle of action of 60 degrees, a climb angle of 45 degrees, and a cam-roll of 2 inches diameter (relatively large for a 1½-inch throw) we find that

$$R = 0.75 \left[\sqrt{\left(\frac{180}{60 \tan 45} \right)^2 + 1} - 1 \right] = 1.62 \text{ inches}$$

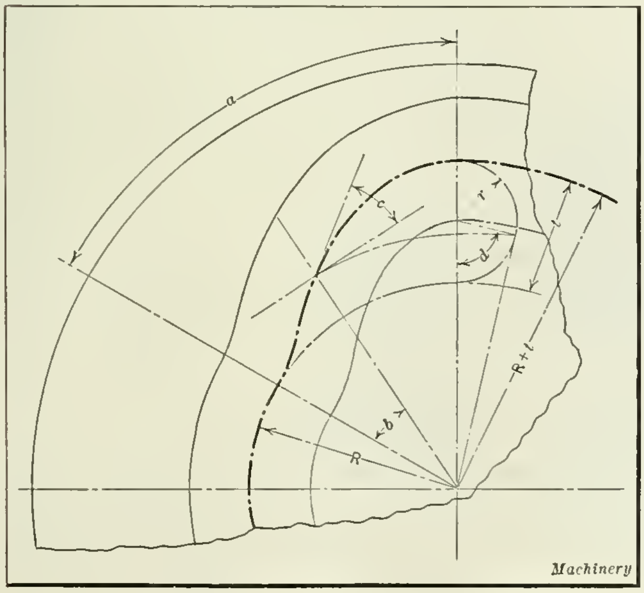


Fig. 1. Diagram for laying out Harmonic Cams

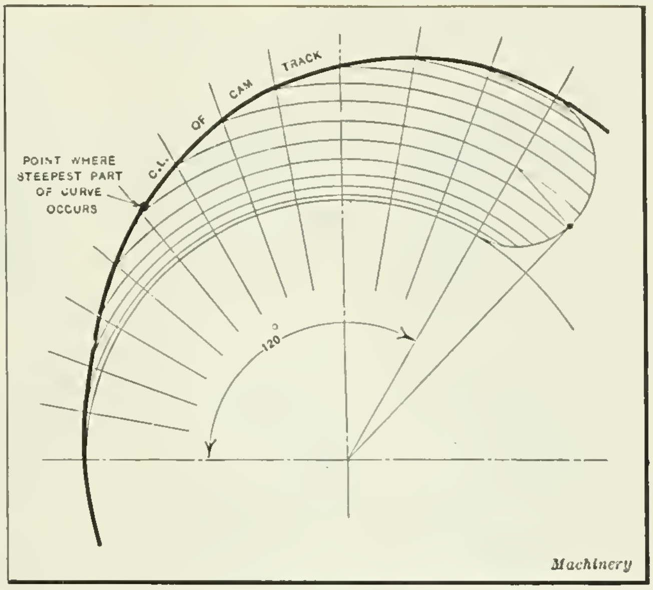


Fig. 2. Character of Curve when Angle of Action is Large

and

$$C = \frac{3.12^2}{3.12 + 0.75\,(180 \div 60)^2} = 0.985 \text{ inch}$$

The value of C then is less than the radius of the cam-roll, a condition that will, as previously stated, cause under-cut.

The foregoing examples, together with the table of formulas and their application, will probably be sufficient to show how the cam elements, for a given set of conditions, can be arrived at accurately without having to spend a considerable amount of time in laying out cam curves.

* * *

ARC WELDING IN THE FOUNDRY

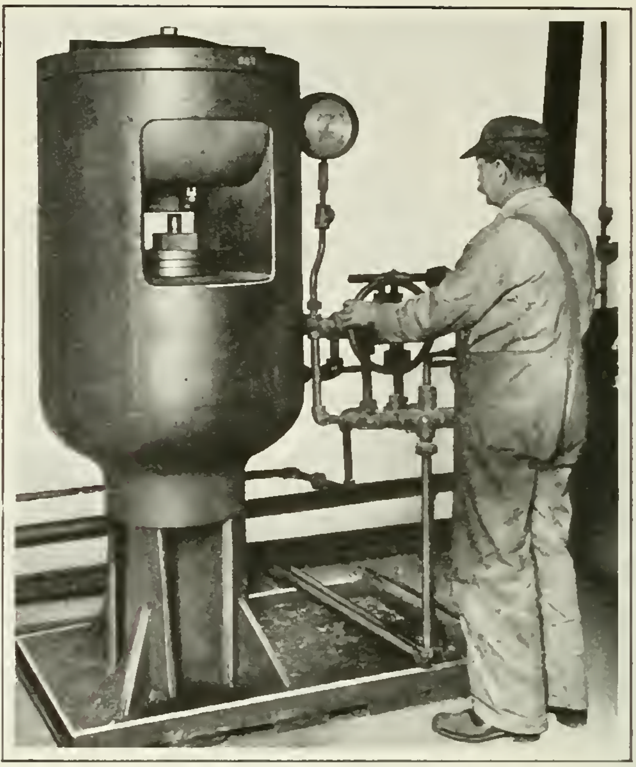
One of the most recent applications of arc welding in foundry practice is in the repairing of worn flasks, according to a statement made by A. M. Candy of the Westinghouse Electric & Mfg. Co. The operation is said to have been very successful and to result in marked savings. When the hole in the upper malleable iron lug of a flask wears to such a large diameter that the pin in the other half of the flask will not fit it sufficiently tight to hold the parts in alignment, the hole can be reamed out to a diameter of about ¼ inch larger than that required for the pin, and then completely filled by the use of the metallic electrode arc-welding process. A new hole is then drilled through the built-up metal. The object of having the filled hole ¼ inch in diameter larger than the size ultimately required is to prevent difficulty in drilling the hole. There will be a layer of very hard, chilled, high-carbon cast steel about 1/16 inch thick in the region where the deposited metal unites with the casting. This metal will not affect the drilling if the filled hole is made ¼ inch larger than the final drilled hole. The cost per hole, for welding, is stated to be from 6 to 7 cents.

* * *

An automatic furnace for hardening rock drills, working on the principle that steel becomes demagnetized at its critical temperature when it is ready to be quenched, has been developed in South Africa. It is stated that the tool, when it has reached the required temperature, disconnects an electrical circuit so that it is automatically pulled from the furnace, operating a bell as it is withdrawn and thereby giving notice to the hardener that the tool is ready for quenching. It is claimed that uniform results are obtained with this furnace, and that tools can be hardened at the rate of from 150 to 200 per hour.

Making Steel Molds by Hobbing

Process of Sinking Duplicate Impressions in Mold Dies by the Use of Hobs in Conjunction with Enormous Hydraulic Pressure



IN the manufacture of molded products, such as are made from bakelite, hard rubber, and various compositions for the electrical and numerous other industries, the making of the molds is a very important feature. As steel molds are the most durable and satisfactory, they are being used chiefly at the present time, although some molds are made of cast iron or soft metal, depending upon the material to be molded and the class of service for which they are to be used. This article is confined to the making of steel molds. Incidentally, a mold, as the term is here used, consists of an upper die and a lower die for forming a complete cavity into which the given product can be molded. It is evident, therefore, that the function of these upper and lower dies is similar to that of the cope and drag in ordinary foundry work, except that they are made of steel and are used for relatively small parts.

As these molded products often are required in large quantities, a multiple process of molding is commonly employed, whereby a number of duplicate parts are molded at the same time. In connection with this method, several molds are required, which has been an important factor in developing methods of producing duplicate molds cheaply and accurately.

General Methods of Making Molds and Principle of Hobbing Process

There are three general methods of producing the dies for forming molds: One is by machining; another is by a so-called "hobbing" process; and a third method is by combining the machining and hobbing processes. The machining method is unsatisfactory, particularly when the impression in the die is of complex or intricate form and must be duplicated in several molds, because duplication is practically impossible, and the work requires not only a high degree of skill but also considerable time. For this reason, the machining method, generally speaking, is impracticable, although it might be employed for making very simple dies, especially if it is not necessary to produce these in duplicate.

The hobbing process has long been employed for making dies such as are used in producing coins, medals, and various products of the silversmithing and jewelry trades. This method is designated as hobbing, because a "hob" or "force" is used, which is in the form of a punch and has a shape corresponding to the impression required in the die. In other words, the hob, at its formed end, is a duplicate in hardened tool steel, of the part to be molded in the hobbed die. While this hob must be made accurately and be given a fine finish, it is, of course, much easier to produce than would be a cavity or impression of corresponding shape. Furthermore, after the hob is made, it can be used to advantage in reproducing duplicate impressions in a number of different dies. The hob is hardened so that it will withstand the extremely high pressures employed in connection with the production of dies by this method.

In a general way, the method consists in forcing the hob into the unheated die blank by means of hydraulic power so that the shape of the hob is reproduced in the die impression. As this method is ordinarily employed, however, considerable difficulty is frequently experienced on account of the hardening of the die as the hob is forced into it. To overcome this, it is customary to force the hob part way in and then anneal the die. In some cases, the annealing must be repeated quite a number of times before it is possible to finish the impression. This repeated annealing requires considerable time, and is not conducive to the best results, because wherever the hobbing is discontinued for annealing, a slight wave or ridge is left in the impression.

Improved Method of Hobbing Mold Dies

An improved method of producing dies has been developed by the Burroughs Co., 246 N. Tenth St., Newark, N. J. The hob used in connection with this method is similar to the type ordinarily employed, but the pressure is exerted against the die being formed in such a way that die impressions requiring several annealings by the old method are finished in "one push," or by a continuous operation. Special hydraulic presses are used for this work, in order to secure a gradual application of the high pressures required. One of these presses is shown at work in the heading illustration. As will be seen, it has a rodless frame formed of one solid casting. The press is operated by a duplex type of pump having two plungers on the low-pressure side and two plungers on the high-pressure side. The low-pressure side is used in making ordinary adjustments, and the high-pressure side is employed for the hobbing operation.

If the die to be made is a simple form and the impression is easy to produce, the hob is forced into the die blank without confining the blank, which is allowed to spread laterally as the hob descends. The impression thus formed is slightly larger than the hob, but for many classes of work this difference in size is negligible. The die blank which has been bulged outward is machined afterward to whatever external width may be required.

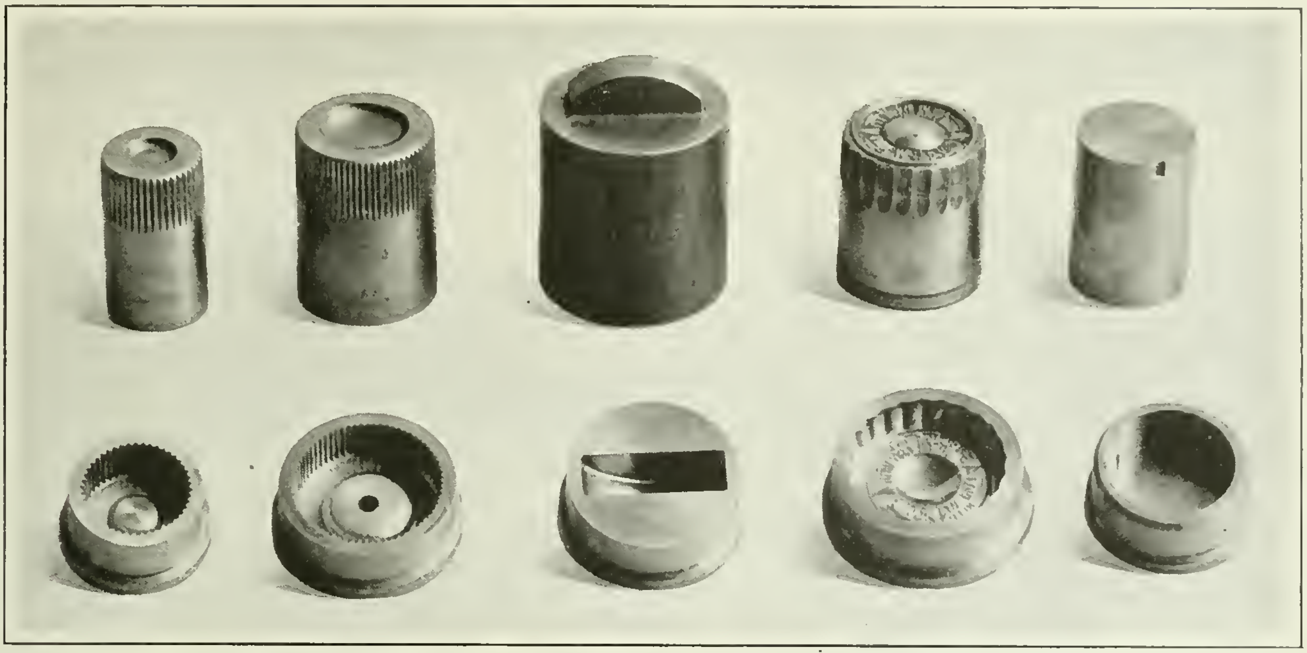


Fig. 1. Typical Hobs, and Dies which have been formed by them under a Hydraulic Press

When an impression must be an accurate reproduction of the hob, the equipment includes a heavy "chase ring," having a hole in the center in which the die blank is confined while the hob is forming the impression. This central hole is in a hardened tool-steel bushing which fits into the main body of the chase ring. The latter is made of pack-hardened machine steel, and it is heavy enough to prevent any lateral spreading of the die blank as the pressure is applied. On one side of the die to be formed there is the hob, and on the other side a hardened plug of cylindrical form; the die blank is between these parts and within the central hole of the chase ring. As the pressure is gradually applied, the metal of the die blank flows slowly over the hob end, so that the shape of the latter is accurately reproduced in the die impression.

The Hob and its Relation to the Die Blank

It is evident from the foregoing that the making of these dies or mold sections requires (1) a hob or force shaped to fit the required impression; (2) a die blank of suitable size and shape; and (3) hydraulic press equipment capable of exerting the extremely high pressure required for forming the impression in the die.

The hob itself is made from high-carbon tool steel, and accuracy of form combined with a very smooth finish are essential. (See Figs. 1 and 2.) In many cases the hob also requires engraving either to form lettering or possibly an ornamental design. The hob must be without under-cuts, and a certain amount of draft or taper is essential, about 1 degree being considered the minimum. After the hob is machined and polished, it is made glass-hard, iced brine sometimes being used to obtain the greatest degree of hardness. The importance of a fine finish is illustrated by the fact that slight scratches would be reproduced in the die impression, and even a piece of lint between the hob and die would leave an imprint. After hardening, the general practice is to draw the temper very slightly by immersing the hob in boiling water.

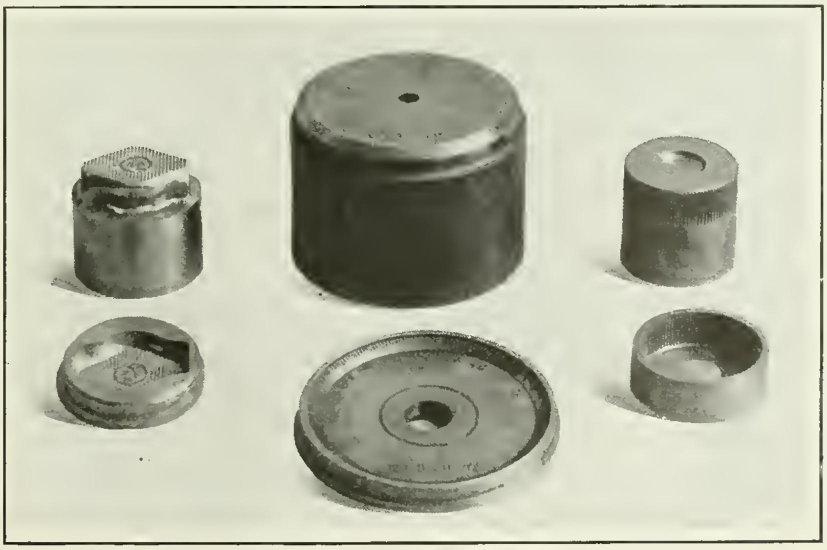


Fig. 2. Additional Examples of Hobs and Corresponding Dies

The difficulties encountered in hobbing die impressions depend in a general way upon the relation between the form and the depth of the impression. For instance, a die having a comparatively shallow impression of simple shape, can be made readily and may not require much experience, but if the impression is deep in proportion to its size, and particularly if there are fine edges or designs which must be an accurate reproduction of the hob, there are a number of important points to consider, as outlined in the following: Aside from the exacting and skillful work of making the hob, much depends upon the shape of the die blank, assuming that the impression is not a simple one to reproduce. Sometimes a plain cylindrical die blank having flat ends may be used, whereas other blanks are given a slightly conical shape on the impression side in order to supply metal where it will be needed as the hob is forced into the blank. Still other blanks are machined to form the impression partially, and in some cases the machining is done on the side opposite the impression to allow the metal to flow to the best advantage. Each die represents a separate problem, because the exact method of producing it depends upon the shape of the impression and its depth, and the best form of blank to be used in a given case often must be determined experimentally.

General Procedure in Hobbing a Die

After the hob has been made and is hardened, and the shape of the blank has been determined, the actual making of one or more dies is a short operation. If the die is of a type requiring the use of a chase ring, this ring, together with the hob and die blank, is placed between the ram and the press anvil; a hardened steel plunger is also placed on the side of the die blank opposite the hob. The die blanks are made either of low carbon steel or of high-grade wrought iron, it being essential to use metal having good flowing qualities. The steel is annealed thoroughly before it is used to remove any hard spots and reduce the pressure required for hobbing. Although well annealed tool steel can be hobbed, its flowing quality is relatively poor, so that the hobbing of deep impressions is particularly difficult.

The press is controlled by two handwheels (see the heading illustration) which operate valves, thus regulating the flow of liquid from the pump, and consequently the action of the press ram. As soon as the ram encounters the high resistance due to the hobbing operation, the suction valves of the low-pressure pump are lifted automatically from their seats and the high-pressure side comes into action. The ram then ascends very slowly, although a die impression may be finished within one or two minutes, the time depending, of course, upon the depth of the impression. As the hob sinks into the die blank, the operator watches the pressure gage. The pressure ordinarily rises to the maximum required for a particular die, and then remains nearly stationary as the hob continues to sink into the impression. This continuation of the hobbing operation at practically the same pressure indicates that the work is proceeding satisfactorily and that the metal is flowing up around the hob. As soon as the latter reaches the required depth, the pressure immediately rises, which shows that the operation is completed.

The pressures required ordinarily range from 50 to 200 tons per square inch of die impression. The pressure not only varies for steels of different composition, but also depends upon the method of hobbing. For instance, if the die blank is confined by a chase ring, the pressure may be double that required for hobbing an unconfined blank. In some plants where only small dies or molds are used, a press of 150 tons' capacity meets the requirements, whereas in others, a press capable of exerting a pressure of 1000 or possibly 5000 tons may be necessary.

After a die has been hobbed in the manner described, the impression has a fine finish and clean-cut edges, because the smoothness of the hob is imparted to the die and the density of the metal is increased as the result of the enormous pressure. After the hobbing operation, the upper surface of the die, which is irregular owing to the unequal flow of metal, is machined to whatever shape may be required for matching the opposite die section. The die is then pack-hardened to a depth of about 1/32 inch ordinarily, and the temper may also be drawn, although this depends upon the class of service for which the dies are intended. The final operation is that of polishing the surfaces of the impression, to restore whatever luster may have been lost as the result of heat-treatment.

Examples of Hobs and Dies

In Figs. 1 and 2 a number of typical hobs are illustrated, and beneath these hobs are shown the corresponding dies. The two dies at the left of Fig. 1 are for molding knurled knobs. If these dies were made by machining, the usual procedure would be to make a knurled ring and a separate baseplate, thus forming a two-piece die. It is essential in this case to have a slight chamfer on the outer edge of the knob, and the difficulty of providing for this if the die were machined, is apparent. In fact, it would be impracticable, and the usual method would be to form the chamfer on the molded product by a separate machining operation. It will be noted, however, that this chamfer may be formed readily by the hobbing process, as it is only necessary to chamfer the end of the hob the amount desired. Another disadvantage of the two-piece mold is that a slight fin is likely to form at the joint between the two sections, especially after the die has been used, and this fin interferes with the ejection of the molded part and causes breakage at the corners.

The die shown in the central position, Fig. 1, also illustrates an advantage of hobbing. In this case, the bottom surface of the impression has a circular form, but each end of the slot terminates in vertical sides, consequently, it would be difficult to machine this impression. When the hob is used, it is simply cut away on each side, as shown, in order to form these vertical surfaces.

The next example in Fig. 1 illustrates a hob and die of fluted shape having lettering which is required on the molded product. The die at the extreme right has three equally spaced projections extending a short distance up from the bottom. Because of these projections, if this die were machined, it would be necessary to bore down as far as these small lugs, and then leave enough metal to form the lugs by milling in conjunction with hand work. When a hob is used, three notches are cut at the end of the hob, and projections of corresponding shape are formed in the die accurately and in the same relative position in different dies.

Referring now to Fig. 2, the die at the left has a letter in the center and a knurled bottom surface. The clean-cut and smoothly finished impression obtained from the hob is apparent from the illustration. The larger die shown in the center is for making a graduated dial of the type used for radio apparatus. In making the hob, the letters and figures are sunk into the end by an ordinary engraving machine, and the beveled edge is graduated by sinking lines or impressions of the right size and location. The die obtained from this simple form of hob, has, of course, raised lines, figures and letters, and the difficulty involved in making such a die by machining the surfaces to form these raised lines, figures, and letters is apparent to anyone at all familiar with machining processes. The die at the extreme right of this illustration is another example of the type used for molding knurled knobs. These few examples, which are typical, illustrate not only some of the advantages of hobbing, but also to some extent the variety of dies formed by this process, which, as may readily be seen, is capable of wide application.

The hob cost per die varies according to the number of duplicate dies to be made and the intricacy of the design. Frequently one hob can be used for making all the dies of one design that are required, and when the number is quite large, the hob cost per die is relatively low, especially as compared with machining, and the quality of the work is superior both as regards finish and accuracy.

* * *

FURNACE THAT SHOWS WHEN CORRECT HARDENING HEAT HAS BEEN REACHED

An electric furnace, known as the Wild-Barfield furnace, marketed by the Automatic Electric Furnaces, Ltd., 175 Farringdon Road, London, England, has been developed for the purpose of definitely indicating when the steel heated in the furnace has reached the temperature at which it loses its magnetic properties, so that quenching and consequent hardening may take effect at the right moment.

A coil of wire is wound around a form that constitutes the walls of the furnace. This wire is heated by its resistance to the passage of an electric current. Around the heating wire coil is placed another coil which is connected to some form of galvanometer. The passage of the current through the heating coil induces a current in the external coil which is modified by the magnetic action of the iron or steel in the furnace. When the steel in the furnace has entirely lost its magnetism, the deflection of the galvanometer ceases, and this indicates that the temperature has been reached at which the steel should be removed and quenched.

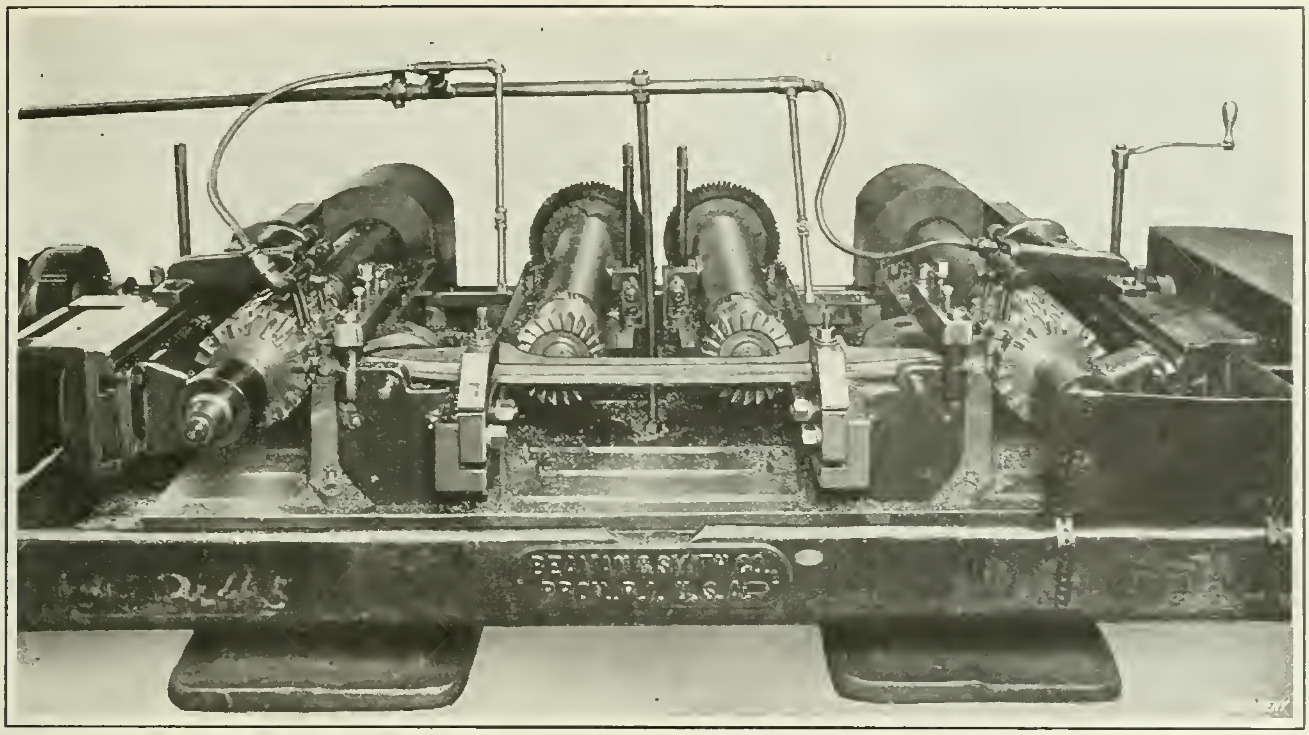


Fig. 1. Straddle-milling the Yokes and face-milling the Spring Pads of Automobile Axles

Manufacture of Automobile Front Axles

Machining Operations on Axle Forgings, Steering Knuckles, and Steering Arms

By EDWARD K. HAMMOND

THIS article describes the manufacturing procedure followed in making front axles for both passenger automobiles and motor trucks, and gives similar information relating to the machining of steering knuckles and arms, which may properly be regarded as part of the front axle equipment. The practice described is that of the Eaton Axle Plant of the Eaton Axle & Spring Co., Cleveland, Ohio. The forgings are made of molybdenum steel, and are double heat-treated, in accordance with S.A.E. specifications.

All forgings receive a searching visual inspection and are ground to reveal any structural defects or cracks at those points where the service is expected to be exceptionally severe. This grinding operation, of course, simply removes the outer scale. The front axle forging, for example, is ground on the surfaces along the yokes at each end, which immediately brings to notice any defects that may be present in the steel or have been caused by the forging.

The first step in machining the front axle forgings consists of straddle-milling the surfaces *A*, Fig. 3, at the yoke ends of the axles, and milling the spring pad surfaces *B*. The forgings are set up on a Beaman & Smith special milling machine in the manner illustrated in Fig. 1. Eight inserted-tooth milling cutters are used for the straddle-milling operation, and two solid side-milling cutters are used for the spring pad surfaces. The axles are laid flat in the milling fixture, which has provision for adjusting the position of the work relative to the cutter. The fixture is equipped with substantial hinged clamps to give rigid support in back of the spring pads and other clamps at each end near the yokes. By the arrangement shown, the axles are positively held against the thrust of the milling cutters.

The axle forgings are next drilled. This work is performed on a special Foote-Burt drilling machine having four spindles, two of which carry five-spindle auxiliary heads for drilling the holes *C*, Fig. 3, in the spring pads; the other two spindles are used for drilling the king-pin holes *D*, one at each end of the forging. All the drills operate together. The machine is equipped with an air-operated work-holding fixture consisting of a pair

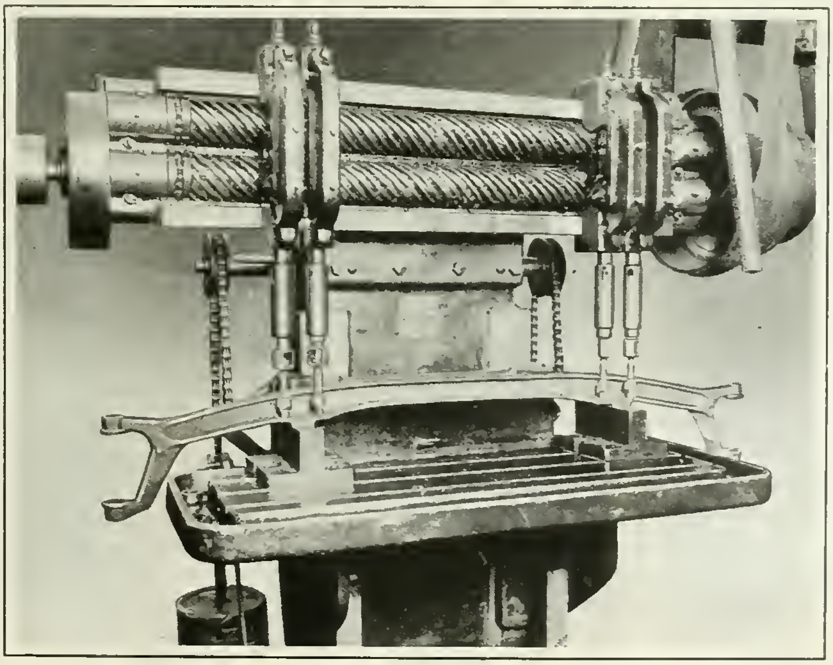


Fig. 2. Spot-facing the Under Side of the Spring Bolt-holes

of sliding V-blocks which engage the ends of the forgings. This arrangement enables the axles to be rapidly put in place and securely held during the drilling operations.

Reaming and Counterboring Operations on the Axles

The remaining machine work required to complete the axles consists of reaming the king-pin holes and counterboring the spring-pad holes from the under side. The reaming of the king-pin holes is done in a lathe, with the axle supported at the yoke end by a chain hook and a hoist. With this arrangement it is a comparatively easy matter for the operator to swing the work so as to advance it to the reamer. After reaming in the lathe, the holes are finish-reamed with a line reamer by hand.

The machine used for counterboring the spring-pad holes is a Moline "Hole Hog." The axle is supported on the table of this machine by T-irons in the manner illustrated in Fig. 2. Two piloted counterbores operate simultaneously on the holes at one side of each pad. The shanks of these counterbores are of reduced diameter so as to clear the I-section of the axle. The operation is simply one of spot-facing the surfaces for bolt-heads, and after the holes on one side of the web have been machined the position of the axle is changed for spot-facing the holes on the opposite side.

First Operations on Steering Knuckles

After the heat-treatment and preliminary inspection of the steering knuckle forgings, the work is delivered to a single-spindle Foote-Burt drilling machine where the king-pin hole *F*, Fig. 4, is drilled and reamed.

The forgings are next centered relative to the shank *H*, with the set-up illustrated in Fig. 7. The machine used is a duplex centering machine of Cadillac design. The steering knuckle is held in a fixture that contains a pilot at the rear for locating the work from the previously drilled king-pin hole. The shank of the forging is firmly clamped between two V-shaped jaws that are moved toward each other by a screw with opposite-hand threads, which is operated by the handwheel at the front of the machine. The spindles carrying the centering tools are advanced by hand by means of the two levers shown.

The turning of the shank of these forgings is done in a "Lo-swing" lathe, specially tooled. The tooling arrangement provides for turning the three straight diameters on the shank *H*, Fig. 4, as well as the tapered surface. A rear view of this lathe with its equipment, showing a forging mounted between centers, is shown in Fig. 5. The special turning attachment with which the lathe is equipped for this work enables all the surfaces of the shank to be turned during one traverse of the carriage.

The next operation in the sequence consists of rough-spot-facing both ends of the hole *F*, Fig. 4. This work is performed on a single-spindle Foote-Burt drilling machine, and the forging is located by a pilot fitting into the drilled king-pin hole. The spot-facing tools used in this operation are of the piloted type.

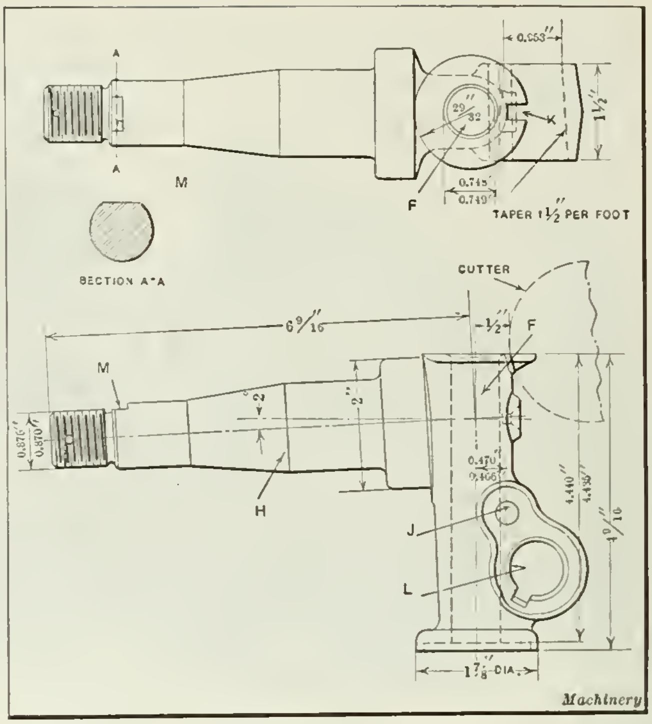


Fig. 4. Detail Views of an Automobile Steering Knuckle

The Foote-Burt single-spindle drilling machine on which the steering-arm hole *L*, Fig. 4, is drilled, is illustrated in Fig. 6. The fixture in which these forgings are located during the drilling operation contains pilots which enter the king-pin hole, and V-blocks which engage the shank. To compensate for variations in the form of the forgings, these V-blocks are operated by equalizing levers, as are also the pilots, which permits the work to be located, regardless of its irregularities, so that the steering-arm hole will be at right angles to the center line of the king-pin hole.

After drilling the steering-arm hole, the same type of fixture and the same type of machine are used in drilling and reaming the draw-key hole *J*, Fig. 4. Both the holes *L* and *J* are then spot-faced. During these operations the work is located by pilots which enter the king-pin hole, and is secured by straps which clamp the forging and hold it securely in a V-block. The tapered steering-arm hole *L* is then reamed on a Foote-Burt drilling machine. Two operations—roughing and finishing—are performed, in both of which special Skelton reamers are used. The roughing operation is shown in Fig. 8, where it will be seen that the special reamer used has straight cutting edges, whereas the type of tool used in the finish-reaming operation (see Fig. 9) has helical blades which take a very fine shaving cut and insure a good finish. In this jig also a pilot is employed to locate the forging correctly relative to the tools.

Milling, Spot-facing, Thread-milling, and Grinding

After the steering-arm hole has been finished, the forgings are transferred to a No. 3 Cincinnati milling machine equipped with a 2½-inch cutter for milling the slot *K*, Fig. 4. This slot is for the accommodation of a lock-pin. A keyway is then broached in the steering-arm hole *L*, using a Lapointe broaching machine and standard broaching equipment.

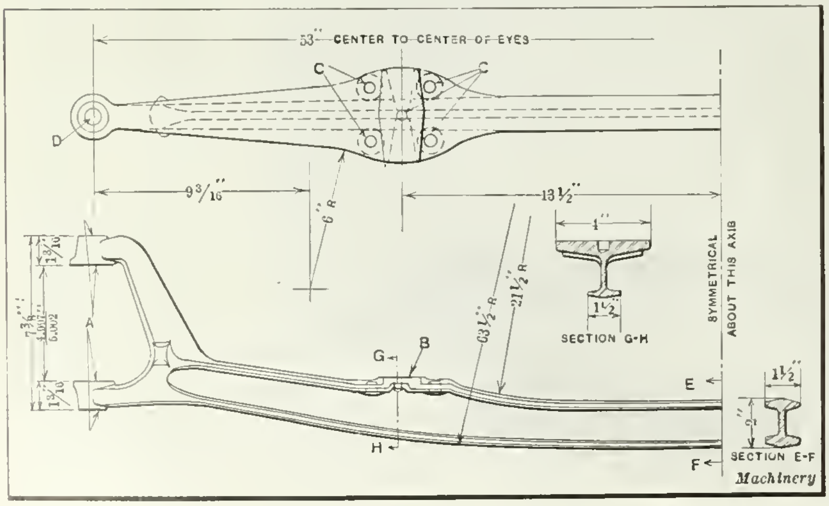


Fig. 3. Front and Plan Views of One End of an Automobile Axle

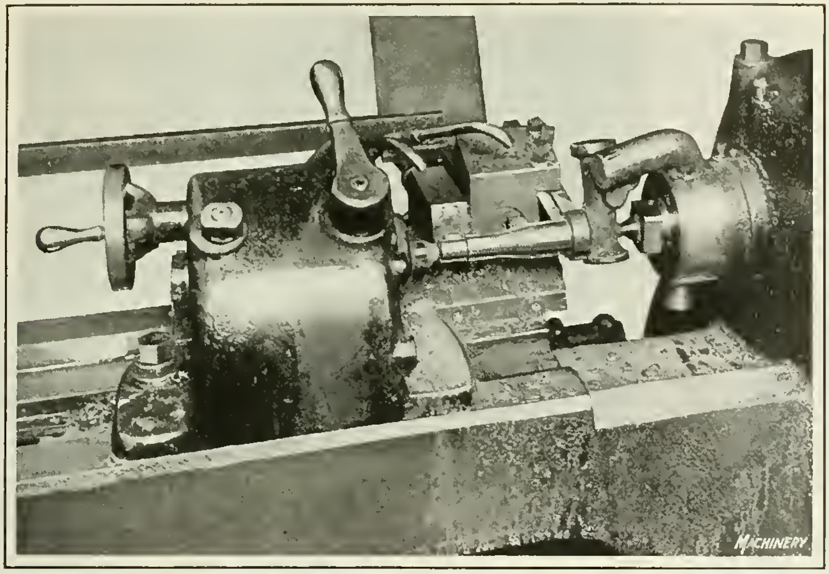


Fig. 5. Turning the Shank of the Steering Knuckles in a Lathe having Special Tooling Equipment

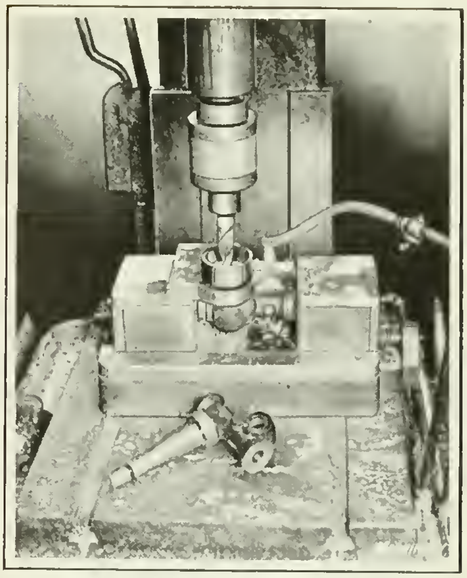


Fig. 6. Set-up for drilling the Arm Hole in the Knuckles

From Fig. 4 it will be seen that the distance from the counterbored surface surrounding the king-pin hole to the opposite end of this hole has a tolerance of 0.005 inch. To establish this dimension, a finishing operation on the previously counterbored hole and on the surface surrounding the hole at the opposite end is performed. The work consists of finish-spot-facing and finish-counterboring, and is done on a Warner & Swasey hand screw machine. After this operation has been completed, a flat *M* is milled on the shank near the end which is later to be threaded. This slabbing is done on a No. 2 Cincinnati milling machine with the work piloted in the king-pin hole and the shaft *H* secured in V-blocks. The purpose of the flat is to afford the necessary bearing surface for a lock washer. Two cotter-pin holes are next drilled in the end of the work.

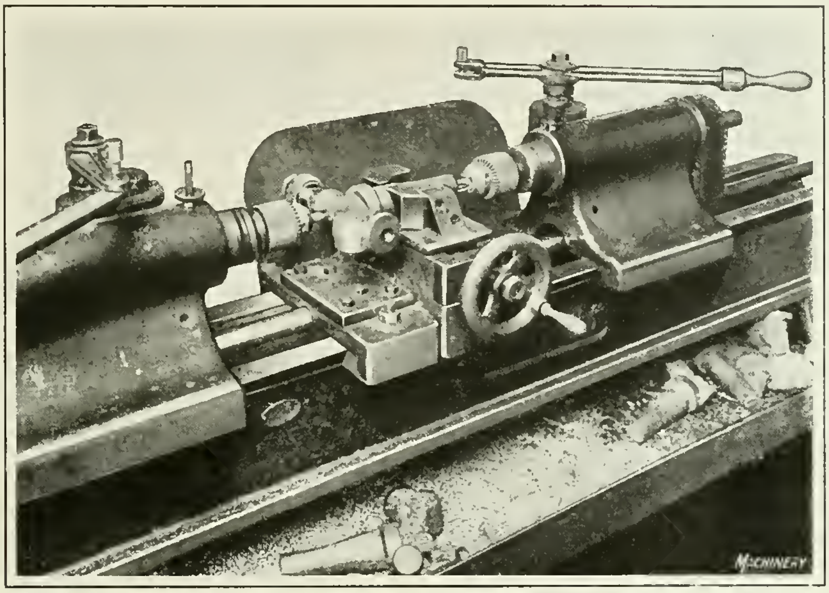


Fig. 7. Centering the Steering Knuckles

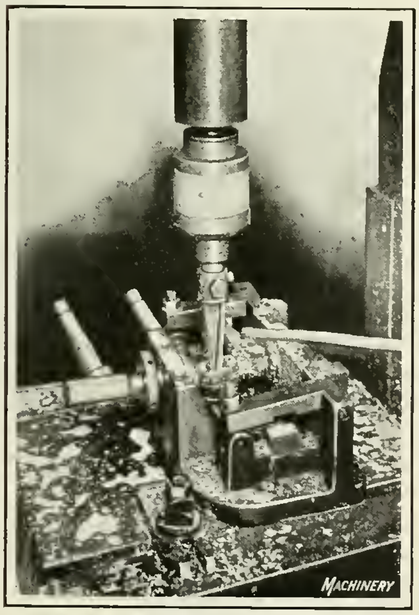


Fig. 8. Rough-reaming the Arm Hole in the Knuckles

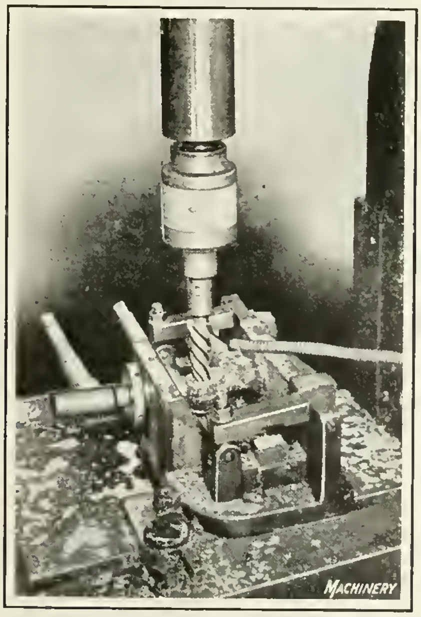


Fig. 9. Finish-reaming the Arm Hole in the Knuckles

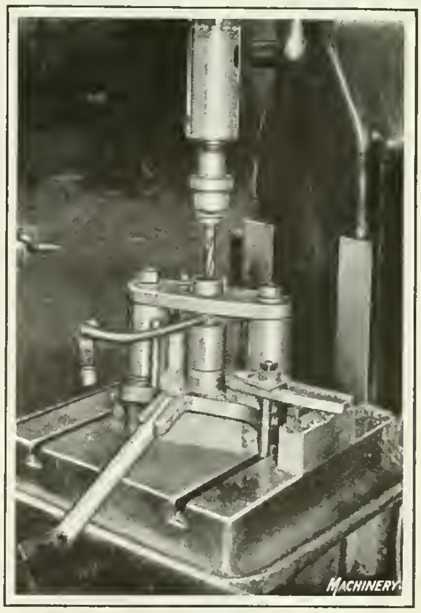


Fig. 10. Set-up for drilling the Steering Arm

The forgings are now ready to have the threads cut in the ends. This is done on a Lees-Bradner thread milling machine. The threaded end is next faced off in a Reed speed lathe and the work is recentered, preparatory to grinding the shank. During the recentering operation the work is located in a steadyrest which holds the shank by the large diameter. The final operation is that of grinding the two straight diameters of the shank, and for this purpose a Norton cylindrical grinding machine and wheel are employed.

Machining Automobile Steering Arms

The steering arm that is assembled to the steering-wheel end of the axle is of the design shown in Fig. 11, and has an extension *T* to which the drag-link forging is attached. The drag link connects the steering arm with the steering-wheel shaft by means of a bolt passing through hole *P*. The opposite-hand arm has no such extension; it inclines at an opposite angle, but otherwise is of the same appearance as that shown in Fig. 11.

After the preliminary heat-treating and grinding to disclose structural defects of the forging, the first machining operation is performed with the drilling machine set-up shown in Fig. 10. The forgings are held in a "pump handle" type of jig attached to the table of a Foote-Burt vertical-spindle drilling machine while drilling holes *O*, Fig. 11, and also hole *P* (in the case of the drag-link type of steering arm). The pump-handle jig is a convenient means of clamping the work for operations of this kind, it being merely necessary to push down on the long handle shown projecting from the front of the jig to raise a spring-actuated clamping member and release the work. In reloading, a forging is slipped into place while the handle is down, after which the spring clamp is forced down on the work by raising the handle. Various methods of locating are used on jigs of this type, but on such pieces as steering-arm forgings it is convenient to use bell-mouthed bushings that embrace the boss in which the hole is to be drilled.

The spot-facing operation for holes *O* and *P* is performed by a battery of two-spindle Barnes drilling machines. One of these machines is illustrated in Fig. 12 with two fixtures on the table of the machine, one of which shows the work in place and the other unloaded. These holes, it will be noted, are tapered so that in locating by means of a pilot, it is necessary to use a different pilot arrangement for each side of the boss. This is a very simple matter where the job consists of spot-facing that surface of the boss which is at the small end of the hole (in which case the work is simply slipped over the tapered pilot), but when the opposite side is being machined and the forging is reversed in position, a special arrangement is necessary. To locate the work in this position, the tapered pilot is dropped into the hole, this pilot or pin having a shank which enters a hole in the work-holding fixture. In both cases the pilot which enters the hole is of such a length that it leaves exactly the necessary space between it and the end of the facing tool pilot to establish the correct depth of cut.

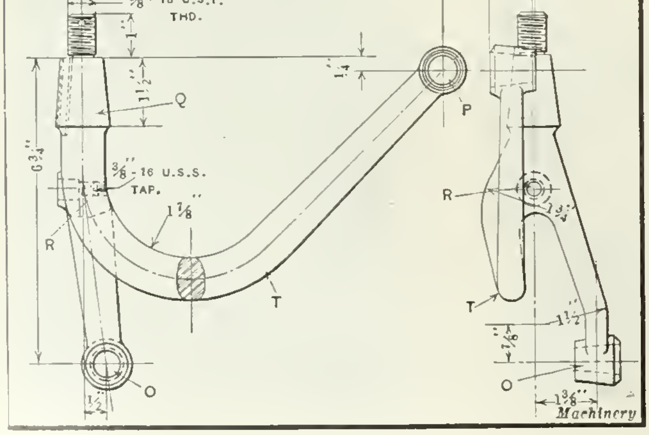


Fig. 11. Steering Arm of the Type used on the Steering-wheel Side of Automobiles

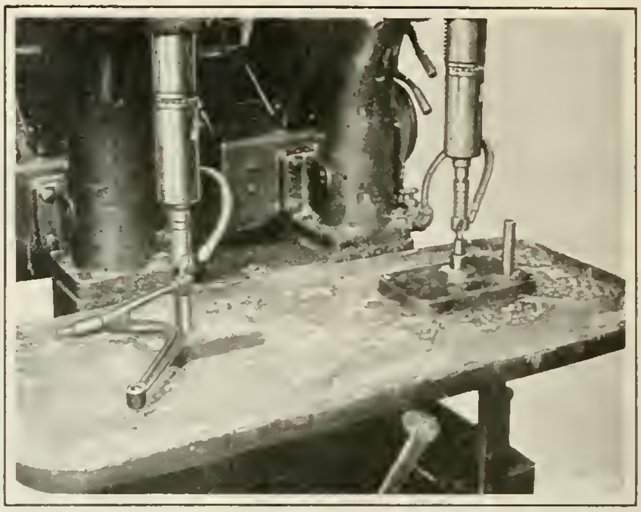


Fig. 12. Two-spindle Machine and Fixtures for spot-facing Holes in Steering Arms

The drilling and spot-facing operations on the holes *O* and *P*, Fig. 11, having been finished, the forgings are set up on a Warner & Swasey turret lathe which is equipped with a pot chuck for holding the steering arm while the surface *Q* is being taper-turned and the end threaded. For cutting the 5/8–18 U. S. F. thread on the work, a Geometric die-head is used on the turret lathe. The final machining operations are drilling and tapping hole *R* for a 3/8–16 thread stop-screw. The work is located over a pilot which enters the tapered hole *O*. These drilling and tapping operations are performed on Cincinnati-Bickford vertical drilling machines. This completes the machining of the steering arms, and they are then delivered to the assembling department, where they are assembled with the steering knuckles into the front axle yokes.

* * *

RESULTS OF EFFORTS TO PREVENT ACCIDENTS

The United States Steel Corporation has carried on a consistent campaign for reducing accidents in its mills and shop since May, 1906. The results of this safety campaign are best indicated by pointing out the reduction in the number of accidents per 1000 employes. Since 1920, the accidents, compared on this basis, have been less than half what they were in 1906, and if the men were subjected to the same rate of accidents today as they were in 1906, 3000 more men would have suffered serious or fatal injury in 1922 than is now the case. As a matter of fact, in the seventeen years that have passed since the inauguration of the safety work in the mills of the United States Steel Corporation, over 35,000 men have been saved from serious or fatal injury, basing the number of injuries upon the average number previous to the inauguration of the "Safety First" campaign. The value of these figures is that they show what can be done in a practical way in accident prevention. Safety work, while it should be undertaken from humanitarian motives, is generally recognized to be a business proposition as well, and to have great economic value not only to the employer, but also to the employes and the entire community.

* * *

The Pressure Vessel Committee of the American Bureau of Welding has issued a report relating to welded pressure vessels, which is published completely in the May number of the Journal of the American Welding Society, and which may be obtained from the society's headquarters, 33 W. 39th St., New York, at $1.50 by members and $5 by non-members.

MACHINERY'S DATA SHEETS Nos. 15 and 16

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GEAR TOOTH PARTS

Diametral Pitch	Circular Pitch	Module (Metric System)	Circular Pitch	Thickness of Tooth at Pitch Line	Addendum	Whole Depth of Tooth
1	......	......	3.1416	1.5708	1.0000	2.1571
......	3	......	3.0000	1.5000	0.9549	2.0598
......	......	24	2.9669	1.4834	0.9149	2.0380
1 1/4	......	......	2.5133	1.2566	0.8000	1.7257
......	2 1/2	......	2.5000	1.2500	0.7957	1.7165
......	......	20	2.4724	1.2362	0.7874	1.6984
......	......	18	2.2252	1.1126	0.7087	1.5284
1 1/2	......	......	2.0944	1.0472	0.6666	1.4381
......	2	......	2.0000	1.0000	0.6366	1.3732
......	......	16	1.9786	0.9893	0.6299	1.3584
1 3/4	......	......	1.7952	0.8976	0.5714	1.2326
......	1 3/4	......	1.7500	0.8750	0.5570	1.2016
......	......	14	1.7314	0.8657	0.5512	1.1888
2	......	......	1.5708	0.7854	0.5000	1.0785
......	1 1/2	......	1.5000	0.7500	0.4775	1.0299
......	......	12	1.4835	0.7416	0.4724	1.0190
2 1/4	......	......	1.3963	0.6981	0.4444	0.9587
......	......	11	1.3606	0.6803	0.4331	0.9342
2 1/2	......	......	1.2566	0.6283	0.4000	0.8628
......	1 1/4	......	1.2500	0.6250	0.3979	0.8583
......	......	10	1.2362	0.6181	0.3937	0.8492
2 3/4	......	......	1.1424	0.5712	0.3636	0.7844
......	......	9	1.1126	0.5563	0.3543	0.7642
3	......	......	1.0472	0.5236	0.3333	0.7190
......	1	......	1.0000	0.5000	0.3183	0.6866
......	......	8	0.9894	0.4947	0.3150	0.6792
......	15/16	......	0.9375	0.4687	0.2984	0.6437
3 1/2	......	......	0.8976	0.4488	0.2857	0.6163
......	7/8	......	0.8750	0.4375	0.2785	0.6007
......	......	7	0.8657	0.4328	0.2756	0.5944
......	13/16	......	0.8125	0.4062	0.2586	0.5579
4	......	......	0.7854	0.3927	0.2500	0.5393
......	3/4	......	0.7500	0.3750	0.2387	0.5150
......	......	6	0.7416	0.3708	0.2362	0.5095
4 1/2	......	......	0.6981	0.3490	0.2222	0.4793
......	11/16	......	0.6875	0.3437	0.2189	0.4720
......	......	5 1/2	0.6803	0.3401	0.2165	0.4671
5	......	......	0.6283	0.3142	0.2000	0.4314
......	5/8	......	0.6250	0.3125	0.1989	0.4291
......	......	5	0.6181	0.3090	0.1969	0.4246
5 1/2	......	......	0.5712	0.2856	0.1818	0.3922
......	9/16	......	0.5625	0.2812	0.1790	0.3862
......	......	4 1/2	0.5562	0.2781	0.1771	0.3821
6	......	......	0.5236	0.2618	0.1666	0.3595
......	1/2	......	0.5000	0.2500	0.1592	0.3433

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MACHINERY'S Data Sheet No. 15, New Series, August 1923

Contributed by E. G. Bishop

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GEAR TOOTH PARTS

Diametral Pitch	Circular Pitch	Module (Metric System)	Circular Pitch	Thickness of Tooth at Pitch Line	Addendum	Whole Depth of Tooth
......	......	4	0.4944	0.2474	0.1575	0.3396
7	......	......	0.4488	0.2244	0.1429	0.3081
......	7/16	......	0.4375	0.2187	0.1393	0.3003
......	......	3 1/2	0.4328	0.2163	0.1378	0.2972
8	......	......	0.3927	0.1963	0.1250	0.2696
......	3/8	......	0.3750	0.1875	0.1194	0.2575
......	......	3	0.3708	0.1854	0.1181	0.2547
9	......	......	0.3491	0.1745	0.1111	0.2397
......	......	2 3/4	0.3401	0.1700	0.1082	0.2335
10	......	......	0.3142	0.1571	0.1000	0.2157
......	5/16	......	0.3125	0.1562	0.0995	0.2146
......	......	2 1/2	0.3090	0.1545	0.0984	0.2123
11	......	......	0.2856	0.1428	0.0909	0.1961
......	......	2 1/4	0.2781	0.1390	0.0885	0.1910
12	......	......	0.2618	0.1309	0.0833	0.1798
......	1/4	......	0.2500	0.1250	0.0796	0.1716
......	......	2	0.2472	0.1236	0.0787	0.1698
13	......	......	0.2417	0.1208	0.0769	0.1659
14	......	......	0.2244	0.1122	0.0714	0.1541
......	......	1 3/4	0.2163	0.1081	0.0688	0.1486
15	......	......	0.2094	0.1047	0.0666	0.1438
16	......	......	0.1963	0.0982	0.0625	0.1348
......	3/16	......	0.1875	0.0937	0.0597	0.1287
......	......	1 1/2	0.1854	0.0927	0.0590	0.1273
17	......	......	0.1848	0.0924	0.0588	0.1269
18	......	......	0.1745	0.0873	0.0555	0.1198
19	......	......	0.1653	0.0827	0.0526	0.1135
20	......	......	0.1571	0.0785	0.0500	0.1079
......	......	1 1/4	0.1545	0.0772	0.0492	0.1061
......	5/32	......	0.1562	0.0781	0.0497	0.1073
22	......	......	0.1428	0.0714	0.0455	0.0980
24	......	......	0.1309	0.0654	0.0417	0.0898
......	1/8	......	0.1250	0.0625	0.0398	0.0858
......	......	1	0.1236	0.0618	0.0393	0.0849
26	......	......	0.1208	0.0604	0.0385	0.0829
28	......	......	0.1122	0.0561	0.0357	0.0770
30	......	......	0.1047	0.0524	0.0333	0.0719
32	......	......	0.0982	0.0491	0.0312	0.0674
......	3/32	......	0.0937	0.0469	0.0298	0.0644
......	......	3/4	0.0927	0.0463	0.0295	0.0636
34	......	......	0.0924	0.0462	0.0294	0.0634
36	......	......	0.0873	0.0436	0.0278	0.0599
40	......	......	0.0785	0.0393	0.0250	0.0539
......	1/16	......	0.0625	0.0312	0.0199	0.0429
......	......	1/2	0.0618	0.0309	0.0198	0.0424

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MACHINERY'S Data Sheet No. 16, New Series, August 1923

Contributed by E. G. Bish

American Standard Screw Threads

THE report of the sectional committee on the standardization and unification of screw threads, upon which work has been in progress for some time, has now been placed for final adoption before the councils of the American Society of Mechanical Engineers and the Society of Automotive Engineers. Upon approval and adoption by these boards, it will be submitted by them to the American Engineering Standards Committee for formal adoption as the American standard for screw threads.

The sectional committee referred to was organized in the fall of 1920, with instructions to make a complete review of the progress report of the National Screw Thread Commission. In April, 1921, the members of the committee began their detailed study of the screw thread commission's report, and the work has since proceeded under the chairmanship of Luther D. Burlingame of the Brown & Sharpe Mfg. Co., Ralph E. Flanders of the Jones & Lamson Machine Co., being vice-chairman, and Clifford B. LePage, of the American Society of Mechanical Engineers, secretary. In carrying out its work, the sectional committee found slight modifications in the report of the National Screw Thread Commission desirable, and these changes were thoroughly discussed with the commission; the meetings with the commission led to the adoption of modifications that were mutually satisfactory.

NUMBERS OF THREADS PER INCH AND CORRESPONDING DIAMETERS

Size	Basic Major (or Outside) Diameter, Inches	Fine Series, Threads per Inch	Coarse Series, Threads per Inch
0	0.0600	80	..
1	0.0730	72	64
2	0.0860	64	56
3	0.0990	56	48
4	0.1120	48	40
5	0.1250	44	40
6	0.1380	40	32
8	0.1640	36	32
10	0.1900	32	24
12	0.2160	28	24
¼	0.2500	28	20
5/16	0.3125	24	18
⅜	0.3750	24	16
7/16	0.4375	20	14
½	0.5000	20	13
9/16	0.5625	18	12
⅝	0.6250	18	11
¾	0.7500	16	10
⅞	0.8750	14	9
1	1.0000	14	8
1⅛	1.1250	12	7
1¼	1.2500	12	7
1½	1.5000	12	6
1¾	1.7500	12*	5
2	2.0000	12*	4½
2¼	2.2500	12*	4½
2½	2.5000	12*	4
2¾	2.7500	12*	4
3	3.0000	10*	4

Machinery

*These pitches are suitable for work requiring short engagement where it is not practical to specify tolerances for all conditions.

Field Covered by the Report

The sectional committee has definitely limited the field to be covered by its first report to screw threads for bolts, machine screws, nuts, and commercially - tapped holes. The report as now presented contains: (1) Definitions of the terms used in screw thread practice; (2) symbols to be used for screw thread parts; (3) specifications for the form of thread; (4) number of threads corresponding to given diameters; (5) classification of fits; (6) tolerances; and (7) appendices relating to derivation of tolerances, and the relation of lead and angle errors to pitch diameter tolerances.

This report does not present a new set of standards for screw threads, but rather an extension of existing standards, by specifying limiting dimensions for the various sizes and pitches of threads already in common use. It also gives official sanction to certain processes, such as over-size drill sizes, which have long been established by common use. Altogether it is an attempt to codify the best current practice on screw thread production.

The committee's decision to limit the field covered by its first report to threaded parts for holding purposes, such as bolts, nuts, machine screws, and commercially tapped holes, seems to be well founded. The standard practice codified by this report will first be given a fair tryout by the American screw thread industry and there will be an opportunity for revision or correction if necessary. Later efforts may be made toward further establishment of standards for threading tools and screw threads for special purposes. Among the latter are included studs and fine threads of large diameter and short engagement, as, for instance, those that are used for cap-nuts on machine tool collars, hub and radiator caps, etc. The sectional committee fully realized that the screw thread field is so broad as to make it impossible to cover the entire field in its first report. Furthermore, the experience that it is hoped to gain by the use of its first proposals will be of great value in working out satisfactory standards for other applications.

Since it is impracticable to reproduce in MACHINERY the complete report of the committee, only the table giving the number of threads recommended, corresponding to given diameters, has been included in this article. The report is now being prepared for publication in pamphlet form, and it is expected that these pamphlets will be ready for general distribution by August 15; those who desire copies of this report should apply to the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

Form of Thread

The form of thread profile specified is the same as that which has previously been known as the U. S. standard or Sellers thread, but it is proposed that hereafter this thread form be known as the American (National) form of thread. Two thread series are adopted—a coarse and a fine. The coarse thread series is the present U. S. standard thread supplemented in the sizes below ¼ inch by sizes that were formerly included in the special machine screw sizes adopted by the American Society of Mechanical Engineers. The fine thread series from ¼ inch to 1½ inches inclusive, is in accordance with the present screw thread series of the Society of Automotive Engineers, supplemented in sizes below ¼ inch by the standard machine screw sizes (except the No. 10 machine screw) adopted by the American Society of Mechanical Engineers.

Classification of Fits

The report established for general use has four distinct classes of screw thread fits known as loose fit, free fit, medium fit, and close fit. The *loose fit* is recommended as a commercial standard for tapped holes in the numbered sizes only. The *free fit* applies to the great bulk of screw thread work of ordinary quality including both finished and semi-finished bolts and nuts. The *medium fit* includes the better grade of interchangeable screw thread work, such as automobile bolts and nuts. The *close fit* includes screw thread work requiring a fine snug fit, somewhat closer than a medium fit, such as high-class aircraft parts. In this class of fit, selective assembly of parts may be required. It is not considered practicable as a commercial standard for tapped holes of the numbered sizes.

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IMPORTANCE OF SUITABLE SMALL TOOLS

Almost everyone is familiar with the remarkable improvements that have been made in machine tools during recent years. The power of many types of machines has been more than doubled, the rigidity has been increased, and many new features have added to their operating facility. But the machine tool user who installs this improved equipment should remember that, however high the quality of the machine tools, they cannot produce the best results unless careful attention is given to the selection and use of suitable small tools and tooling equipment.

In an address before the Electric Power Club at its annual meeting, R. W. Gardner, vice-president of the Otis Elevator Co., called particular attention to this point. He mentioned that the machining—boring, facing and milling—of a gear-case on a special high-grade machine tool required two and one-half hours, when no special fixture or attachment, other than regular cutting tools, was used. By the use of a specially designed fixture with boring, facing and milling attachments, so that these three operations could be performed simultaneously at one setting, the time was reduced to one-half hour. In other words, the same machine tool was capable of producing 400 per cent more work than it formerly did by the provision of suitable fixtures and tools. In cases where stellite can be used to advantage, it has been found possible to increase the speeds and feeds as much as 70 per cent over those used when high-speed steel is employed. In both cases the same machine tools are used, the increased production being due entirely to the cutting tools.

Many shops could get more out of their machine tools than they do if the men in charge of production would study carefully the possible improvements in the tools and other equipment used in connection with the machines. Some superintendents are satisfied that with the installation of a machine of the latest design, the highest possible production will be obtained; but it is the man who studies fundamentals that recognizes that the machine itself solves only a part of the production problem, and that the methods employed and the tools and equipment used on the machine, are responsible for the other part. By all means use the best machine tools available; but give them a chance to show what they are capable of by providing them with the best tools, fixtures, or other equipment.

* * *

COST REDUCTION BY IMPROVED MACHINERY

It was the general belief at the end of the boom period in the automobile industry in 1920 that the automobile plants were so well equipped and their methods so highly developed that only minor economies could be accomplished by further improvement in the near future. The automobile companies were not regarded as important purchasers of new equipment for some time to come, especially as the prospects for good business in that field were not promising.

But even in that highly developed industry, means were found to reduce costs by improved machinery and methods, and automobile manufacturers were large buyers of machine tools during the latter half of 1921 and in 1922, although there was but little demand for new machinery in other machine-building fields. It is of interest to record the actual savings accomplished by one automobile company through the use of improved machines and methods in a period of two years: In March, 1920, this company built 6126 automobiles with 8216 employes, and considered that a fair output. In May, 1922, the same company built 7147 cars with 4365 employes—an increase in output per man of about 120 per cent. Some of this increase should be ascribed to the greater efficiency of labor. This, of course, is a variable quantity which cannot be estimated in exact figures, but some manufacturers claim an increase of as much as 25 per cent, as compared with the high-pressure period in 1920, basing their estimate on the fact that 75 per cent of the former force now produces about the same output as the entire force did in 1920, without any important changes in manufacturing methods or equipment.

Here are a few recent examples of cost reductions by high-production machinery:

In the manufacture of driving chain, one part produced in large quantities is now made by improved automatic machines at the rate of about 40 pieces per hour, as compared with 8 to 9 pieces by the equipment formerly used. The new machines installed in one shop enabled the manufacturer to so undersell his competitors that when they learned the reason for his reduced costs they immediately ordered similar equipment as the only method of meeting the competition.

A pipe fitting is now machined in 40 seconds on an automatic machine costing $7000, which formerly was produced in 3 minutes on a machine costing $12,000.

A newly developed screwdriving and nut-setting machine proved so efficient, as compared with older methods, that it saved its cost in 3½ months, because one man was able to do the work that formerly required two.

These examples indicate better than general statements the value of the improvements in machine tool equipment developed during recent years. When manufacturers in the machine-building industries fully realize the savings that can be made through the use of modern machine tools, many of the less productive machines of former days will be relegated to the scrap heap and replaced by new machinery.

* * *

UTILIZING TIME AT CONVENTIONS

Often the most valuable ideas carried away from an industrial convention are developed from the discussions of the papers read; but intelligent discussion of such papers usually requires some preparation, and for this reason considerable time could be saved if the papers to be presented were printed or mimeographed and distributed to the members a week or two in advance, as is done by the American Society of Mechanical Engineers. If this were done generally, not only would considerable time be saved, but many good ideas would be brought out during the discussion. As the members interested would have an opportunity to acquaint themselves with each paper before its presentation to the convention, it would not need to be read in full there, but a summary might be presented covering the essential points. More time could then be devoted to intelligent discussion, the interest of the convention would be more easily sustained and more value would be received for the time given.

The preprinting or mimeographing of convention papers adds somewhat to the cost, but this addition would be only a small percentage of the total expense, and as it makes possible the use of the time at the meeting to better advantage and facilitates the interchange of ideas, the money would be well spent.

MACHINE TOOL STANDARDIZATION

There are a great many difficulties to be overcome in bringing about such standardization in the machine tool industry as has been declared desirable by many of the manufacturers in this field as well as by the users of machine tools. It is evident that it is a serious matter to make changes in existing designs, and many manufacturers of machine tools, although they recognize the value of standardization, hesitate to commit themselves to any radical changes in their product in order to conform with similar products made by other manufacturers.

There is, however, a field of standardization that would prove profitable to the manufacturer as well as to the user, without involving too radical changes in present practice. This field of standardization is within the complete control of each manufacturer, and consists in standardizing his own product to such an extent that, where he builds several types or sizes, the number of parts may be reduced to a minimum. Some comprehensive standardization work in this direction has been carried out by the Jones & Lamson Machine Co., Springfield, Vt. The design of the turret lathes built by this company has been so standardized or unified that eight specific machines, providing a range that covers the majority of all bar and chuck work in the average machine shop, can be built up from a small number of separate units, as follows:

3 Beds
2 Headstocks
1 Driving Mechanism
3 Spindles
1 Feed Mechanism
1 Apron
3 Turret slides
3 Turrets

In addition to this, many of the parts of the driving mechanism are reduplicated; for example, all the clutch members in a given headstock are identical, except for the thickness and the number of the friction disks.

A number of important advantages accrue to both the manufacturer of the machines and the user from standardization of this kind. It is evident that if eight different types or models can be built from units that are the same for several or all of the machines, it is possible to reduce manufacturing costs, so that a machine of the same quality can be sold at a lower price, and yet will provide a more substantial return to the manufacturer. A machine tool builder who so unifies the design of his machines that he can build certain units in quantity and yet has a wide range of types to offer can include improved details of design, such as ball bearings, heat-treated gears, and many other features that are essential in a high-grade machine, without increasing the cost; because, owing to the larger production of unit parts in a standardized design, the cost of the machine can still be held within reasonable limits.

A larger number of types of machines can be provided than would otherwise prove economical, and in this way the range of work for which the line of machines is suitable can be increased without increasing the price of the machines. Thus machines that would otherwise be considered special are produced at the same price as a standard line. Furthermore, the different types of machines built by one maker, when constructed according to the unit system of standardized design, will be similar in many respects, and there will be a smaller number of parts to deal with in case of repairs. The problem of management in the user's shop is therefore greatly simplified, and the men in the shop will become more readily familiar with the upkeep and adjustment of a complete line of machines. In large shops, where repair parts are carried in stock, a smaller number is required. This applies, in fact, both to the machine tool builder's stock and to the users.

Furthermore, by standardizing a line of machine tools built by one maker, the problem of teaching the workmen in the user's shop to adjust and operate an entire line of machines will be materially simplified. A man once trained on one machine of a given make will be able to operate, with equal facility, a number of other types of machines of the same make. The training itself can be standardized, and the men can be more easily taught proper methods of running and adjusting the machines. All of this reduces costs, makes changes in personnel less serious, and creates a smoother running organization.

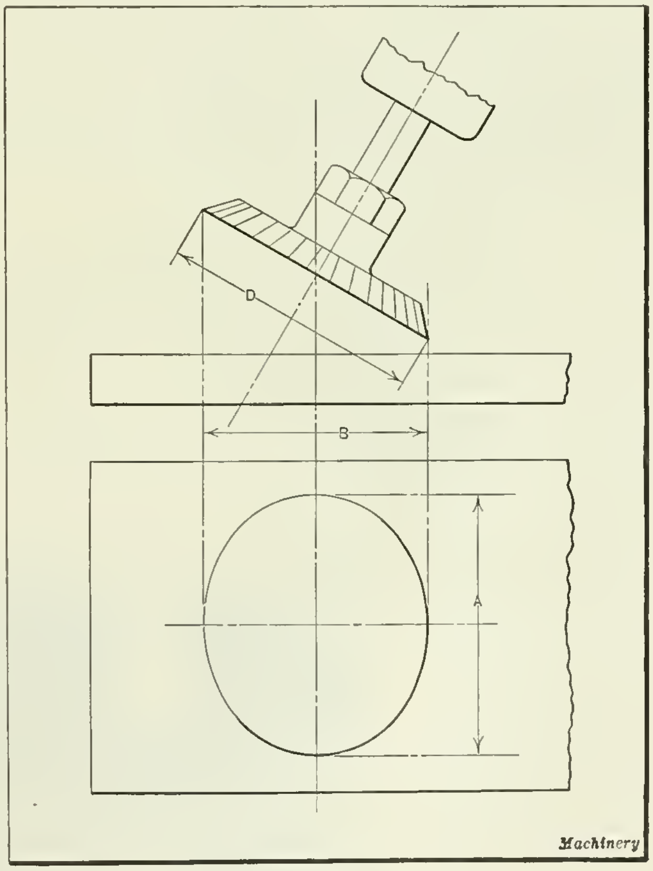
During the last two years, when the production in machine tool shops has been far from capacity, a good deal of attention has been given to standardization problems affecting the products of the shops, and this is a great step forward in standardization in the machine tool field. It is a case of beginning at home to develop standards of design, and later, cooperation between machine tool builders may carry this movement to still greater lengths for the benefit of both the machine tool manufacturer and the user.

* * *

MILLING AN ELLIPTICAL HOLE IN A STEEL PLATE

By G. A. LUERS

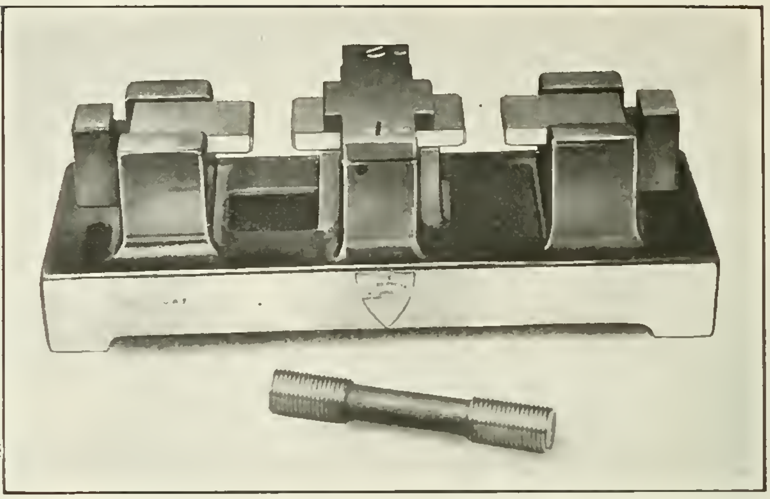
A method of cutting an elliptical hole in a steel plate is shown diagrammatically in the accompanying illustration. If a solid cutter like the one shown is used, the diameter *D* must be equal to the major axis *A* of the hole. The milling head is tilted so that when the work is fed upward in a vertical direction the cutter will mill a hole having the required minor axis *B*. The face-cutting teeth would remove the metal at the center of the hole if they could be extended to the center of the tool, but as this cannot be done, it is necessary to remove most of the metal by boring or drilling, if the work is 1/16 inch or more in thickness. Thinner stock will bend in some cases in advance of the tool so that no hole need be cut previous to the milling operation. The work is clamped to the milling machine table on parallel bars, or held in a fixture that will permit the cutter to pass through far enough to finish the hole completely at one setting. An adjustable fly cutter may be used in place of the milling cutter if desired, or if a milling cutter of the right size is not available.



Method of milling Elliptical Hole

Thread Measuring Devices

By B. M. W. HANSON, President
Hanson-Whitney Machine Co., Hartford, Conn.



IN determining upon tolerances for screw thread fits, it is of the greatest importance that the tolerance on the pitch diameter be considered in connection with the tolerance on the lead of the thread. Many people well versed in mechanics in general simply consider the tolerance on the pitch diameter and seem to believe that that is all that is necessary. As a matter of fact, in practice, the least important dimension of a screw thread is the pitch diameter, and the most important is the lead; because no matter how accurate the pitch diameter is, this accuracy is valueless if the lead is incorrect. This subject has been dealt with by the writer in a previous article in MACHINERY, and is also thoroughly explained in a book entitled "Handbook of Small Tools," by Erik Oberg. Notwithstanding the publicity that has been given to this subject, there still seems to be a lack of understanding of the relation existing between the tolerances on pitch diameter and on lead, and the effect of the length of the nut.

Importance of Correct Thread Angle

The angle of the thread is not accorded the importance that this important detail of the tap or screw merits. The writer considers the accuracy of the angle of the thread to be next in importance to the accuracy of the lead. Furthermore, it is much easier to obtain accuracy of pitch diameter than it is to obtain accuracy in lead and in the angle of the thread. A screw thread may have a very accurate pitch diameter and be quite accurate in lead, and yet, if the angle is incorrect, it will have an imperfect bearing in the nut.

Many attempts have been made to establish tolerances both for pitch diameters and lead errors, and while this work is commendable as far as it goes, such tolerances are of little real value unless means are provided for accurately measuring the different factors that enter into a correctly produced screw thread. The writer has therefore concentrated his attention on the design of measuring devices for maintaining established tolerances on screw threads.

The heading illustration shows an inspection gage by means of which what might be called the "combination tolerance" on pitch diameter and lead may be established, and work measured to determine whether it is within the established tolerances. This device consists of two jaws, which are solidly held after having been adjusted, one at the extreme right and one at the extreme left. In the middle is a single, double-ended jaw, which is positively held against movement in a longitudinal direction, but which is free to float crosswise of the measuring device, so that the threads in its face can adjust themselves to the thread grooves of any tap or screw being measured between the floating and the solidly held jaw.

In the foreground of the illustration is shown a double-ended plug thread gage which is part of the measuring system, one end of this plug being made to the maximum size of the screw to be tested, and the other end to the minimum size. This plug thread gage is used for adjusting the solid jaws of the inspecting gage, so that the gage will be set to maximum and minimum dimensions.

In use, this inspecting gage is placed on a bench, and large quantities of screws can be quickly inspected, as they should pass freely through one set of gage jaws and not pass through the other set at all. This gage has the advantage that even though the pitch diameter is correct, it will not pass screws that have too great an error in lead, because the combination of lead and pitch errors would prevent the screw from entering the nut for which it is intended, with a proper bearing in the threads, as already mentioned.

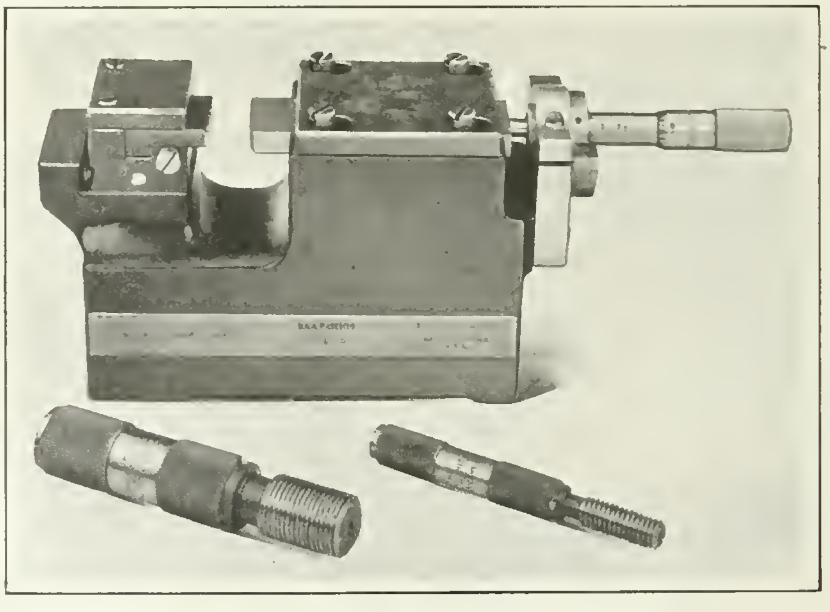


Fig. 1. Thread-measuring Device showing Combined Accuracy of Pitch Diameter and Lead

Fig. 1 shows a thread-measuring device, the object of which is to detect errors in lead as well as to measure pitch diameters. This gage has two jaws; the one at the right is operated by a micrometer screw and the one at the left is held positively as regards longitudinal movement in the direction of the micrometer screw, but it can float back and forth crosswise of the measuring device so that the threads in the jaw will accurately fit into the threads of the gage, tap, or screw being measured. The sub-frame of the floating jaw is also capable of swiveling, and two adjusting screws are provided in the rear so that it may be set very accurately in a position parallel with the other jaw. The jaws can be easily removed from the gage body and other jaws substituted for measuring different pitches of thread.

In the foreground of this illustration two plug thread gages are shown, ⅜ and ¾ inch in diameter, respectively. These gages will serve as an example of the use of the instrument. They are of the same pitch, the diameters only differing. The micrometer readings are so adjusted that when the ¾-inch plug is inserted, the micrometer will read ¾ inch, and when the ⅜-inch plug is put in position, the micrometer will read ⅜ inch, although the measurement is not taken over the tops of the thread, but in the actual angle of the thread.

The threads in the jaws are accurately ground to the correct angle and are very accurate in lead, so that when they engage with the threads of the object to be measured, errors in lead, as well as in the form of the angle of the thread, can be observed by visual inspection, and the combined error of inaccuracies in lead and pitch diameter will register on the micrometer reading.

In order to prove whether or not the lead is accurate, the object to be measured is first engaged the full length of the jaw, and afterward engaged about two threads only, and measured. If the lead is correct, the micrometer reading should be the same in both cases. If the lead is incorrect, the reading will be larger when the gage jaws are engaged for the full length. This method of measurement, therefore, will show whether or not the lead is correct, and it will also give the total effect on the pitch diameter of the error in lead in a length equal to the width of the jaw. A table may be provided that will show what the actual error in pitch diameter is for jaws one inch wide, and various micrometer readings.

However, as the fit of the nut depends not upon the pitch diameter alone, but upon the combined effect of errors in pitch diameter and lead, the real measure of the tolerance of the screw thread is the actual micrometer reading, which, as mentioned before, may be termed the "combined tolerance."

Gage for Measuring Taps with Odd Numbers of Flutes

Fig. 2 shows a measuring device by means of which the correct diameter and lead of a three-fluted tap may be gaged. This device has two jaws inclined toward each other at a 60-degree angle. The jaws are hardened, and the threads are finished by grinding, the thread grooves corresponding accurately to the lead or pitch of the tap to be measured. In the past there has been no satisfactory means for measuring taps with an odd number of flutes, and as this style of tap is a necessity for many classes of work, a device for measuring diameters of such taps is of considerable value. For a five-fluted tap, the angle between the jaws is, of course, different from the angle used for a three-fluted tap.

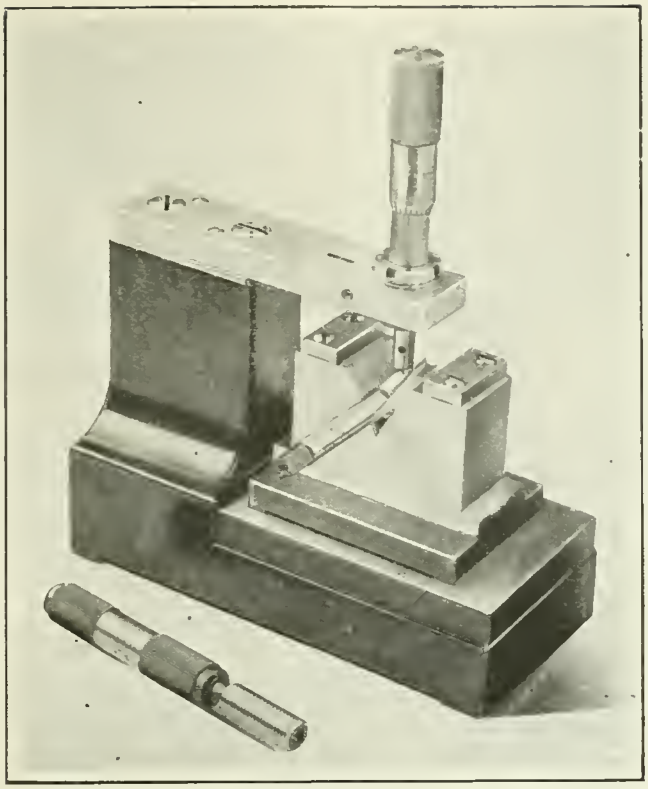


Fig. 2. Measuring Device for Taps with Odd Numbers of Flutes

The micrometer of this gage is so graduated that it reads directly the diameter being measured, compensation being made in the micrometer graduations for the angle of the gage jaws. In addition to measuring pitch diameter, this device indicates errors in the lead or angle of the thread, based on the same principle as that by which the combination errors of lead, angle, and pitch diameter are found in the devices previously described. It is evident that if the lead is inaccurate, the tap will not fit or sink down to the full depth of its thread in the jaws, and hence the micrometer reading will be correspondingly larger.

Lead Measuring Machine

Fig. 3 shows a new lead measuring machine which has been designed with a view to providing a simple lead measuring device of great accuracy. Simplicity of operation has been one of the main considerations in its design, and the effect of the personal element of the man taking the measurement has been removed. After brief instruction, anyone can accurately measure lead errors by this device. This machine is constructed somewhat on the principle of the well-known Pratt & Whitney measuring machine, but, in addition, it has a multiplying device with compound levers pivoted on points such as are used in high-grade weighing scales.

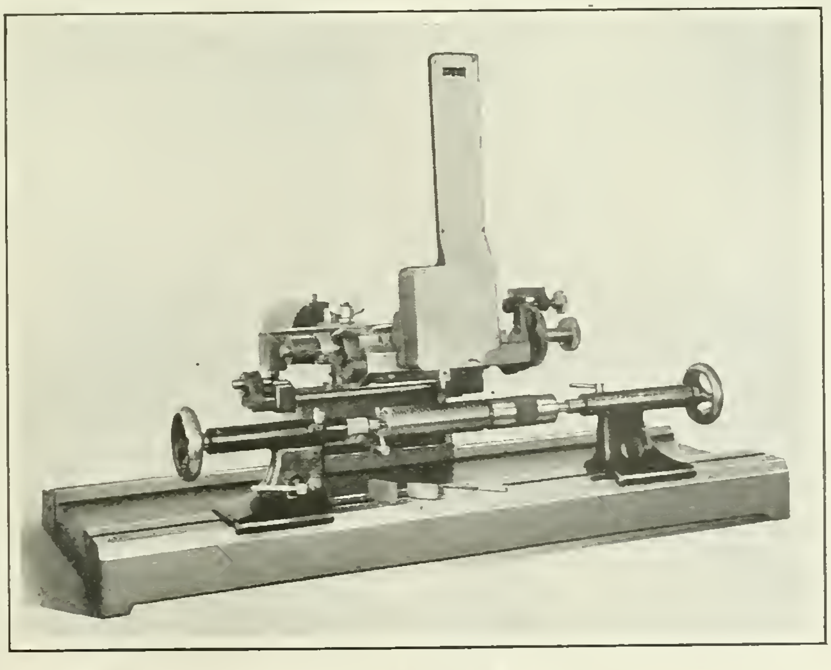


Fig. 3. Lead Measuring Machine

The illustration shows a threaded plug between the centers of the device. One of the centers is provided with a spring so that parts to be measured can be easily put in and taken out by simply pushing the center backward. Immediately above the plug to be measured will be seen a holder for a ball point that enters in the thread groove. At the extreme upper end of the bracket attached to the front of the device there is a window, inside of which is a graduated scale, each graduation representing 0.0001 inch. As the lever multiplies 150 times, each graduation is approximately 1/64 inch, which is amply large enough to enable even one-half of a ten-thousandth of an inch to be easily read with the naked eye.

The application of the device is simple. After the threaded plug, tap, or screw has been put in place between the centers, the ball point is brought down until it rests in a thread groove, and then the slide carrying the bracket with the ball point and the lever mechanism is adjusted until the pointer reads zero on the scale at the top of the bracket. The exact location of the measuring machine part of the device is determined the same as in a Pratt & Whitney machine by means of a feeler piece which drops by its own weight when the correct amount of pressure has been applied in the setting.

Now the slide is moved an exact predetermined distance—½ or 1 inch, as the case may be. The setting in the new position is determined by inserting a Johansson gage-block between the measuring surfaces in the rear of the device. The exact setting is determined by first locating the slide approximately, and then adjusting it slightly until the feeler piece falls by its own weight. This indicates that the slide and consequently the ball point, has been moved exactly either ½ or 1 inch. The ball point is now again brought down into the thread groove. If the lead is exactly correct, the pointer will remain at zero. Any error in the lead will be shown by the pointer moving a certain distance either to the right or to the left, and the amount of error in the lead—plus or minus—is determined at a glance.

The device is so counterweighted that the ball point is normally out of contact with the thread to be measured, but it is brought down into contact by a simple movement of the hand, which swings the entire mechanism forward. The lower of the two knurled-head screws shown to the right is for quick adjustments of the slide, and the upper screw, which engages with the stem or shaft of the lower one by means of a gear and pinion, is used for the fine adjustment necessary to actuate the feeler piece.

There are many refinements in design involved in this mechanism, but the outline of its operation, as given in the foregoing, explains the main principles involved. For combined simplicity of operation, accuracy and sensitiveness, it is believed that this lead testing device will meet practical requirements more fully than has previously been possible.

* * *

HYDRAULIC PRESSURE INTENSIFIER

By JOHN N. SIOUSSA

Hydraulic equipment for producing pressures greater than 25,000 pounds per square inch is required in comparatively few industries. A careful investigation by the writer revealed the fact that little is generally known or has been written about the design of hydraulic equipment for pressures above 30,000 pounds per square inch. Recently there was need in a certain plant for equipment capable of producing a pressure of 125,000 pounds per square inch, and the intensifier shown diagrammatically in Fig. 1 was built to meet this demand. The design is simple, and has given satisfactory results. It can be operated at small cost, and its productive value is high.

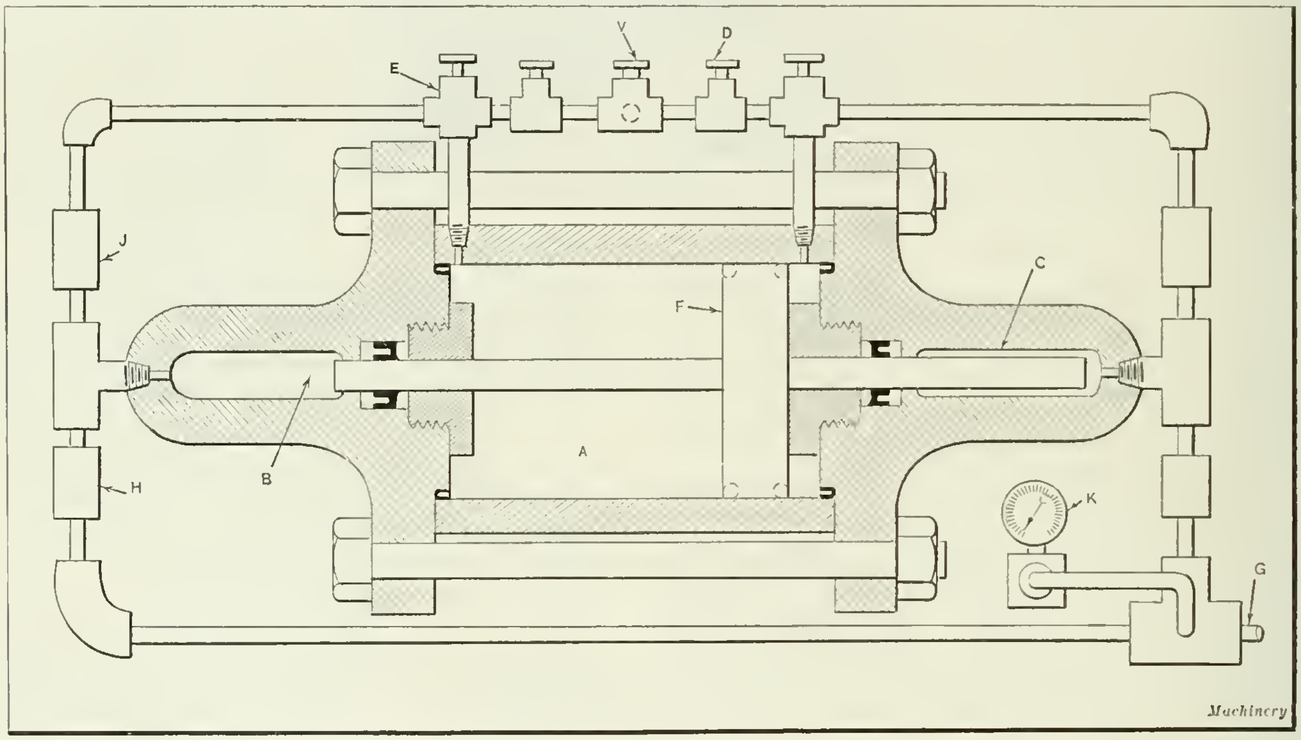


Fig. 1. Hydraulic Intensifier for obtaining a Pressure of 125,000 Pounds per Square Inch

Commercial hydraulic pumps having a capacity of about 5000 pounds per square inch are used to operate the hydraulic intensifier. The diameters of the differential pistons of the intensifier are in the ratio of 25 to 1. The low-pressure cylinder *A* is located between two high-pressure cylinders *B* and *C*, which are secured to the ends of the low-pressure cylinder by bolts, as shown. The piston-head is fitted with a plunger at each end. These plungers compress the liquid in the high-pressure cylinders. The intensifier is double-acting; in other words, while the liquid in one cylinder is being compressed and forced into the delivery pipe, the liquid is being admitted or drawn into the other cylinder so that it will be filled, ready to be compressed on the return stroke.

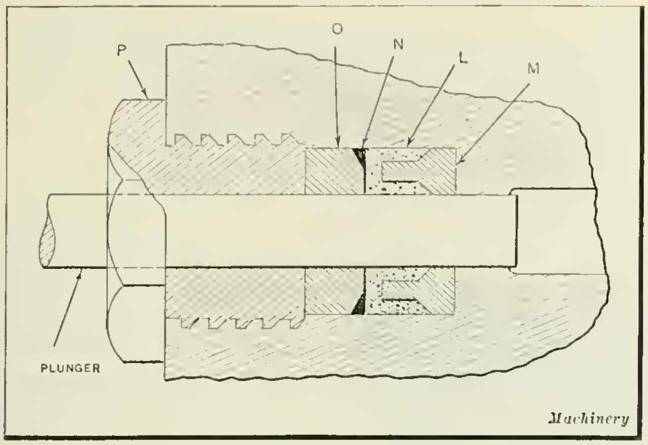


Fig. 2. Packing used to prevent Leakage between High- and Low-pressure Cylinders

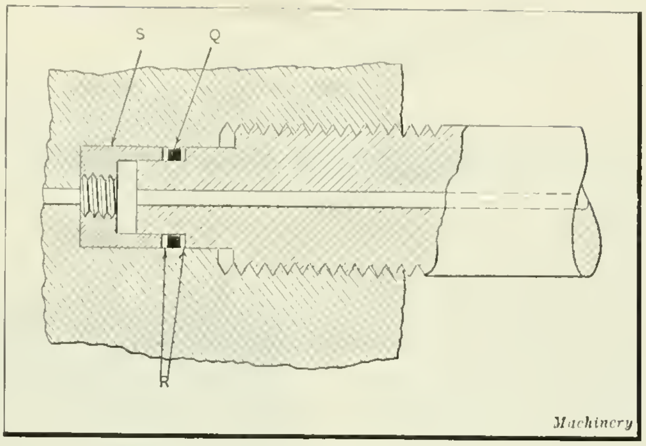


Fig. 3. Sectional View of Pipe Connection of High-pressure Equipment

The supply from the hydraulic pumps at a pressure of 5000 pounds per square inch is connected to valve *V* and admitted to the right-hand end of low-pressure cylinder *A* through pressure valve *D*, while drain valve *E* at the other end of the cylinder allows the exhaust liquid to flow back into the supply tank. As piston *F* is forced to the left, the liquid in the high-pressure cylinder *B* is compressed and forced into the delivery pipe *G* through check-valve *H*, which also prevents the liquid from flowing back into the high-pressure cylinder. On the return stroke the high-pressure cylinder *B* is refilled from the delivery pipes of the low-pressure pumps, and the check-valve *J* on the low-pressure side prevents the liquid from returning when the piston reverses and repeats the operation. The high-pressure cylinder *C* is filled from the low-pressure supply, and exhausts into the high-pressure delivery line in the same manner as cylinder *B*. The dial gage *K*, which is attached to the high-pressure delivery pipe as shown, indicates the pressure at which the liquid is being discharged from the intensifier.

Provision for Preventing Leakage

The packing used on the piston *F* and the cylinder head is of the common U-shaped type, and is subjected to a pressure of only 5000 pounds per square inch. In the high-pressure cylinders the packing is somewhat different from that used in the low-pressure cylinder. Fig. 2 shows the method employed to prevent leakage between the high-pressure and the low-pressure cylinders. This method of packing is one of the features of the equipment that have made it possible to obtain safely pressures of 125,000 pounds per square inch. The leather packing of the high-pressure cylinder is shown at *L*. This is made from the best grade of leather, specially treated in a bath of hot tallow and beeswax to adapt it for use in hydraulic equipment subjected to high pressures. The treatment given this packing supplies the necessary lubricant for the plunger, and also prevents the liquid from being forced through the leather.

As indicated in the illustration, the packing is formed with lips of the usual length, the ends being trimmed uniformly at a slight angle. The thrust face is flat, and the corners are square and sharp. A retaining ring *M* is used to keep the packing in position, and an expanding ring *N* prevents the packing from flowing between the wall of the packing chamber and the gasket *O*. It will be noted that the cross-section of the expanding ring *N* is triangular in shape. The angular position of the contacting faces of the packing and of the lead gasket *O*, together with the carefully beveled joining ends of the expanding ring *N*, provides for the expansion required to prevent leakage when the inner walls of the packing chamber become dilated under the extremely high pressures developed.

The nut *P* securely holds the parts *L*, *M*, *N*, and *O* in place. Nut *P* is secured by a differential buttress thread; this form of thread has great strength and the differential pitch provides for the proper distribution of the thrust load over the entire thread, so that no single thread will be overstressed. As the pressure builds up, each thread takes up its part of the load gradually, until the highest pressures are reached.

Pipe Connections

The joints or connections used for the tubing and fittings that convey the liquid under high pressure were designed as shown in Fig. 3. Unusually heavy tubing and fittings were, of course, required, to withstand the extremely high pressures. The screw threads used for the coupling joints were of the type approved by the National Screw Thread Commission. Steel washers *R* were placed on each side of the lead gasket *Q*. One of the steel washers bears against the end of the gland cup *S*. Under the pressure of the screw joint, the lead composing gasket *Q* is forced to flow and thus seal the joint so that it is absolutely leakproof.

The check-valves used were of the ball type, as shown in Fig. 4, a small steel bearing ball *T* being used as a check. The ball seat was ground and lapped to a spherical shape to fit the surface of the ball. A cage *U* was incorporated in the check-valve so as to keep the ball close to the seating surface. Needle valves of special design were employed in order to provide a means of gradually releasing the pressures.

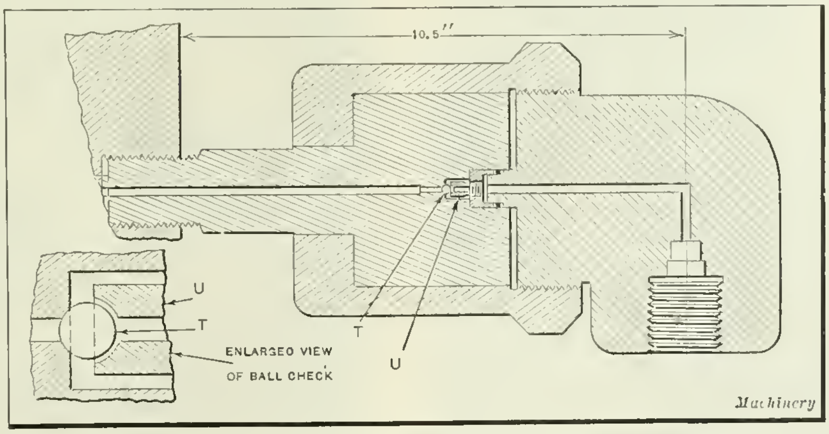


Fig. 4. Sectional Views of Ball Check-valve such as indicated diagrammatically at J and H, Fig. 1

INDUSTRIAL CONDITIONS IN GERMANY

From MACHINERY'S Special Correspondent

Berlin, July 9

Conditions in Germany change so rapidly from day to day that a statement as to the present conditions may not apply by the time this letter is printed and read. The Ruhr occupation is, of course, the one important feature in the entire situation. At the beginning of the occupation it was expected that the lack of coal and coke would prove an extremely serious handicap, but the condition is not so bad as was expected. There has been considerable importation of British, American, and South African coal, and this, together with the fuel from the non-occupied districts, has enabled the machine-building industries to keep going up to the present time. The industry is not running at the high pressure that it did in 1922, owing to lack of orders, and hence the lack of raw materials has not been so severely felt as was expected.

The Machine Tool Industry

There has been a great reduction in the exports of machine tools, present exports being hardly one-half the pre-war business. Other retarding factors in the machine tool industry are the high prices of castings, the scarcity of young skilled workers, and the difficulty in quoting prices that will meet the steady decline of the mark. It is evident that when payments are made by installments, a very difficult problem arises, because the mark may have a much greater value at the time one installment is paid than it has when the next is due. Methods have been devised for taking care of this trouble, but nevertheless, great difficulties are naturally experienced when a medium of exchange is used that varies so tremendously from week to week, and even from day to day.

One of the difficulties in the foreign market is that at the present time German manufacturers are not able to meet the prices of their foreign competitors. For example, Danish lathes are offered in Finland 15 per cent cheaper than those built by German makers. French twist drills have been sold in Finland for one-quarter the price quoted by German manufacturers. The foreign trade in automobiles is practically cut off for the same reason; American automobiles are offered at prices much lower than those that German manufacturers ask.

Among the few firms that report activity are Ludwig Loewe & Co., whose volume of business has been greater than in 1922; the works have been fully occupied on current orders. The Wotanwerke A. G. of Leipzig has also been working to capacity in all departments, and the Pittler Werkzeugmaschinenfabrik of Leipzig has been fully occupied until quite recently, although the booking of new orders has been slow. The R. Stock A. G. Spiralbohrer & Werkzeugfabrik of Berlin-Marienfelde is also reported to have plenty of orders on hand. But these firms are among those that are in an unusually good position and are not representative of conditions in the German machine tool industry, because the average shops are now working short hours and are hampered by lack of business, curtailment of credit, and scarcity of raw materials.

The Automobile Industry

Of all the German machine-building industries the automobile building plants are best occupied at present. Naturally, with the mark constantly falling in value, nobody keeps money, but exchanges it as soon as possible for some form of goods. This has aided the automobile industry in that many have bought automobiles with their available cash, rather than keep it and see it constantly decrease in value. In some cases, the owners of the new cars are unable to pay for gasoline for the continuous running of the car, but nevertheless they feel that they are better off having their money in a concrete piece of property. At the present time, there is one automobile in Germany for each 360 inhabitants. Many new developments have been made in the automobile industry, and efforts are especially being made to improve the design with a view to decreasing air resistance, in order to increase the gasoline mileage.

General Industrial Conditions

In business circles, combinations or trusts are still being formed, and there is a tendency to combine the production of raw materials and finished products under the same management. One recently formed combination, for example, controls coal, steel mills, and machinery-building establishments. A great many foreign enterprises have been organized by German concerns. It is said that the firm of Hugo Stinnes owns over one hundred foreign industrial concerns, not including the foreign branches of the Siemens-Rhein-Elbe-Schuckert-Union. The Algemeine Elektrizitats Gesellschaft has eighty foreign branches, and a great many of the other large German companies are operating mining concessions, factories, or branches in foreign countries. The trade with Russia has not developed to any important extent, the business with that country suffering mainly from the utter lack of buying power in Russia.

Labor conditions are no longer so good as they were last year. Many of the industrial workers have had their hours reduced, and the number of workers without employment increases from week to week. The lack of employment applies especially to the smaller plants, and from Saxony, the industrial center of Germany outside of the Ruhr district, reports of the dismissal of workers in factories are frequent. Locomotive and car shops are suffering from lack of business, and in the shipbuilding industry there is no new construction to speak of, most of the yards now doing only repair work. The work on new ships has been suspended on account of lack of materials, owing to the cutting off of supplies from the Ruhr district. There have been no serious labor difficulties, and those that have taken place have largely been caused by the increases in prices, which have mounted faster than wages. Most of them have been settled in a friendly way. The only serious strikes that have taken place have been those of a political character, fomented by the communists.

* * *

EASY METHOD OF READING A CHART

By N. G. NEAR

Considerable time is often spent in locating the edge of a ruler or straightedge on the points that represent the known values on two different graduated lines of a chart, so that an unknown point may be located on a third graduated line by the edge of the ruler. The difficulty lies in locating the straightedge on the two separate points at the same time. The third point, which represents the value to be found, is, of course, in line with the other two points and can be quickly and accurately read if the straightedge is properly located. Now if means are provided for separately locating the straightedge at the known points on the two first-mentioned scales or graduated lines, the work will be greatly facilitated.

This may be accomplished by using a simple device consisting of a soft pine stick, or handle, about the size of a lead pencil, which has a fine needle driven into one end and a fine black silk thread with a knot tied on the end threaded through the eye of the needle. The needle should project about 1/4 inch beyond the end of the stick. With this device, the head of the needle is placed on whatever point is selected on the first graduated scale, and the free end of the thread swung around until it is located over the second point. The third point is thus immediately and accurately located. It is a good plan to make a mark of some kind on the stick, so that it can be seen at a glance if it is held so that the eye of the needle is correctly positioned.

Cutting Instrument Gears

Production of Small Gears by Means of Hand-operated and Automatic Machines of the Formed-cutter and Hobbing Types—First of Two Articles

By FRANKLIN D. JONES

GEARS of the small precision class used for various kinds of measuring and recording instruments, pressure gages, meters, vending machines, clock mechanisms, etc., are produced by three general methods, the selection of which depends upon the size of the gears and the quality desired. One method is to form the gear teeth by some cutting process such as milling or hobbing; another is to use a sub-press die; and a third method is to form the teeth by a drawing process, as applied to the production of pinions in rod form.

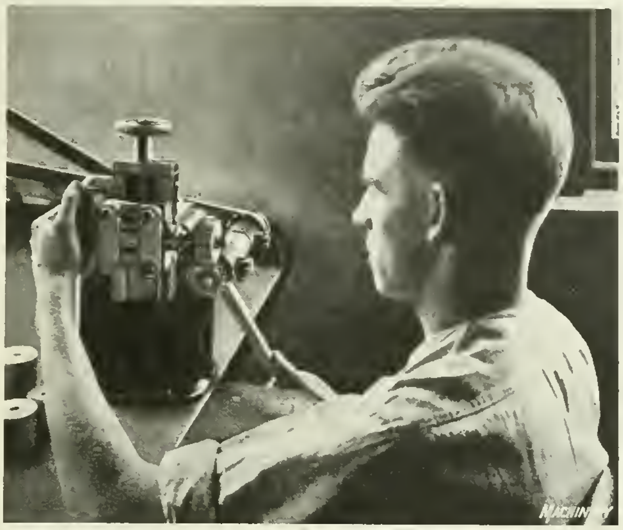


Fig. 1. Cutting a Stack of Small Gears on a Hand-operated Machine

When the teeth are milled, it is common practice to use a die for cutting the plain blanks from flat stock of the right thickness. These die-cut blanks may or may not be turned before the teeth are cut, the practice varying for different classes of work. Many gears, especially if small and quite thin, are placed in the gear-cutting machine just as they come from the dies; but when comparatively thick stock must be used, the die-cut blanks are often turned to size, although in either case the blank may be left slightly oversize in order to allow for a "topping cut." In other words, there is a slight allowance on the blank diameter to permit finishing the tops of the teeth in the gear-cutter. This practice is quite common in cutting precision gears for instruments, meters, and similar classes of work.

Small precision or instrument gears that have the teeth formed by a cutting process are cut either on machines using a formed cutter, the shape of which is reproduced in the gear tooth, or on machines of the generating type, using hobs. The machines using formed cutters may be controlled by hand or may be automatic.

While different designs of automatic and semi-automatic machines have been developed for cutting small precision gears, it is the practice at the plant of D. S. Plumb, 73 Norfolk St., Newark, N. J., to use hand-operated machines for cutting most of the precision gears. These machines are simple in design, and by their use, gears can be cut very rapidly, notwithstanding the fact that the machines are hand-controlled.

A general view of one of these machines is shown in Fig. 1. The gear (or stack of gears) to be cut is carried

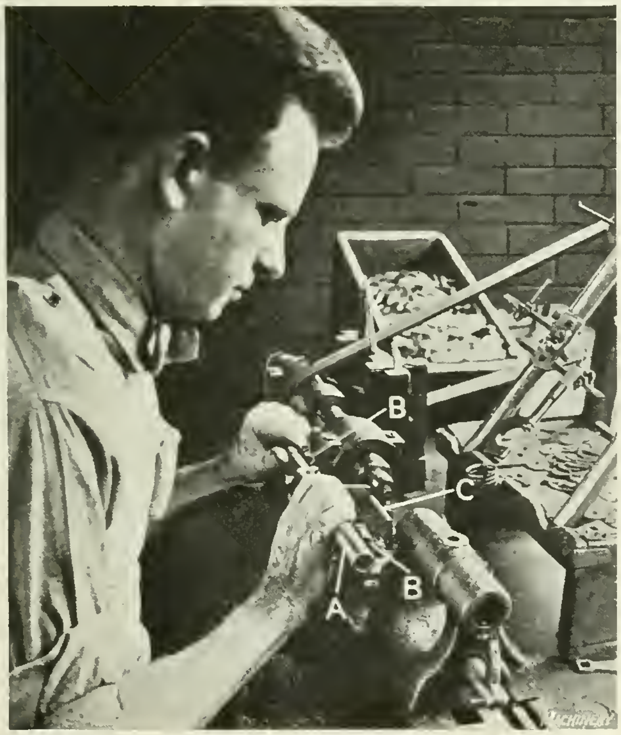


Fig. 2. Rapid Method of turning Small Instrument Gear Blanks

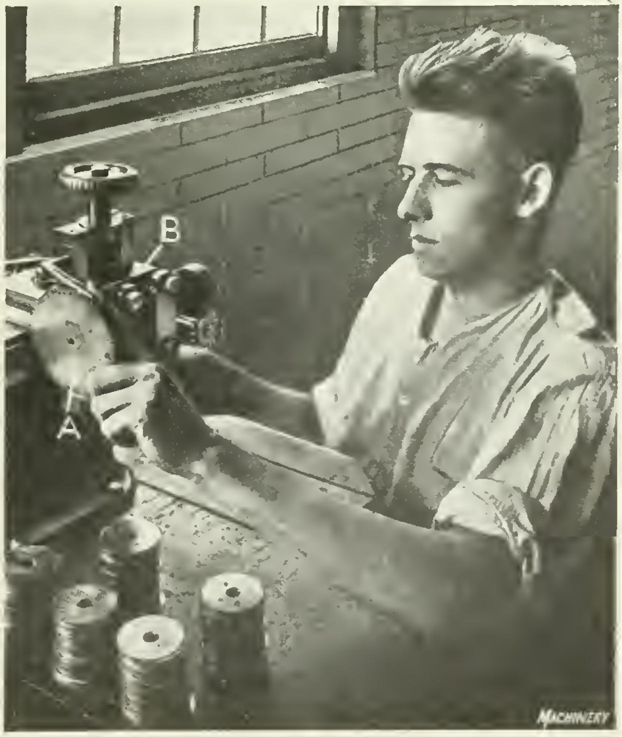


Fig. 3. How Indexing is controlled by Hand on Machine in Fig. 1

by a spindle having at the rear end an index-plate *A* (see Fig. 3) with notches corresponding to the number of teeth required. This spindle is mounted in a quill, which, in turn, is clamped in a V-shaped groove on vertical slide *B*, which provides adjustment to suit the gear diameter and depth of cut. This vertical slide also has lateral adjustment to permit centering the work relative to the cutter, and it is carried by a main slide which can be moved at right angles to the axis of the cutter-spindle by a hand-lever. The cutter-spindle is supported by a fixed bearing, and is driven by belt from a countershaft at the rear of the machine.

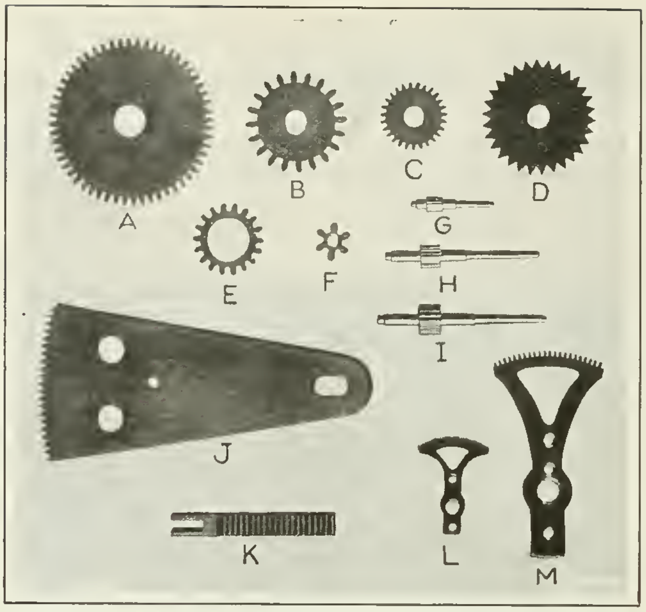


Fig. 4. Samples of Instrument Gears cut on Hand-operated Machines

When this machine is in use, the operator feeds the blank (or blanks) across the cutter by the hand-lever on the right-hand side, and after each tooth space is milled and the slide withdrawn, the work-spindle is indexed to the next notch by using the left hand. The method of holding the work depends upon its shape. For instance, small instrument pinions cut integral with a staff or shaft would be cut one at a time while held between some kind of supporting centers. On the other hand, flat blanks would be stacked on an arbor to permit cutting quite a number in one operation. The hand-controlled feeding and indexing movements are executed so rapidly that a high rate of production is obtained, as indicated by the following specific examples of gear-cutting practice on these machines. While other types have been used, the hand-operated machines are considered the best for most of the precision gear-cutting operations at this plant, as regards both quality and quantity.

Examples of Precision Gear Cutting

The examples of instrument gear work shown in Fig. 4 are from the plant of D. S. Plumb. All these pieces were machined on the hand-operated machines just referred to, and they illustrate in a general way not only the variety of gear-cutting done on these machines, but the rates of production for different classes of work. Gear *A* has 60 teeth, of 36 diametral pitch, and is cut at the rate of 100 per hour. Gear *B*, which is used in a meter, has 20 teeth and is cut at the rate of 300 per hour. This gear is made of No. 16 gage stock. Gear *C* has 26 teeth, of 52 pitch, and a 1/8-inch face. The cutting rate is 250 per hour. The escapement wheel shown at *D*, which is 1 inch in diameter and has 30 teeth cut in it, is turned out at the rate of 250 per hour.

It will be understood that in most cases several blanks are cut at the same time, although this is not always practicable, as shown by some of the examples to follow. Pinion gear *E* has 18 teeth, of 32 pitch, and 180 pinions are cut per hour, five being placed on the arbor at one time. Pinion gear *F* has 6 teeth, of 24 pitch, and is cut one at a time at the rate of 140 per hour. Pinions of the type illustrated at *G*, *H*, and *I* are cut one at a time. Pinion *G* has 13 teeth, of 125 pitch, a 5/32-inch face width, and the cutting rate is 150 per hour. Pinion *H* has 18 teeth, of 90 pitch, a 3/16-inch face, and is cut at the rate of 100 per hour. Pinion *I* has 16 teeth, of 64 pitch, and is cut at the rate of 100 per hour.

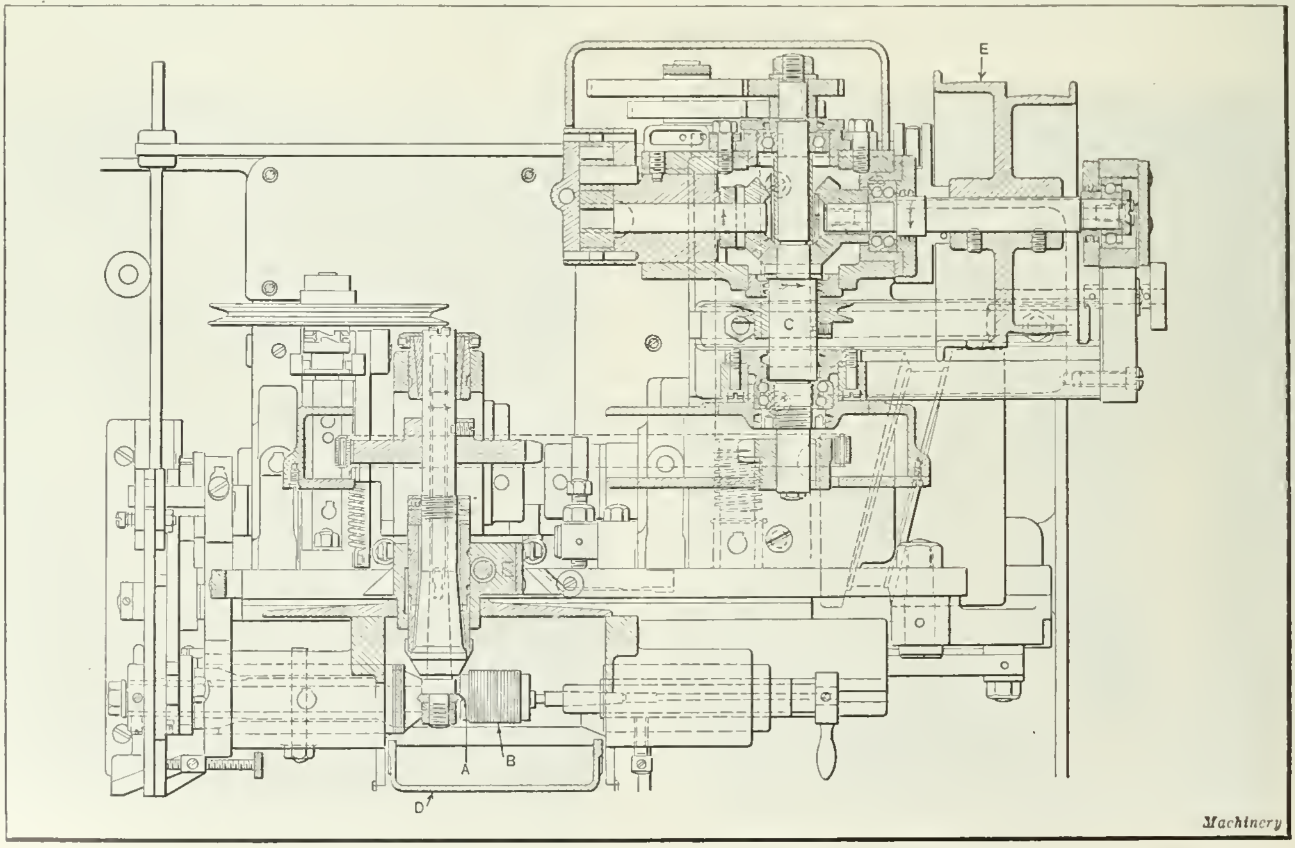


Fig. 5. Plan View of Machine for cutting Spur Gears up to 4 Inches Pitch Diameter

In cutting the segment gears *J*, ten are placed on one arbor. These segments have 21 teeth, of 48 pitch, and are made of No. 11 gage stock. The rate of cutting is 100 per hour. The nickel-silver racks *K* are cut five at a time, at the rate of 80 per hour. These rack teeth have a linear pitch of 0.049 inch. An example of very fine gear-cutting is shown at *L*, the gear teeth being only 150 diametral pitch. These segments are cut at the rate of 260 per hour. Segment gear *M* has 22 teeth, of 64 pitch, and the rate is 300 per hour.

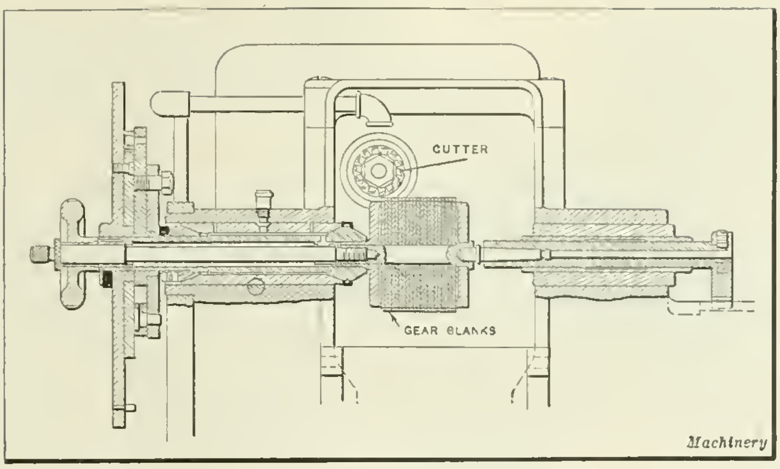


Fig 6. Method of holding Stack of Gear Blanks on Machine illustrated in Fig. 5

Special Machines for Turning Small Gear Blanks

The special type of lathe illustrated in Fig. 2 is used at the plant previously referred to for turning small gear blanks prior to cutting the teeth. These small lathes are exceedingly simple in their arrangement, but they make it possible to obtain a very large production. The gear blanks, as they come from the dies, have holes in the center, and are slightly larger than the correct outside diameter. Fifteen or twenty blanks are inserted over a projecting end of the lathe spindle, and a nut is screwed on to hold them together. The driving belt is then shifted, and as the blanks revolve rapidly they are turned by means of a hand-operated cutter-bar.

This cutter-bar *A* is simply a tube containing a small cutting tool, which extends outward far enough to turn the blanks to the correct size when the bar is pushed along the supporting members *B*. As will be seen, the bar rests against vertical faces on these fixed supports, so that the cutter, which bears on an additional support *C* near its outer end, is always in the same position. After a stack of blanks has been turned, this cutter-bar is placed on the bench, so that it will not interfere with the removal of the finished blanks and the reloading of the spindles. As soon as a new stack of blanks is in place, the cutter-bar is again placed on its supports, and as it is pushed along parallel with the lathe spindle the blanks are rapidly turned to size.

An idea of the rate at which blanks can be turned on this simple machine may be obtained from the following examples: Brass blanks for meter gears 15/16 inch in diameter, made of No. 16 gage stock, are turned at the rate of 600 per hour. In doing this work, fourteen blanks are placed on the arbor at one time. Blanks 5/8 inch in diameter, made of No. 8 gage stock, are turned at the rate of 500 per hour, six blanks being placed on the arbor at a time. This machine does not only rapid but also accurate work.

Automatic Machines for Cutting Small Gears

Machines of the automatic or semi-automatic types have been widely used for cutting small gears in watch and clock factories, and by manufacturers of meters, recording instruments, and various other kinds of apparatus requiring gearing of the class mentioned. Methods of using some of the machines built by the Waltham Machine Works, Waltham, Mass., are described in the following: Fig. 5 shows a plan view of a semi-automatic machine for cutting spur gears up to 4 inches pitch diameter with diametral pitches of 16 and finer. This machine is so designed that the movements of the slides and the indexing are automatically controlled, and are continued until the machine stops after completing the last cut. The insertion or removal of the work, however, is done by hand, so that the machine is not fully automatic like some of the types referred to later. This machine is of the formed-cutter type.

Referring to Fig. 5, the cutter may be seen at *A*, and ordinarily a stack of gear blanks *B* is held on an arbor supported by two spindles, as shown more clearly by the detailed view, Fig. 6. The cutter-spindle is driven from shaft *C* (Fig. 5) by a silent chain transmission. A feeding movement is imparted to the work-slide by means of a cam which gives a quick return. The position of the work-slide relative to the cutter can be changed readily by means of a rack and pinion adjustment. During the return stroke, and

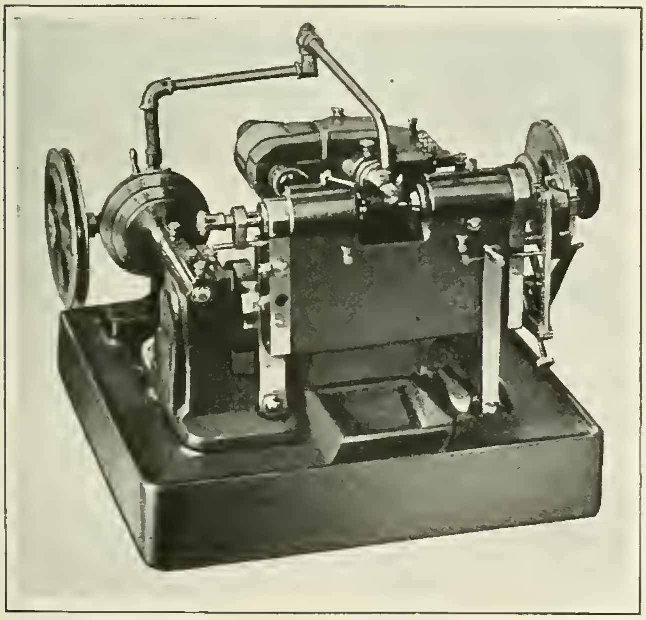


Fig. 7. Type of Gear-cutting Machine designed to meet Requirements of Watch Factories

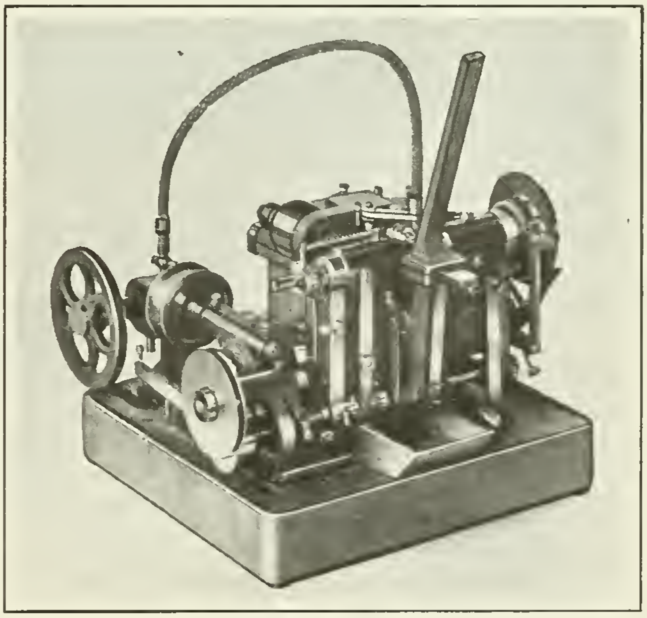


Fig. 8. Automatic Gear-cutting Machine equipped with Magazine Feeding Attachment

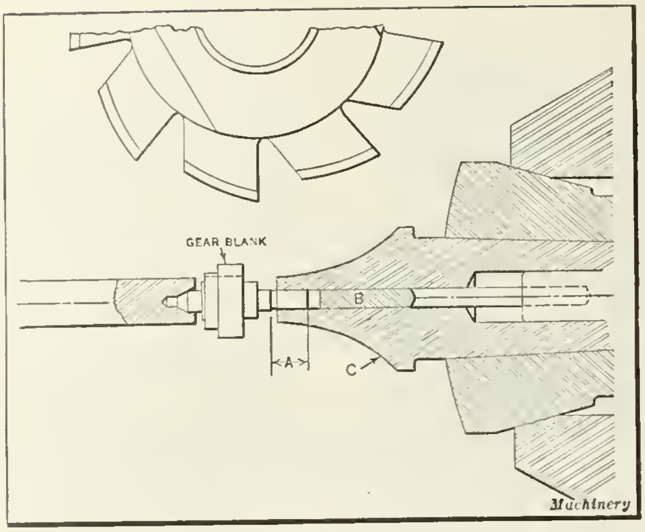


Fig. 9. Method of holding a Pinion Blank

while the work is being indexed the cutter-spindle slide is elevated automatically, and this slide is clamped automatically during the cutting stroke. Vertical adjustments of the cutter-slide for regulating the depth of cut are controlled by a handwheel graduated to thousandths of an inch.

The front bearing of the cutter-spindle is threaded on the outside, and is rotated for centering the cutter relative to the work. A hinged cover *D* on the work-slide completely encloses the cutter and work. The positive indexing movement is controlled by one revolution of a camshaft which is idle except when indexing. The index-plate may be seen at the left of the work-spindle in Fig. 6. While the index mechanism may be arranged for obtaining different divisions, it is considered advisible, for manufacturing purposes, to use one index-plate for each number of divisions required.

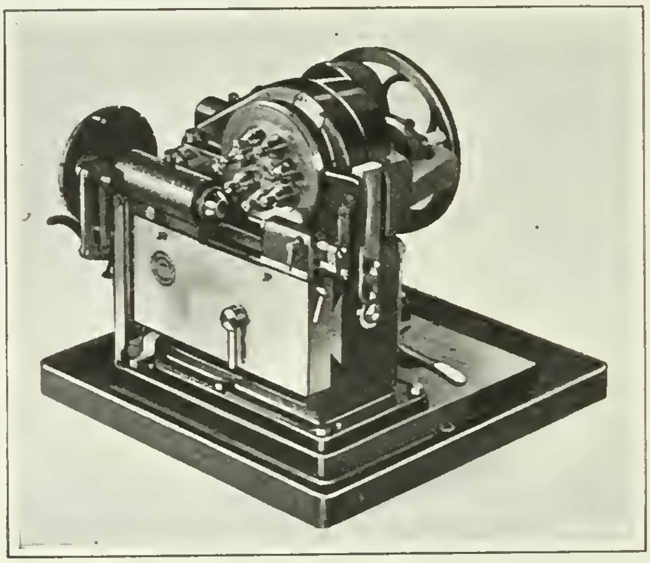


Fig. 10. Machine used for cutting Teeth of Watch Escapement Wheels

The sprockets for the chain drive to the cutter-spindle are of different diameters and are interchangeable, so that either one may be used as a driver to vary the cutting speed. Additional changes are obtained by means of the stepped cone pulley *E*, Fig. 5. Speeds of 300 and 375 revolutions per minute are used for steel work, and 1200 and 1500 revolutions per minute for brass. For cutting tool steel of average quality and temper, a feed of 4 inches per minute is about right. For soft steel, the feed should be increased to about 7 inches per minute, for bronze to 15 inches per minute, and for brass to 20 inches per minute. These speeds and feeds are based on the use of a high-speed steel cutter 1¼ inches in diameter.

Machine Equipped with Roughing and Finishing Cutters

The gear-cutting machine shown in Fig. 7 is one of a line designed to meet the requirements of watch factories, etc. This particular machine is arranged for cutting pinions. The cutter-spindle is equipped with three cutters, two for roughing and one for finishing. The finishing cutter is nearest the front bearing and in the most rigid position. The cutter-spindle is shifted automatically for locating each of the three cutters in the working position. This machine is intended particularly for cutting steel pinions of 48 diametral pitch or finer. A similar machine equipped with a magazine feeding attachment is illustrated in Fig. 8. This machine is, of course, fully automatic in its operation, the blanks being automatically brought into the cutting position by the magazine feeding attachment.

Machine having Seven Cutter-spindles

The machine shown in Fig. 10 is used for cutting the teeth on the escapement wheels of watches. It has seven cutter-spindles, and each one carries a cutter of a different shape. The indexing of the turret, which contains the seven spindles, is automatically controlled, so that all operations are continuous after the work is placed in position. The spindles have screw adjustments for varying both the depth of cut and the location longitudinally, as some of the cuts are in a central position and others off center.

Methods of Holding Small Gears for Cutting

The type of work-holding arbor illustrated in Fig. 6 is recommended for use in connection with the 4-inch machine shown by the plan view, Fig. 5. The arbor holds a stack of blanks between two flanges that are nearly as large as the root diameter of the gears to be cut, thus providing rigid support. Figs. 9, 11, 12, and 13 show various methods of holding pinions and gears on machines of the class shown in Figs. 7 and 8. These same methods, however, may be applied equally well on larger machines.

Fig. 9 shows how a pinion is held to insure cutting the teeth concentric with the pivots. The tapering section marked *A* is not a part of the finished pinion, but is merely used for holding the blank while the teeth are being cut. The opposite end is supported by a conical center in the tail-spindle. Machines operating on work of this class should be equipped with a magazine feeding mechanism. The rod *B*, within the head-center *C*, is used as an ejector.

Two methods of holding hollow pinions on automatic pinion-cutting machines having magazine feeding mechanisms are illustrated in Fig. 12. Referring to the upper view *A* in this illustration, the hollow pinion blank *b* is pushed on a slightly tapering center arbor *c* by the tail-center *d* in order to hold it firmly in place. The finished pinion is removed from the tapering arbor by the ejector-sleeve *e*, having a cross-pin that is engaged by ejector-rod *f*.

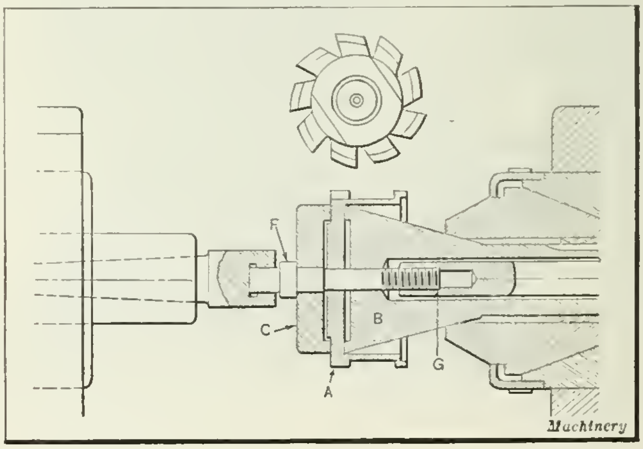


Fig. 11. Arrangement for holding Steel Spring Barrel A while cutting Gear Teeth

The lower diagram *B* shows a hollow pinion blank which is centered by the tailstock center and forced against a headstock center having corners that act as a driving dog for indexing the pinion blank. When the tail-spindle is withdrawn, the finished pinion comes against a stripper *g*, which strips or pushes the pinion off the center.

Holding a Steel Spring Barrel

In Fig. 11 is shown a method of holding a steel spring barrel while cutting the gear teeth on an automatic machine. The spring barrel *A* is held firmly against the end of chuck *B* by clamp *C*, which, in turn, is tightened by means of arbor *F* and draw-in screw *G*. The outer end of arbor *F* is supported by the tail-center.

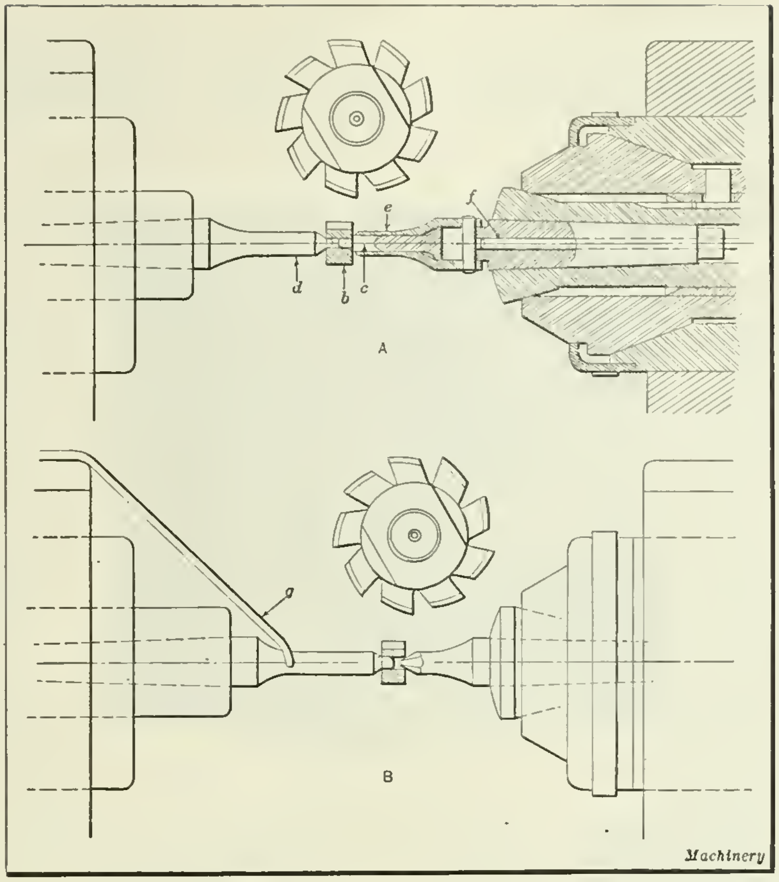


Fig. 12. Two Methods of holding Pinions having Center Holes

The upper diagram *A*, Fig. 13, shows a design of segment arbor such as is used for blanks with spokes. As the sectional view to the left shows, the segments of the arbor are between the spokes and hold the blanks by the inside of the rim. The stack of wheel blanks *a* is held between the nut *b* and the clamping nut *c*. Two arbors should be used to permit loading the blanks on one while the other is in the machine. When the arbor is to be loaded with blanks, clamping nut *c* is first turned back against the arbor shoulder, and nut *b* is removed. After sliding the blanks on the arbor, nut *b* is screwed against the shoulder at the slotted end of the arbor, and then nut *c* is tightened against the stack of blanks. These wheel blanks are without center holes, and a formed cutter is used to trim the tops of the teeth at the same time that the sides and root are finished. The gears are afterward held by the outside in order that the center hole may be located accurately relative to the teeth.

Holding Sector-shaped Blanks

Diagram *B* shows a method of holding sector-shaped blanks. The faceplate *f* has a pin or dog *d* engaging plate *e*. The blanks are clamped between this plate and the one on the opposite side, by nut *n*. The clamping stud and arbor locate the blanks (see end view), and the dog locates the holding device. The index-plate of the machine is set in relation to this locating dog. A duplicate work-holding device should be used to permit loading one while the machine is operating on work in the other.

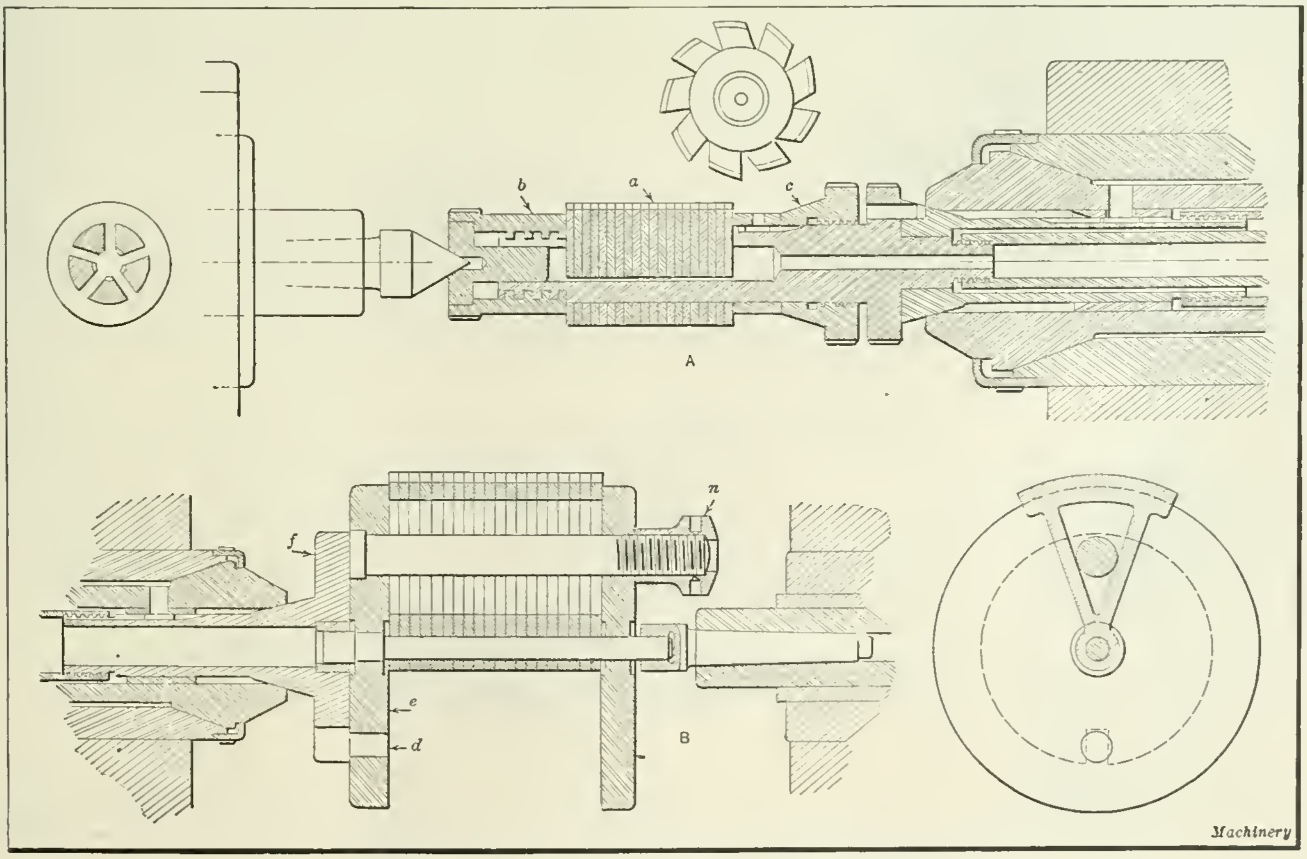
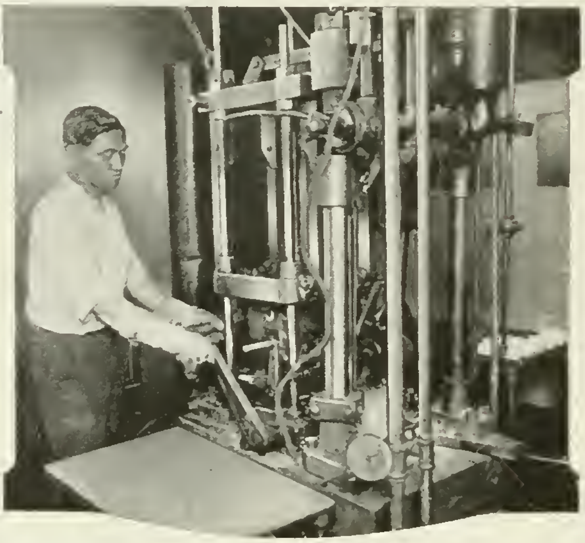


Fig. 13. (A) Segment Arbor for Blanks having Spokes; (B) Method of holding Segment Gears

Cores and Slides for Die-casting Dies

By CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



CORES and slides are the special means provided for casting holes, irregular sections, undercuts, etc., and the possibilities of producing a part by the die-casting process often depend on the ingenuity with which the coring of the casting is arranged. The cores are almost invariably drawn from the casting by a rock and pinion arrangement, as are also the slides, which are usually drawn from the sides. While it is necessary to provide a draft for the cores in nearly every case, when slides are used draft is not necessary for the surfaces of the casting formed by the slides.

The cores sometimes consist of loose pieces which are placed in the die before casting and removed by means of a hammer after the casting is made. The cores may be arranged in a variety of ways and these points are best covered by actual illustrations. Take the case of adding machine frames; aside from being exceptional products with regard to size, these castings also present problems in core arrangement. The ribbed interior of the castings is made from a single huge core, and the exterior from the parts of the die.

With the exception of only one part, that is, the rectangular vertical opening on the keyboard, all the sections are capable of being drawn from each other. Inasmuch as this vertical opening has rounded edges on the outside, it must be formed by a core drawn at right angles to the other cores. To accomplish this, the core used is separate and is ejected with the casting. It remains in the cast hole until subsequently removed. The core is then fitted back in the die for making the next cast.

Die with Several Slides and Two Long Cores

A very good example of die construction using slides and long cores for the central hole is that of the vacuum sweeper brush roll shown in Fig. 1. This part is made from aluminum and contains a central pulley and twenty-four lugs arranged helically so that a straight parting would be impossible on account of unavoidable under-cuts. These lugs are 15 degrees apart, and they are numbered both on the detail view, Fig. 1, and on the illustration of the die, Fig. 2, so that the construction of the die may be more readily understood.

The hole cores *A*, Fig. 2, are tapered from the center line of the pulley, and each is operated in the regular way by a rack and pinion. The length of these two cores makes it necessary to furnish an outboard support at each end of the die for the pinions, to allow for the necessarily long draw. The ejector die, a plan view of which is shown, consists of four slides arranged in pairs. The first pair part on the longitudinal center line of the casting and form lugs 4, 5, and 6 on one side, and 16, 17, and 18 on the other side. Sections of these two slides are shown at *C* and *E* in the lower left-hand corner of the illustration.

Lugs 1, 2, and 3 on one side, and 13, 14, and 15 on the other are formed by stationary die sections, as shown by the sectional view *D*. This two-piece construction facilitates machining, and is the only reason for the sectional design. These sections are of different widths so as to provide a stop or shoulder at the center line which will determine the position of the first-mentioned slides when closed. Lugs 22, 23, and 24 on the right-hand side of the pulley, and lugs 10, 11, and 12 are also produced by a pair of slides arranged to part as shown in the sectional view at the left. These mating slides are also arranged to fit against a stop or shoulder on the right-hand end section of the die which is stationary. This section is one piece and casts lugs 7, 8, and 9, it being unnecessary to use the two-piece construction to facilitate machining the impression. (See sectional view *B*.) The three opposite lugs, 19, 20, and 21 are similarly formed in the impressions in the cover die.

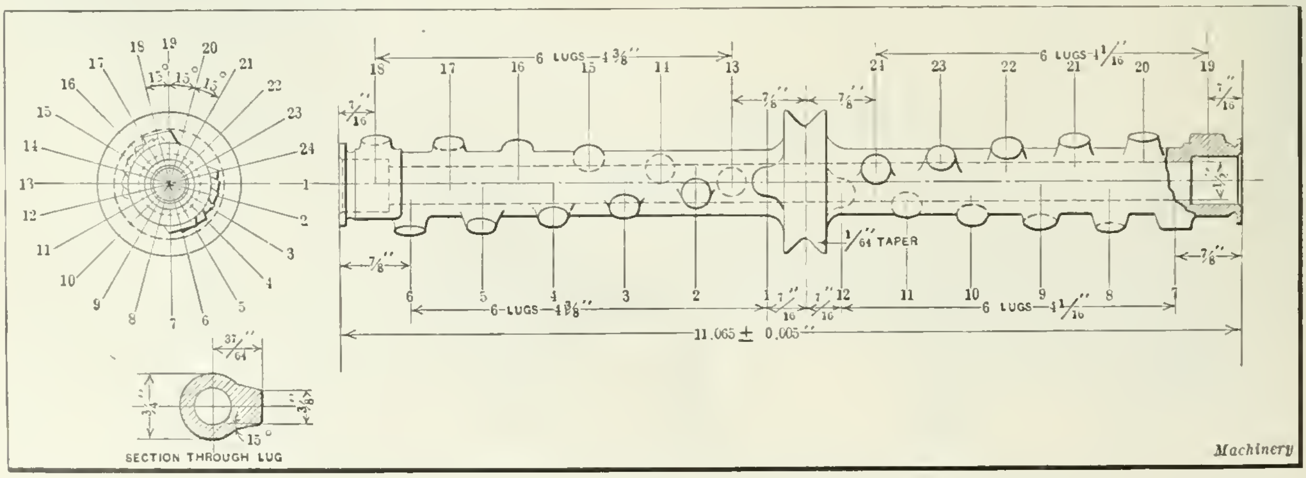


Fig. 1. Aluminum Die-cast Brush Roll for Vacuum Sweeper

The sectional views of the cover and ejector dies shown in their relative positions just before closing, indicate by number the relative position of the lugs. The slides are operated by pinions *F* and *G*. The point of greatest interest in this construction is the ingenuity used in the arrangement of slides so as to make it possible to stagger the parting line every third or fourth lug, thus avoiding under-cuts and making what might otherwise appear to be a most difficult problem, a simple and practical die-casting proposition.

Attention is called to the fact that the cover die is constructed to lock over the ejector die, locking members being provided on all four sides of the cover die. Another detail of importance, especially in large dies, is the location of the water line for cooling the dies. Both the cover and ejector dies are cooled. In this case the water line for the ejector die is shown at *H*. This pipe passes in and loops around under the central section of the casting impression and drains out on the other side. Corresponding water lines in the cover die are indicated at *I*.

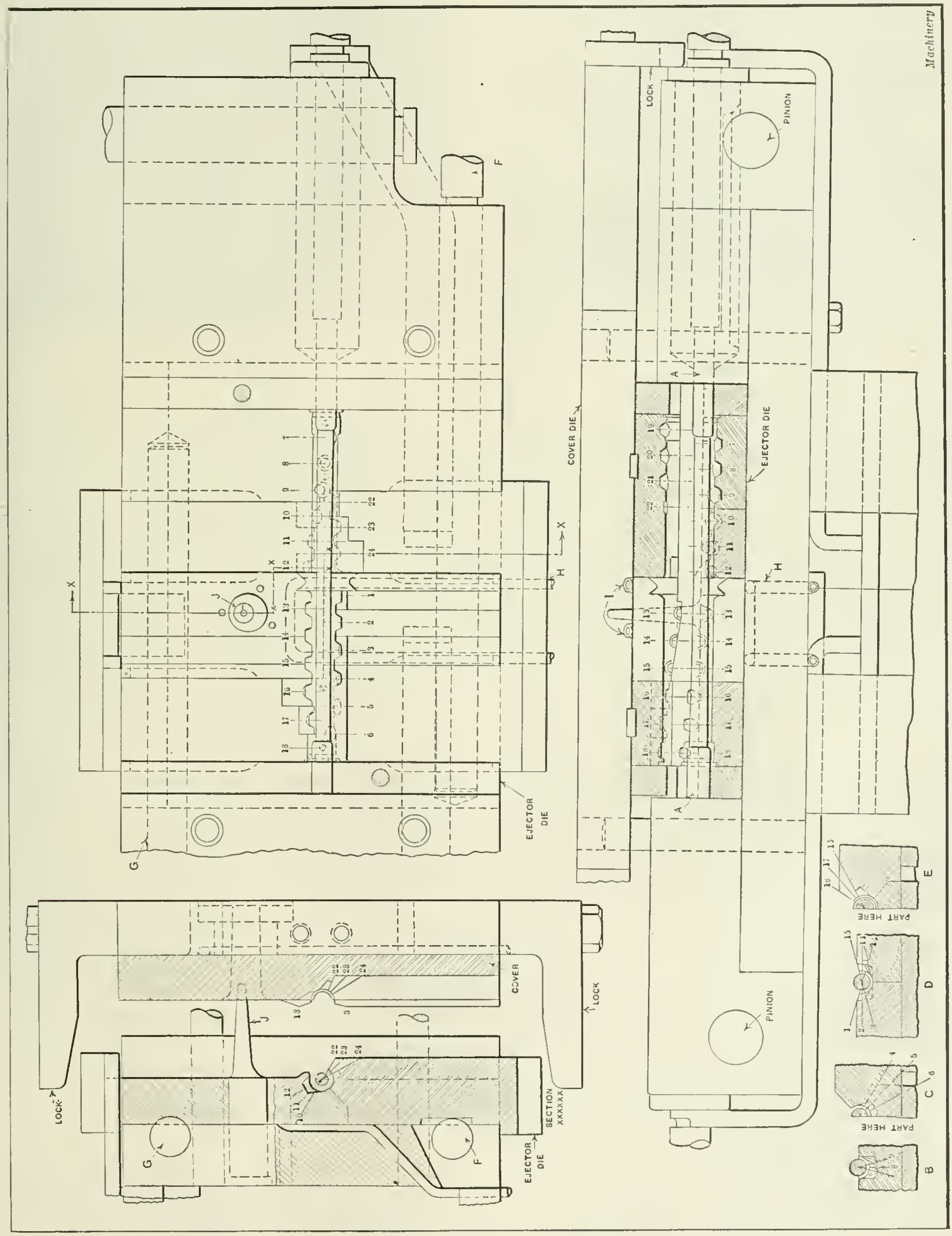


Fig. 2. Dies for casting Brush Roll. Sectional Views of the Cover and Ejector Dies are shown in Alignment

The sprue-cutter is located at *J*. The gate (not shown) is in the cover die, and consists of seven channels so located as to distribute the metal to the cavity proportionately. It will be noted that the sprue-cutter is offset relative to its body so that a larger radius is provided on the side toward the impression than on the other side. This is done to permit the metal to flow more freely in entering the gate. All dimensions on this casting are held to a tolerance of ± 0.005 inch or less, and the holes have a tolerance of + 0.001 and — 0.002 inch.

This is the last article in this series on die-casting machines and methods, and the design of die-casting dies.

* * *

METHOD FOR FINDING LEWIS FACTORS

By M. A. DURLAND, Assistant Professor of Machine Design, Kansas State Agricultural College

The most generally accepted method for finding the comparative strength of various gear tooth forms is by means of Lewis factors. In this method the weakest section of the tooth is found by passing a parabola through the point of intersection of the pressure line and the center line, the pressure line being drawn through the tip of the tooth. The point at which this parabola is tangent to the tooth curve locates the weakest section. The passing of a parabola through a given point tangent to a curve, however, is usually a tedious cut-and-try proposition.

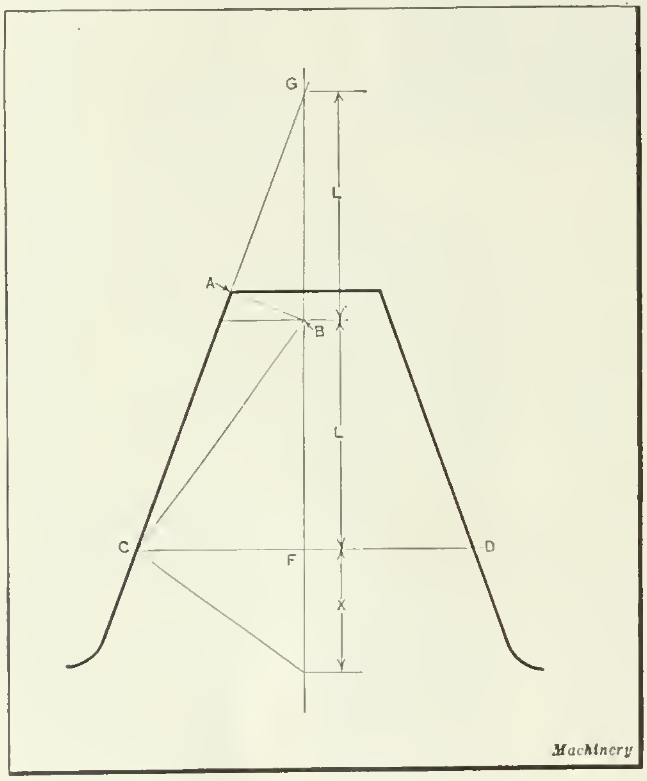


Fig. 1. Diagram illustrating Graphic Method of finding the Weakest Section of a Rack Tooth

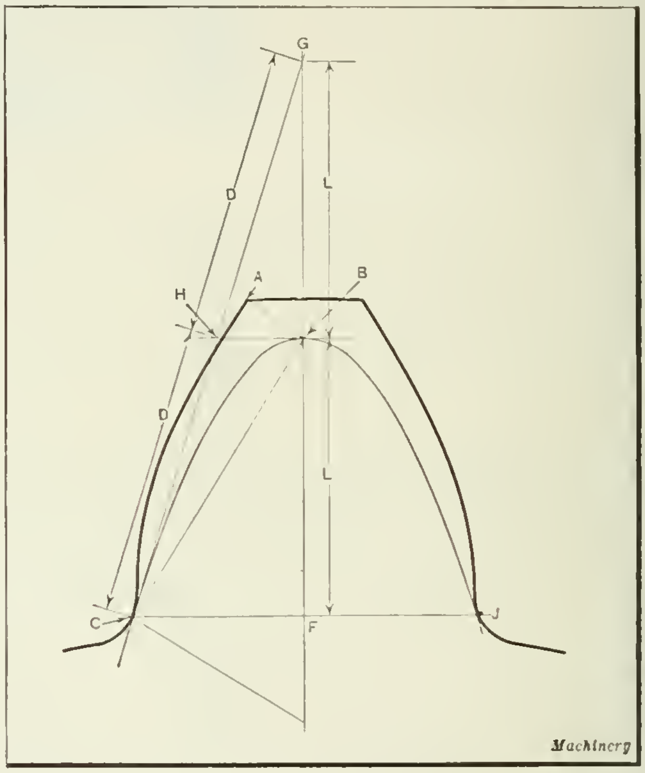


Fig. 2. Application of Method illustrated in Fig. 1 to Problem involving Spur Gear Teeth

In Lewis' original article he states: "In the rack tooth of 20 degrees obliquity this (the weakest section) is found at once by prolonging *CA*, Fig. 1, to its intersection *G* with the center line *FB* and laying off *BF* equal to *BG;* in other cases the weakest section may be found tentatively to a nice degree of accuracy in two or three trials." The first part of this statement is a mathematical fact, but the latter part does not sound particularly inviting.

To illustrate at least one opinion of the method described by Lewis, the writer will quote from an article appearing in October, 1922, MACHINERY, page 109. "The parabola scheme, which is well known, is a rather hit-and-miss method, and in order to obtain accurate results, it is necessary that the person using it have some experience in dealing with the strength of gear teeth. It is simple to apply, but the results are not so accurate as can be obtained by other methods." In the article referred to, an improved method is presented which perhaps gives as accurate results as any other method, but which, nevertheless, leaves much to be desired in the matter of convenience and time required.

Another method is presented here, which, although it may not be new, has never to the writer's knowledge been described in technical publications. It is believed to be a distinct improvement over each of the other methods referred to. At the point of tangency of the parabola and the tooth outline a straight line may be drawn tangent to both. It may be proved mathematically that this straight line will intersect the center line of the tooth at a point such that the distance from *G* to *B*, Fig. 2, is the same as from *F* to *B*. This procedure may be reversed for finding the point of tangency of the parabola and the tooth outline. The construction is as follows: Draw the pressure line *AB* through the point of the tooth. Erect a perpendicular to the center line of the tooth at *B*. Lay a scale tangent to the tooth curve near the root and crossing the center line. Now shift this scale, keeping it always tangent to the tooth curve, until the distance *GH* equals *CH*.

The point of tangency of the straightedge and the tooth curve is also the point of tangency of the parabola and the tooth curve, so that we now have located the weakest section, namely section *CJ*. The parabola shown in Fig. 2 is merely drawn for the sake of illustration, and of course would not be drawn in the actual solution, since the tangent point is all that is desired. This method is mathematically correct and much simpler than other methods in common use. The accuracy obtained is also equal if not superior to that obtained with any other method. It should be remembered that the results obtained with any method are entirely dependent on the accuracy of the gear tooth outline.

* * *

Trolley cars equipped with roller bearings are to be installed in St. Paul and Minneapolis, Minn. It is expected that there will be a saving of from 12 to 15 per cent in the power required for moving the cars, and that, in addition, the cars will be more easily controlled.

Babbitting Fixtures

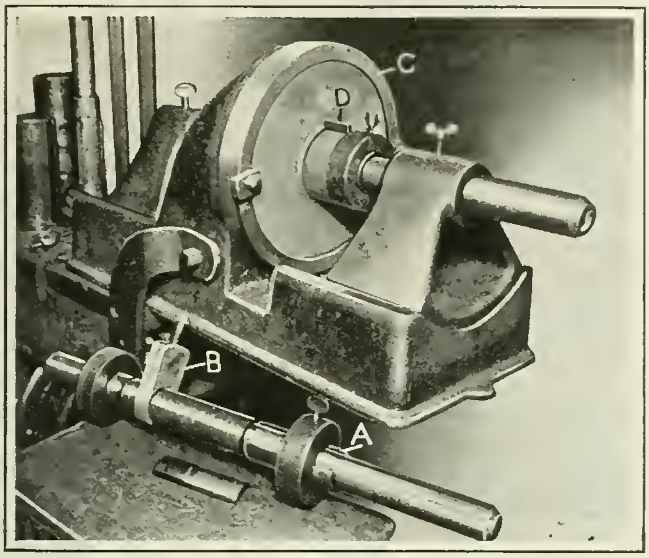


Fig. 1. Fixture used in babbitting Elevator Worm-shaft Bearing Thrust Box

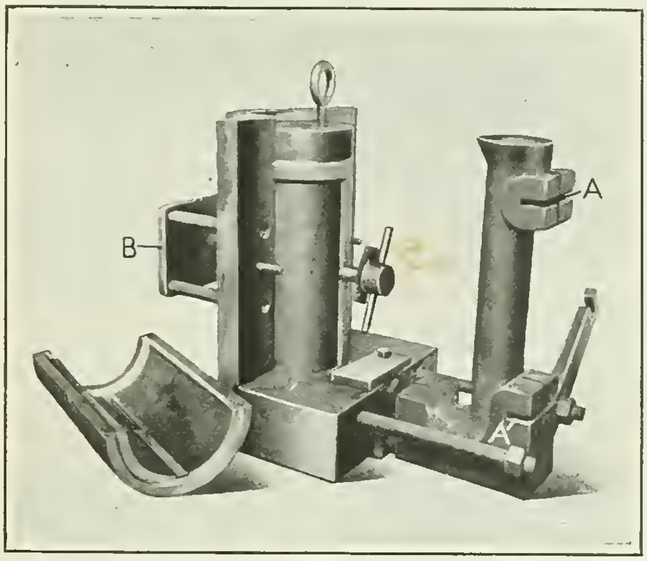


Fig. 2. Babbitting Fixture for Split Bearing Boxes for Elevator Drive Shaft

In order to cast babbitt bearings in rough castings it is necessary to provide a means for holding the work securely while the mandrel for the hole is located in a true central position. The variety of casting design may often lead to the use of babbitting fixtures having special features. In this article a number of such fixtures are illustrated. All mandrels used are made over-size to allow for shrinkage. This may be from 0.005 to 0.010 inch on the diameter, depending on the size of the hole.

A sectional view of a thrust box for an elevator worm-shaft bearing is shown in Fig. 3, the babbitt lining being indicated in solid section. The fixture in readiness for pouring the babbitt, is shown in Fig. 1; an extra arbor with stop-collars used at each end of the bearing hole may be seen in front of the fixture. The mandrel has a key at one end for casting an oil-groove and is reduced in diameter at the forward end to accommodate the three-piece sectional sleeve *A*, which is fitted around this reduced diameter to cast the clearance space *A*, Fig. 3, for the oil seal. The one-inch wide slot *B* is cast by a separate piece *B*, Fig. 1, through which the mandrel passes. This loose piece is located in the proper position by a keyway fitting over a key on the mandrel.

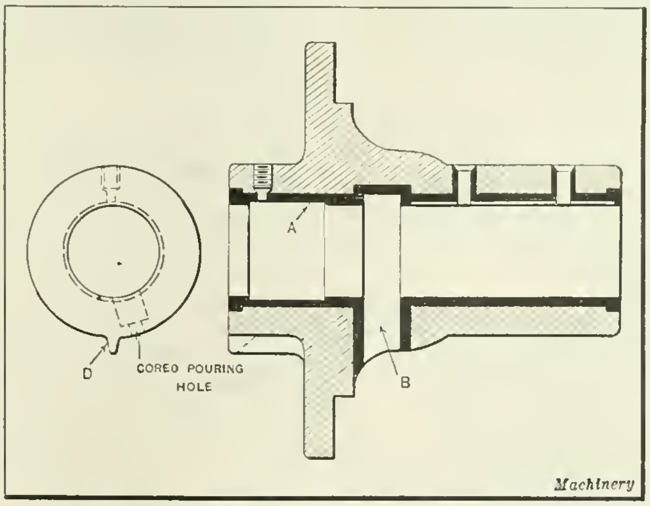


Fig. 3. Thrust Box babbitted in Fixture shown in Fig. 1

The casting has a 2½-inch hole, a hub 4½ inches in diameter and 10 5/16 inches long, and a flange 11 inches in diameter. The casting is clamped by means of a ring *C* in the fixture, which is interchangeable for different diameters of castings. It is located with the ridge *D* in a vertical position, so that the pouring hole cored near this ridge will be on top. The mandrel is passed through the central hole after the casting has been clamped in place, and the stop-collars are located at the front and rear, but are not fastened at this time to the mandrel. The cored opening for slot *B*, Fig. 3, is located vertically. The work-holding part of this fixture has an opening at the rear through which the loose piece for casting this slot is dropped into the cored opening in the casting, where it is centered by the mandrel which is passed through it.

The three loose sectional pieces for the oil seal are then fitted around the mandrel, as the extra mandrel in Fig. 1 shows, and the front stop-collar passed over them against the hub of the casting and clamped; the rear stop-collar is also fastened at this time. The front and rear bearing brackets for supporting the extending ends of the mandrel are then located in position on the base of the fixture. These have a circular base for convenience in moving them laterally into alignment with the mandrel. Finally, the mandrel is fastened in these bearing brackets by means of thumb-screws, and the casting poured.

During the pouring, the operator watches the rise of the liquid babbitt around the loose piece for the oil slot (which is exposed to view), and when it overflows he stops pouring. At this time the cored pouring hole is also filled. To remove the work, the thumb-screws and clamps are loosened at the front and rear, the work with mandrel assembly removed, and the mandrel driven out by hitting it on the end. The split sleeve sections and the loose piece *B* then drop out.

The tapped hole and the two countersunk holes shown in Fig. 3 are machined after the bearing has been babbitted. Ridge *D* is chipped off on the dotted line to form a projection, from which any oil leaking from the end of the bearing may drip, instead of spreading all over the casting. There is always a slight amount of babbitt that escapes between the ends of the cast-

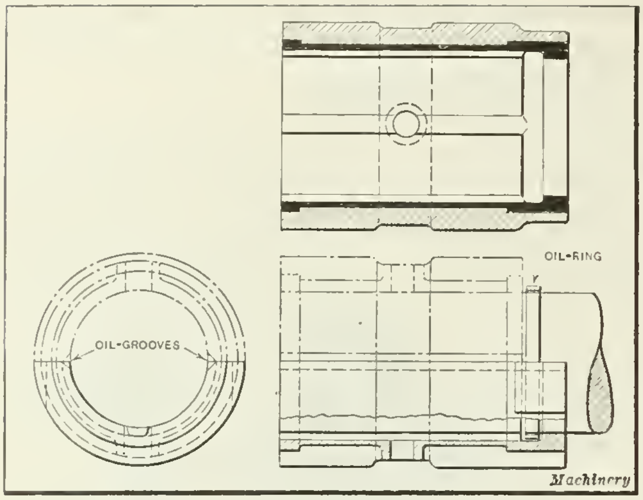


Fig. 4. Split Main Bearings babbitted in Fixture shown in Fig. 2

ing and the stop-collars, and this is subsequently squared off by facing on the ends.

Fixture for Split Bearing Boxes

The babbitting fixture shown in Fig. 2 is used for pouring split main bearing boxes used in elevator construction. The cylindrical part of this fixture has a flange at the bottom which fits into the base; this provides for using other mandrels, when bearings of different diameters are to be cast. The lower half-box has a longitudinal oil-channel leading to the oil-ring groove (see Fig. 4), and both castings have 45-degree beveled edges to form oil-grooves at the parting. These are all cast by means of the fixed mandrel.

In Fig. 2 the fixture is shown before it is fully assembled so as to expose the passage through which the metal enters, and the pouring spout. Best results are obtained in babbitting by pouring from the bottom, so that the metal will rise to the top. The pouring channel or gate is cut into the base of the fixture, and is covered by a strap. The pouring spout is split vertically and held together by clamps. These clamps are not shown in the illustration, but they swing in the slots *A*. The construction permits the pouring spout to be opened in case the sprue extends into it and prevents the work from being removed. The pouring spout is located so as to align with the gate in the fixture base, and fastened by means of a strap and two tie-rods.

The casting is located sidewise by two pins extending at each side, and is clamped by means of a pilot screw. The pilot screw also forms the ¾-inch oil-hole in each casting, and it carries a thick felt washer to seal the hole during pouring. A plate *B* carrying four ejector-pins is operated by a screw from the rear to remove the half-boxes after they are babbitted. The castings are faced on the ends to remove excess babbitt metal and finished at the joint with a file so as to assemble tightly.

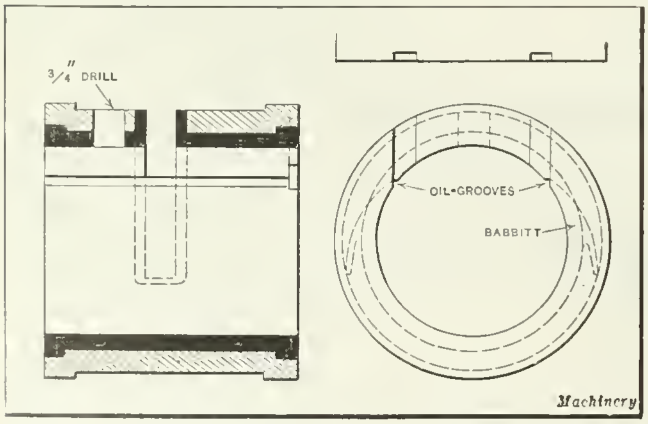


Fig. 5. Solid Bearing Box babbitted in Fixture shown in Fig. 6

Fig. 4 shows the channels for distributing the oil, as well as the assembly of the upper bearing, the position of which is indicated by dot-and-dash outline. The oil channel is ⅝ inch wide and ⅛ inch deep, and extends into the oil-ring groove in the lower member. The upper member of the box extends only to this oil-groove, so that the ring may hang on the shaft as shown. The babbitting of the upper member of the box is identical with that just described, and is performed in the same fixture with the necessary mandrel.

Babbitting Solid Main Bearing Boxes

A main bearing box for an electric elevator sheave shaft is illustrated in Fig. 5, and the fixture used in babbitting the lining in Fig. 6. This casting has two oil-grooves which are formed by projections on the mandrel, and a ¾-inch slot for the oil-ring which is formed by an inserted piece having a semicircular end. The ¾-inch hole in the box is drilled after babbitting, and the ends are faced as in previous examples.

In performing this operation, the cylindrical fixture used is set on a table under a drop-hammer. This set-up is shown in Fig. 6 with the hammer in its elevated position, guided by the side rails of the supporting frame. The hammer is held in this position by a latch, and after the babbitting has been completed it is released to knock the mandrel from the work. The casting is located over a circular plate and the mandrel lowered into it by means of a hoist to a depth determined by the pilot screw shown at the front of the fixture. The upper part of the fixture consists of two hinged members which are swung together to enclose the casting. These have a slot in which the previously mentioned loose piece is inserted and brought up against the mandrel, where it is held while strap *A* is slipped over posts on the swinging members. This securely clamps the entire arrangement.

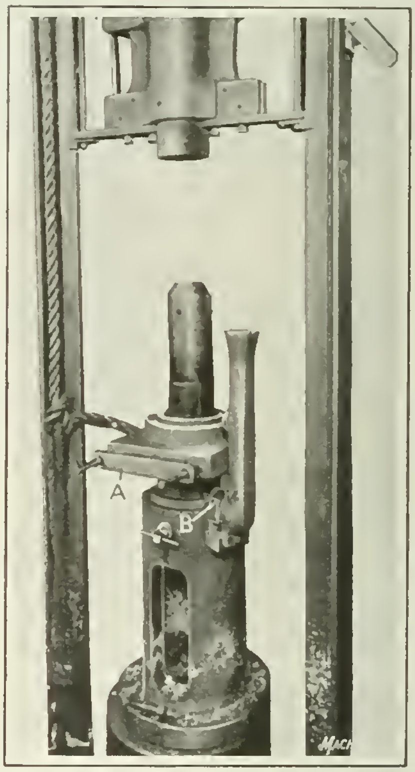


Fig. 6. Fixture for babbitting Bearing Boxes for Elevator Shaft

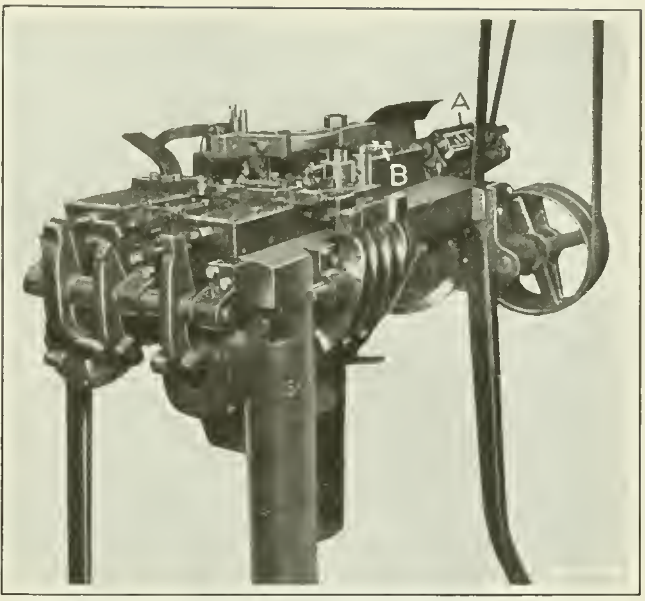
Piece *B* is then fastened to the side of the fixture. This piece contains the channel or gate through which the metal is admitted to the bearing. The pouring spout is then bolted to this piece, the arrangement being similar to that described in connection with Fig. 2. This pouring spout is also split longitudinally and clamped together when in use. After the bearing has been poured, it is necessary to remove the pouring spout before the hinged members can be swung to release the work. When this is done, the hammer is dropped to remove the mandrel. Various sizes of these bearings are all handled on this fixture by the use of suitable mandrels and loose pieces for the oil-ring slot.

The examples here cited are selected from the practice of the A. B. See Electric Elevator Co., Jersey City, N. J., where all bearing work is babbitted in fixtures of which these are representative.

Latch Needle Manufacture

A Description of the Methods Employed in Making Knitting Machine Needles, and the Special Equipment Employed

By FRED R. DANIELS



KNITTING machine latch needles are made in a great many designs, and the methods of manufacture are nearly as varied as the types of needles. The work is of a delicate nature, and the machines employed are ingenious in their construction and of special design. The names of the different parts of a latch needle of common design are indicated in Fig. 1. This illustration also shows a greatly enlarged view of the latch, and an enlarged sectional view of the needle blade.

The operations in the making of a needle of this type are as follows: (1) Cut off stock, bend butt, bend shank; (2) swage hook end; (3) flatten both sides (see sectional view); (4) mill slab; (5) set back point so that under side of needle will be straight its entire length, cut off pointed end to length, and center for latch rivet hole; (6) point; (7) mill slot for latch; (8) drill latch rivet hole, broach latch slot (under side); (9) tap for threaded latch rivet; (10) remove burrs from slot; (11) grind to remove burrs from edges; (12) assemble latch and rivet; (13) set down rivet; (14) grind ends of rivet flush with cheek; (15) impress ends of rivet; (16) bend hook; (17) grind end of latch that fits over needle hook; (18) harden and temper; (19) polish and straighten; and (20) inspect. Where two or more operations are given under one operation number, they are performed on a special machine at one time.

Forming the Butt and Shank

The needles are made from high-grade, cold-rolled steel wire, and are first bent to form the butt and the shank. For this work, a cam-operated machine (shown in the heading illustration) is employed, which closely resembles in operation the familiar wire-forming machines on the market. The wire is fed in from a reel at the rear, passed through a whirling wire straightener *A*, consisting of a series of staggered posts with grooves at the ends over which the wire is drawn, and thence into jaws by which it is gripped. The jaws are carried in a cam-operated slide *B*, the stroke of which may be adjusted to suit the length of needle. This slide carries the wire into the center of the machine, after which the slides that carry the bending dies advance in sequence to bend the butt.

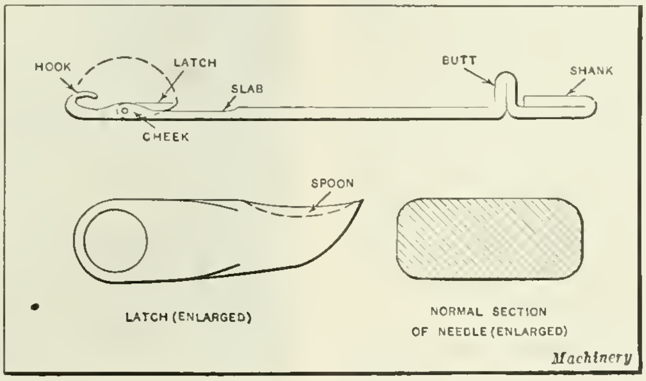


Fig. 1. Typical Design of Latch Needle with Enlarged Views of Latch and Needle Blade Section

If the needle has a bent shank (all needles do not), this is bent around the vertical king-post, which is then withdrawn and another horizontal slide advanced to close the end. The cycle is completed by cutting off the piece, which drops into a receptacle. It is next delivered to the swaging machine where the hook end is cold-swaged, after which it passes to a power press to have both sides of the needle flattened. (For details regarding the forming of wire, see August and September, 1922, MACHINERY; for cold-swaging data, see June and July, 1921, MACHINERY.)

Flattening and Slabbing Operations

Before referring to the flattening we may digress for a moment to refer to the slabbing operation which sometimes follows and sometimes precedes the flattening, according to the accepted practice in different shops. The slab is often short—not more than ¾ inch long—but in many designs of needles it extends for a considerable length. If it is long, it is invariably milled and the operation then follows the flattening; if it is short, it may be produced by indenting the round wire under a press, so that, in flattening, this indentation forms the slab and thus somewhat simplifies the manufacture. Obviously, there will be no rough edges produced by this method like those resulting from milling.

A Waterbury-Farrel power press, equipped with plain dies, and a special feeding arrangement, is used in flattening. This machine is illustrated in Fig. 2. This view shows the cam on the left-hand side and the mechanism that it actuates for operating the feeding device. Beneath the shelf *A* there is a sheet-metal slide which advances and recedes horizontally as the cam causes lever arm *B* to oscillate. The upper part of this arm is a spring-actuated extension, so that a post carried in the extension may travel horizontally in a slot in bracket *C* to move the slide.

Bearing against the under side of the slide, which is known as a "shovel," there is another sheet-metal shovel that is stationary and set at an angle, with its front edge bearing on the under side of the horizontal shovel. When the horizontal shovel is receded, its front edge coincides with the front edge of the shelf, and the angular shovel, which is bearing under tension against the horizontal

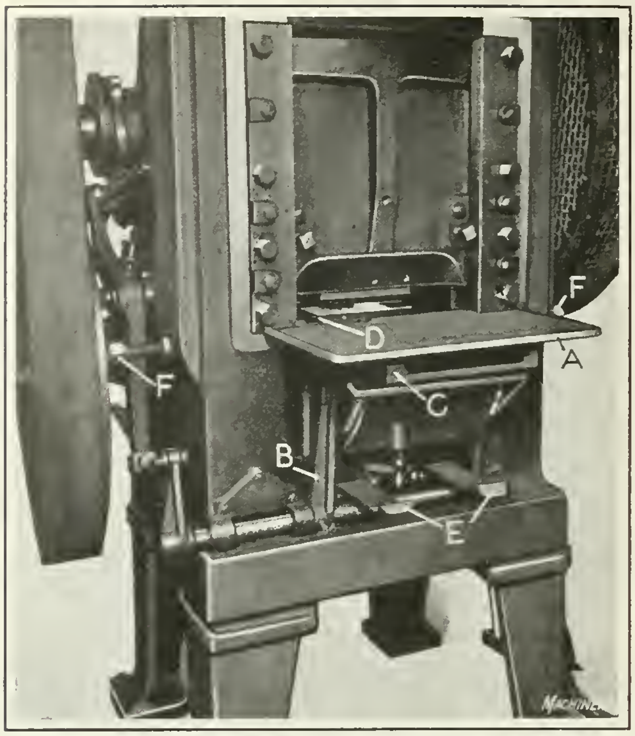


Fig. 2. Power Press Device used in flattening Needles, equipped with a Cam-operated Feeding Device

shovel, extends an inch or more toward the die, with its front edge above the top surface of the die, as shown at *D*.

The operator slides a needle to the edge of the shelf, where it rests flat on the angular shovel. Then the cam-operated shovel advances, sliding the needle along on the other shovel as it forces the end of the angular shovel down. The needle is thus fed along until it is deposited on the die, directly under the flattening punch. With the backward traverse of the shovel a third shovel advances from the rear, operated from the same cam that operates the front shovel. In the course of its return traverse, the front shovel permits the edge of the angular shovel to spring up sufficiently from the level of the die-block so that the rear shovel can push the flattening needle forward under it and into a receptacle supported on the spring arms *E*. This device enables a production of fifty-four needles per minute to be obtained.

The fact that the butt end of the needle is of heavier section than the latch end makes it necessary to use greater pressure at the butt end in flattening. This is accomplished by tilting the die at a slight angle to bring the punch and die closer together at the butt end. The change in the press, necessary to obtain this angular setting, consisted of machining the die-bed to a radius of 12 feet, and then machining the under side of the die to fit this radius. The adjusting screws *F* on both sides of the press are then used to move the die sidewise sufficiently, in setting it up, to obtain this angular setting. After the die has been rocked an amount determined largely by experiment, its position is secured by tightening the check-nuts on the adjusting screws.

If the slabs are milled, that operation follows the flattening, and is performed with a plain milling cutter. The work is stacked on edge in an indexing milling fixture, arranged to give continuous production. Both sides of the milling fixture are alike, so that a number of needles may be stacked on their back and milled while the other station is being loaded.

Machine for Setting Back the Tapered End

At this stage of manufacture the swaged end of the flattened needle is a symmetrical taper. The next operation consists of "setting back" this point so that one edge only will taper and the other will form the straight back edge. An automatic machine performs this operation, and at the same time makes the center for the rivet in the cheek (see Fig. 1), and severs the swaged end of the needle to establish a uniform length between it and the center of the rivet. This dimension is of the utmost importance, as is also the dimension from the rivet to the butt. This machine locates the needle correctly from the butt, so that the latter dimension is also accurately established. The machine is illustrated in Fig. 3.

The needles are stacked, butt up, in a chute *A* which is a portion of the table having a guide to accommodate the ends of the needles. They are fed along by a weight hung over a pulley and connected to a wire finger. The stack of needles is prevented from buckling under the pressure by means of flat springs which bear lightly on the needles and under which they are permitted to pass as they are fed toward the feeder *C*.

This feeder reciprocates, sliding a needle from the chute, between jaws, and into the operative position. One jaw is stationary and the other opens about 1/8 inch, by means of a cam-operated lever connected to a post on the movable jaw. Directly beneath this jaw there is a sheet-metal slide or shelf which allows the needle to be passed over it when the movable jaw is open. As soon as the needle reaches the operative position, the jaw closes and holds it during the functioning of the machine, while the feeder returns to advance another needle. At the completion of the operation, the movable jaw again opens, but previous to the movement of the jaw a spring has pulled the underneath shelf from under the jaw opening, permitting the needle to drop into a receptacle beneath.

This machine has all its movements actuated by cams. With the needle advanced to the operative position, a vertical plunger operated by lever *F* descends against the upturned edge, and holds the needle from moving under the pressure of setting back the point. This plunger contacts with the needle close to the beginning of the swaged taper, and remains in contact while a punch operated from lever *G* descends and sets back the point.

The centering tools for the rivet hole indent both sides of the cheek to a sufficient depth so that when the hole is drilled in a subsequent operation, it will be slightly countersunk to receive the rivet head. The two slides that carry the centering tools are shown at *H*. Finally, the cam-lever *I* advances another slide, which carries one of the cutting-off tools for shearing the ends of the needles to a uniform length; the other shearing tool is stationary but adjustable. The adjustments for setting the slides for centering and cutting off permit all sizes of needles to be handled on this type of machine. The feeder remains in the advanced posi-

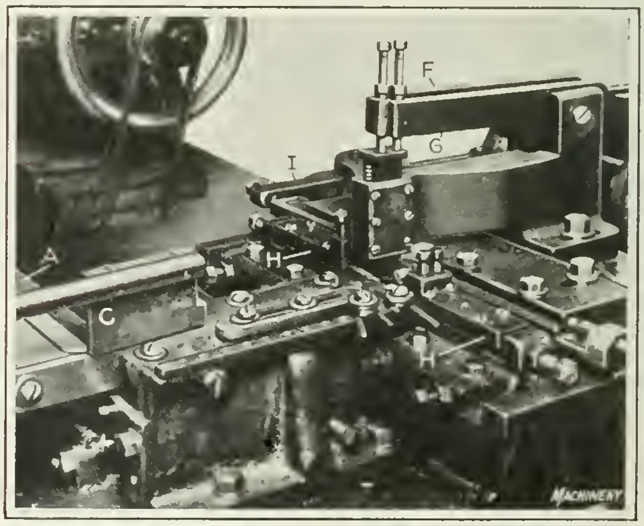


Fig. 3. Machine for setting Back the Taper End, cutting off, and centering Latch Needles

tion during this operation, and on its return the needle drops through the open jaws, as previously described. The severed end of the needle is next pointed, using a bench machine having a tool-head with four blades extending radially, similar to a box-tool.

Milling the Latch Slot

Milling the slot in which the latch is to be assembled is an operation upon the accuracy of which a great deal depends. Needles are made from wire ranging in size from No. 6 to 54 gage, the average size being No. 36, 0.029 inch in diameter. The approximate thickness of the saw is one-third the thickness of the needle, so that for a No. 54 gage needle, which is 0.020 inch thick, the slot would be 0.0065 inch wide. From this it will be seen that an error in central location of even 0.0005 inch would probably cause the work to be scrapped.

The slotting machine is equipped with the standard type of feeding arrangement, and a cam-controlled feed movement for the saw, with provision for varying the depth when desired. The position of the cutter-head may also be adjusted. The saws operate at a speed of 800 revolutions per minute, and the average production on this machine is 4000 needles per eight-hour day. Directly above the saw there is an oil-tube containing a swab, from which an occasional drop of cutting oil flows.

Drilling Rivet Hole and Broaching Slot

The next operations consist of drilling the hole for the rivet, and broaching the slot where it breaks through on the under side. In some methods of needle manufacture, the drilling is performed before cutting the slot, but both drilling and broaching have been combined to advantage in the machine shown in Fig. 4. In this method of manufacture advantage is taken of the passage of the broach to remove the burr from the inside of the slot where the hole breaks through.

This machine is similar in design to the point-setting and centering machine, Fig. 3. The drills operate from opposed spindles horizontally, and the broach *A* operates vertically, by means of the cam-lever *B*. The bellcrank feed-lever for one of the spindles is shown at *C*; it advances by cam action and returns by spring tension. The drills are flat drills, and for the average size needle are 0.016 inch in diameter.

If a threaded rivet is used (and this is generally recognized as an advantage over the straight pin in rivet), the holes are tapped after drilling on a horizontal bench machine with a clutch reversal. The needles are fed on the tap by hand. The tap is 1/64 inch diameter by 250 threads per inch.

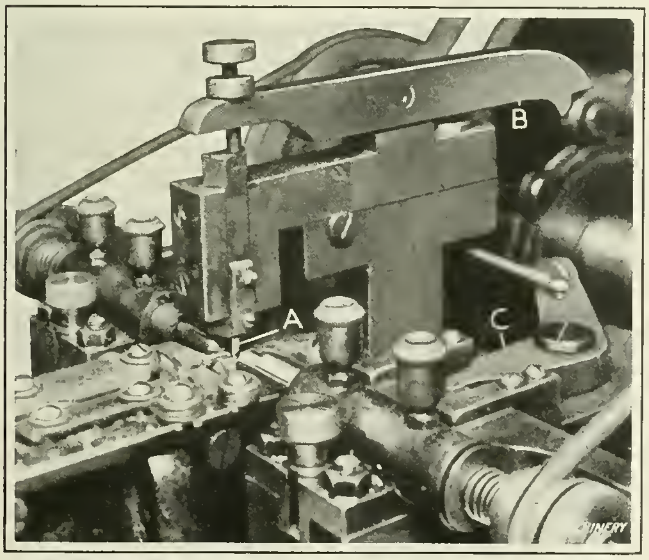


Fig. 4. Drilling Latch Rivet Holes and broaching Latch Slot on an Automatic Machine

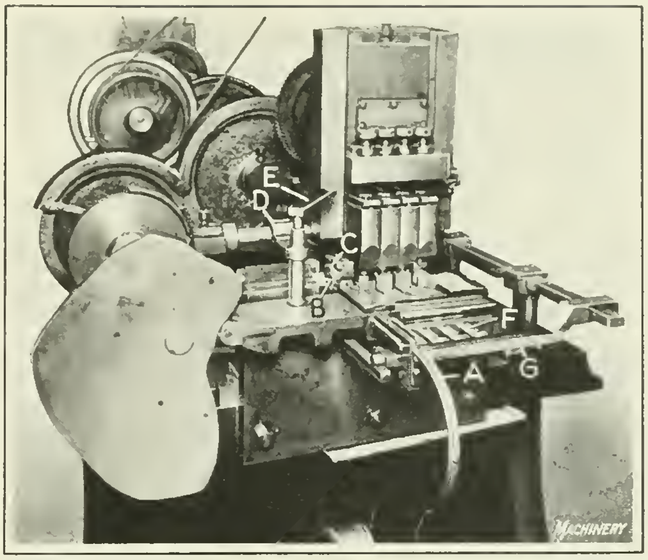


Fig. 5. Machine for making Needle Latches, cutting off Stock and performing All Operations

With the exception of smoothing up the needle by grinding the burrs from the outside of the broached slot, and removing the sharp edges on other parts by grinding, this completes the manufacture up to the time of assembling the latch. The burring of the broached slot and the edges are hand operations in which the needles are passed over the grinding wheel lightly.

Making and Assembling the Latches

Fig. 5 is a view of a latch machine which transforms wire from the reel into finished latches. The machine is unique in appearance and rapid in operation. The wire passes from the reel over the curved arm *A* and through jaws between which it is lightly gripped.

Five distinct operations are performed by this machine, the tools for four of which operate vertically, while the other operates horizontally. A horizontal tool is the first one to function, and this is called a "dapper" or "nooket" punch which forms the spoon in the latch. (See Fig. 1.) The end of this punch is shown at *B*, and directly in back of it there is another tool that holds the wire against the disk-like die *C*. This die has radial notches in which the wire is held. Then cam *D* operates a rod which pushes the chuck to the front. This is possible because the jaws do not hold the wire tightly. The movement of this rod leaves just enough wire projecting from the jaws to make the latch; in other words, it is a measuring device. This is necessary because the spoon is formed first in the end of the wire and permits no cutting off at this end, except trimming, after the latch has been finished.

A large irregularly shaped cam next advances the slide on which the chuck is located, successively to the four remaining stations. The first of these flattens the latch to fit the slot in the needle, the second pierces the rivet hole, the third trims the end, and the fourth cuts off the latch. At each advance of the slide, a hardened steel button on arm *E* is positioned under each of the adjustable stops at each station of the machine. This permits each vertical tool to operate without the others being moved, at each stroke of the vertical slide.

Micrometer adjustment is provided for these stops and also for the stops *F* that are used in setting the lower die-members. The long bar *G* extending across the front of the machine is used to draw back the chuck after each operation, preparatory to the next advance of the horizontal slide. This bar is operated by a cam at the rear of the machine, and springs are used to assist in returning the chuck when advanced to the next station.

At the last station two circular cutters sever the latch, which is deposited in a box at the right. The chuck is then slid back by bar *G* and the slide returned to the starting position, when the cycle is repeated. Bar *G* next advances the chuck so that the short projecting end of the wire can be gripped in die *C*, as previously described, while the chuck is being pushed back to measure off the length of wire needed for another latch. The production is about 20,000 in a nine-hour day.

The assembling of the latches is done by hand, and girls are usually employed for this work. After some experience, the operators become quite dexterous in fitting the flattened end of the small latch into the slot, and screwing in the rivet. The needle, with latch and rivet assembled, is then ready to be riveted. A number of different types of riveting machines have been successfully employed, but possibly the most satisfactory machine is one employing two electric vibrators for delivering the blows. The movement is effected by a blade or spring which is actuated by the magnet of an induction coil, and its vibration produces a succession of rapid blows which can be suitably regulated. It is important that the rivet should not be swelled or bulged on the body at this time.

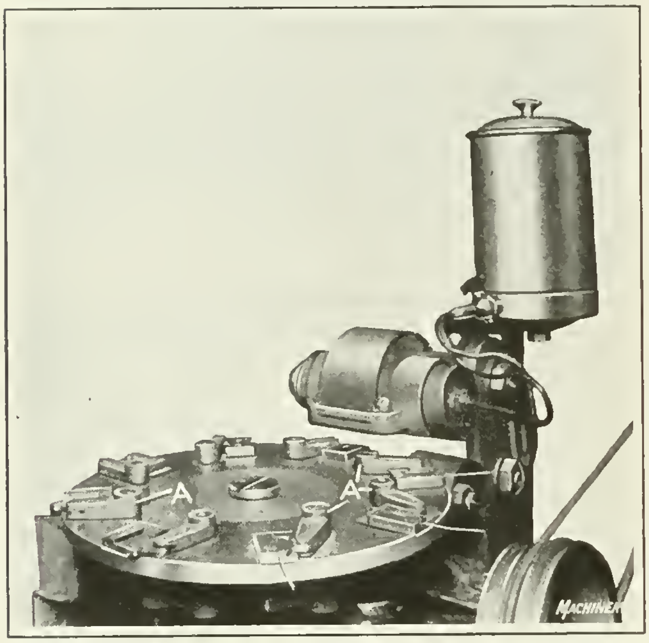


Fig. 6. Semi-automatic Machine which is employed for grinding the Ends of the Rivets Flush with the Cheek

Grinding the Rivets Flush with the Cheek

A semi-automatic machine is used in grinding both ends of the rivet simultaneously. This machine is illustrated in Fig. 6, where a needle is shown held in the jaws at the loading station and two others are about to pass between the two grinding wheels by means of which the operation is performed. A revolving plate carries eight pairs of jaws. The movable member of these jaws is opened when one of the levers *A* is raised by means of a stationary cam beneath the plate. This occurs after the needles have passed between the two wheels, at which time a wire extending vertically dislodges the needle and gives it a spin so that it drops into a receptacle. The plate continues to revolve with the jaws open until the loading station is reached, when the operator inserts a needle and the movable jaw closes.

Another type of machine used for the same purpose employs spring jaws operating vertically instead of a cam-controlled chucking mechanism. These jaws hold the wire by spring tension, and each movable jaw is raised when it is tripped by a lever at the loading station. The spring jaw closes immediately and is opened after the needle has been ground, by the same arrangement.

Each grinding wheel is carried in a separate head and carefully guarded. Suitable provision is made for adjusting the height of these two heads so that they will be equidistant from the center of the needle, to suit work of different thicknesses. The distance between the faces of the wheels must also be accurately set, for which purpose a graduated sleeve with a conical end, located in back of the grinding wheel heads, is employed. Each wheel-head has a projecting lug at the rear, in which an adjusting screw is carried. These contact with the conical end of the graduated sleeve, so that by turning the knurled head of the sleeve both wheel-heads will be spread or brought together at the same time, the micrometer reading being used to determine the space between them. This permits a ready means of compensating for wear on the face of the grinding wheels.

A novel method of lubricating the wheels is employed. This consists of passing tubes into the center hole of each wheel, which is cut out to produce an annular channel in the babbitt, into which kerosene oil is delivered from the tank shown. The centrifugal force causes the kerosene to penetrate the wheel and work out to the periphery. This is an effective means of obviating a difficulty experienced in lubricating the wheels from the outside, when the oil is often precipitated into the operator's face; it also facilitates guarding the wheels.

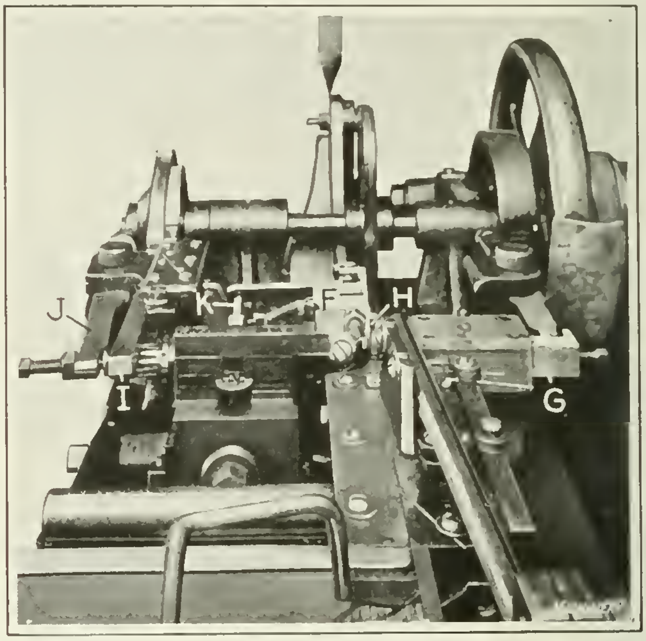


Fig. 7. Front View of Hook-bending Machine, showing Common Type of Feeding Mechanism for Needle Machinery

Importance of Correctly Riveted Latch

It is important to note at this time the finer details involved in the assembling of the latch. It is not simply the setting down of a rivet, as ordinarily conceived of, because there must be not only a free movement of the latch but at the same time only a limited amount of side movement. A great deal of research work has been done to determine the exact size and type of rivet for each size joint, and there is still some difference of opinion regarding this.

After the rivet has been set down, an operation is performed which is known as "impressing" the ends of the rivet. The purpose of this is to bulge the rivet so as to increase its diameter within the latch about 0.004 inch, but not to such a degree that it will be tight in the latch hole. If the diameter of the rivet is, say, 0.015 inch, the hole in the latch should be 0.020 inch, leaving 0.0005 inch clearance all around after the rivet has been bulged 0.004 inch.

This is done to prevent the sides of the slot from contracting due to hardening and leaving the ends of the rivet projecting from the surfaces of the cheeks. This difficulty, of course, is more noticeable with plain rivets than with threaded rivets; in fact, the use of threaded rivets is favored principally for this reason.

With the threaded rivet, the plain hole in the latch has a bearing on the threaded central portion of the rivet which, of course, is theoretically incorrect. However, no ill effects have resulted from this condition, owing, no doubt, to the very fine thread on the rivets—250 per inch. The operation of impressing the ends of the rivets follows the grinding, and it is of great importance. It is performed by simply pressing the rivet from the ends under a uniform and predetermined pressure.

Bending the Hooks

An automatic hook-bending machine is shown from the front in Fig. 7 and from the right-hand side in Fig. 8. This machine is of the same type as the other cam-operated machines previously described, in which the needles are advanced by a feeder, held by jaws, and released so that they drop through when a slide is opened beneath the jaws.

With the work advanced to position in this manner, the roll-carrier *F* is oscillated to bend the hook around a horizontal post. The first movement of the machine is the advance of this post by slide *G*, which locates the post over the point of the needle. There is a grooved roll *H* in the carrier which, in its operative position, is slightly above the end of the needle. The carrier is oscillated on its forward movement by means of the cam-operated rack *I* and a pinion, and at the same time the carrier is pivoted to swing the roll down into contact with the needle. This is accomplished by a lever *J* operating from the side of the cam, which actuates a rod extending through the pinion. The rod has a beveled end that raises post *K*, thus pivoting the carrier.

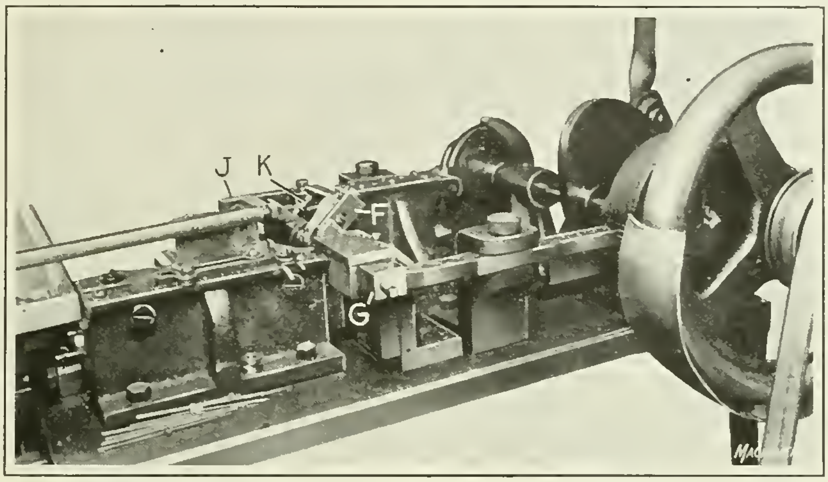


Fig. 8. Side View of Hook-bending Machine shown in Fig. 7

As the carrier is oscillated and the hook formed around the horizontal post, the cam-lever *J* is withdrawn, permitting a spring to raise the roll again before the backward oscillation occurs. The arrangement for pivoting the carrier provides the correct amount of tension required for bending the hook properly. An inspection of the needle in Fig. 1 will show that the end of the hook is not concentric with the center, and consequently pressure must be applied in bending, which will cause the roll to contact firmly with the hook, even at the extreme point.

Final Operations

The final operations in the manufacture of latch needles include grinding the latch on the end near where it engages the hook. This is a hand operation, and is usually performed by one stroke of the work against the grinding wheel. The needles are next hardened and quenched in oil, and then drawn to a spring temper. After tempering, they are polished by tumbling in sawdust, and then straightened. The straightening operation is done manually with a hammer and block, and requires considerable skill. The experienced straightener seems to sense where a blow delivered against the needle will accomplish the desired results. The needles are straightened about as fast as the operator can tap them with a hammer when laid on a block. The final operation is inspecting.

* * *

STANDARD STEEL FOUNDRY TRADE PRACTICES

At a recent meeting of the Electric Steel Founder's Research Group held in Pittsburg, Pa., the following standard trade practices were adopted:

1. Suitable pattern equipment for economical molding shall be furnished by the customer.
2. The foundry will not be responsible for correctness of pattern equipment, except when such equipment is made for the customer under the supervision of the foundry.
3. Repairs on pattern equipment shall be paid for by the customer, except when occasioned by carelessness on the part of the foundry.
4. Patterns must have distinctive colors to identify separately the core-prints, machined surfaces, and rough casting.
5. All patterns, core-boxes, and loose pieces must be properly numbered so that they can be easily identified.
6. All transportation charges on pattern equipment to and from the foundry shall be paid by the customer.
7. The foundry will not carry insurance on customers' pattern equipment.
8. Free replacement will be made of defective castings if reported and returned to the foundry within a reasonable time.
9. The foundry will not be responsible for any expense on defective castings incurred by the customer.
10. The customer will be charged with the cost of molds and cores discarded by the foundry due to change in patterns or core-boxes.

* * *

EXPORTS OF LEADING NATIONS

Notwithstanding the enormous volume of American manufactures, this country is not the leading nation as an exporter of industrial products. Great Britain is still first in the export trade in manufactures, according to E. M. Miller of the National Bank of Commerce, New York. In the iron and steel field, the United States exports only about 6 per cent of the total product, machinery excluded. Germany exported, in 1922, 30 per cent of all the iron and steel products of that country, and the United Kingdom exported as much as 58 per cent of the products of its blast furnaces and steel mills.

On the other hand, it must be remembered that no other nation has a home market like that of the United States, and for that reason it is but natural that this country should consume a much greater percentage of its own products than any other nation in the world. As a matter of fact, the home consumption in the United States is the most important market for our industrial products, and considered from a national point of view, export trade is necessary only to the extent that we may be able to import such raw materials and foods as are not available in the United States.

Tool-room Formulas for Locating Holes in Work with Angular Faces

By W. G. HOLMES

THE formulas presented in this article have been developed for the use of the toolmaker when his work requires the accurate location of a hole in an angular face. This problem is of frequent occurrence in the toolroom, and is often the cause of much disagreement as to the correct solution. The formulas presented cover all cases that are likely to come up in actual practice. For taking measurements from either side of the plug (see Fig. 1), and from surfaces that are located from 0 to 90 degrees with the horizontal, the following four cases must be considered:

1. Where the button is above the plug and the angle A of the working face is less than 45 degrees (see Fig. 1).
2. Where the button is above the plug and the angle A of the working face is more than 45 degrees (see Fig. 2).
3. Where the button is below the plug and the angle A of the working face is less than 45 degrees (see Fig. 3).
4. Where the button is below the plug and the angle A of the working face is more than 45 degrees (see Fig. 4).

Solution for Case 1

In Case 1, we have given the angular surface GG, Fig. 1, and a hole perpendicular to this surface. The angle the surface makes with the horizontal is less than 45 degrees. A plug of radius d is placed in the hole that is perpendicular to the surface GG. A button of radius r is placed above the plug, and in contact with both the plug and the angular surface. The following dimensions are known:

A = angle that surface GG makes with the horizontal (in this case less than 45 degrees);

r = radius of button; and

d = radius of plug.

It is desired to find:

E = vertical distance from top of button to horizontal line through point V;

F = vertical distance from bottom of button to horizontal line through point V;

C = horizontal distance from right-hand side of button to vertical line through point V; and

B = horizontal distance from left-hand side of button to vertical line through point V.

The solution is as follows: As HJ is the diagonal of a square, angle $Q = 45$ degrees.

Then

$$HJ = r \text{ cosec } 45 \text{ degrees} = 1.4142r$$

and

$$T = 90 \text{ degrees} - (45 \text{ degrees} + A) = 45 \text{ degrees} - A$$

Now,

$$Z = HJ \sin T = 1.4142r \sin T$$

$$S = HJ \cos T = 1.4142r \cos T$$

$$P = d \sin A \qquad X = d \cos A$$

$$E = P + S + r$$

But by substitution

$$E = d \sin A + 1.4142r \cos T + r$$

Now

$$F = E - 2r = S + P - r$$

By substitution,

$$F = 1.4142r \cos T + d \sin A - r$$

Also

$$C = X + Z + r$$

By substitution,

$$C = d \cos A + 1.4142r \sin T + r$$

Now B = the difference between $2r$ and C, so either $B + C = 2r$ or $B + 2r = C$. In this case it is evident that $B + C = 2r$, as the perpendicular line through point V passes through the circle representing the circumference of the button. It will be noted from the diagram that:

$$W - Z = N = K = Y = r \sin A$$

$$M = r \cos A - N = r \cos A - r \sin A$$

$$M = r (\cos A - \sin A)$$

From the preceding formulas it is possible to obtain any dimension that is likely to be required in checking or laying out work of the nature shown in Fig. 1.

Solution for Case 2

In Case 2, we have given an angular flat surface such as GG, Fig. 2, and a hole perpendicular to the given surface. The angle that the surface GG makes with the horizontal is

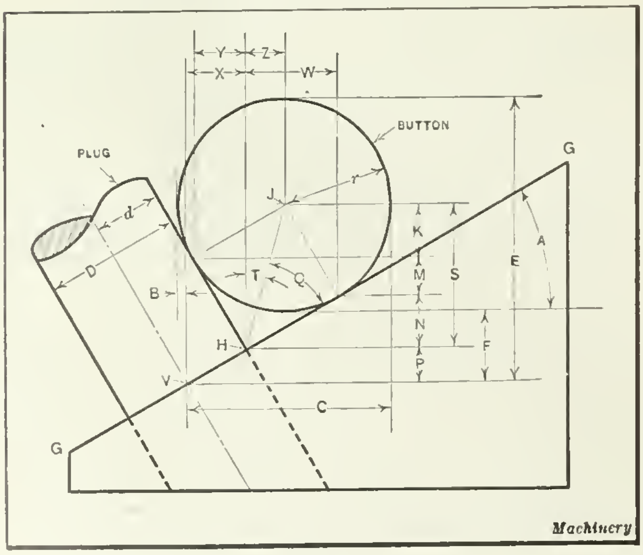


Fig. 1. Diagram used in determining the Location of a Hole in Angular Faced Work

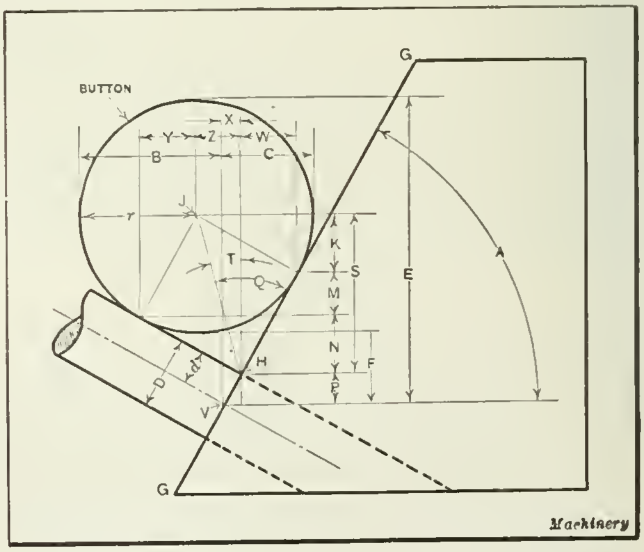


Fig. 2. Diagram used in Place of Fig. 1 when Angle A is Greater than 45 Degrees

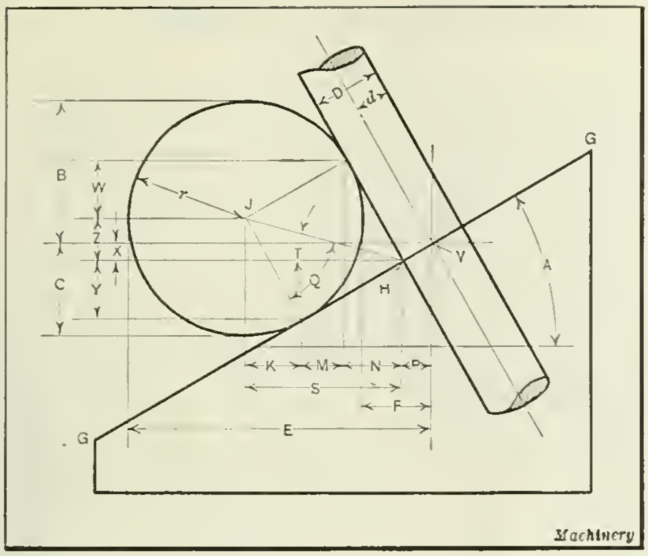


Fig. 3. Diagram showing Button placed below Plug to determine Location of Hole

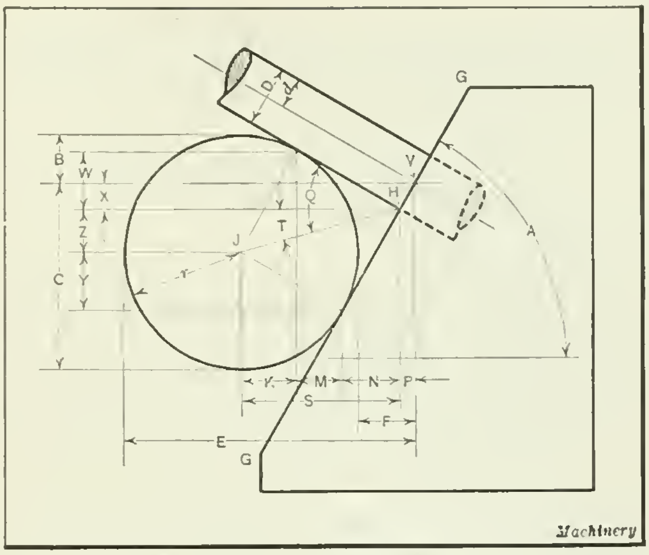


Fig. 4. Diagram used in Place of Fig. 3 when Angle A is Greater than 45 Degrees

greater than 45 degrees. A plug of radius d is placed in the hole that is perpendicular to the angular surface. A button of radius r is placed above the plug and in contact with both the plug and the surface GG. The following are the known dimensions:

$A =$ angle that surface GG makes with the horizontal (in this case greater than 45 degrees);
$r =$ radius of button;
$d =$ radius of plug.

It is desired to find:

$E =$ vertical distance from top of button to horizontal line through point V;
$F =$ vertical distance from bottom of button to horizontal line through point V;
$C =$ horizontal distance from right-hand side of button to vertical line through point V; and
$B =$ horizontal distance from left-hand side of button to vertical line through point V.

As HJ is a diagonal of a square, it is evident that angle $Q = 45$ degrees. Then by trigonometry we have:

$$HJ = r \text{ cosec } 45 \text{ degrees} = 1.4142r$$
$$T = A - 45 \text{ degrees}$$
$$Z = HJ \sin T = 1.4142r \sin T$$
$$S = HJ \cos T = 1.4142r \cos T$$
$$P = d \sin A \quad \text{and} \quad X = d \cos A$$

Then by addition we have,

$$E = P + S + r$$

By substitution,

$$E = d \sin A + 1.4142r \cos T + r$$

Now

$$F = E - 2r = S + P - r$$

By substitution,

$$F = 1.4142r \cos T + d \sin A - r$$

And

$$C = r - Z + X$$

By substitution,

$$C = r - 1.4142r \sin T + d \cos A$$

Now $B =$ the difference between the dimensions $2r$ and C, so either $B + C = 2r$ or $B + 2r = C$. It is evident in this case that $B + C = 2r$, as the perpendicular line through point V cuts the circle that represents the button. It will be seen from the diagram that:

$$W = Y = X = K = r \cos A$$
$$M = r \sin A - X = r \sin A - r \cos A$$

or

$$M = r\ (\sin A - \cos A)$$

Solution for Case 3

In Case 3, we have an angular surface GG and a hole perpendicular to this surface, as shown in Fig. 3. The angle

that the surface GG makes with the horizontal in this case is less than 45 degrees. A plug of radius d is placed in the hole that is perpendicular to the angular surface. A button of radius r is placed below the plug and in contact with both the plug and the surface GG.

The following dimensions are known:

$A =$ angle that surface GG makes with the horizontal (in this case less than 45 degrees);
$r =$ radius of button; and
$d =$ radius of plug.

With the values given, it is desired to find:

$E =$ horizontal distance from left-hand side of button to vertical line through point V;
$F =$ horizontal distance from right-hand side of button to vertical line through point V;
$C =$ vertical distance from bottom of button to horizontal line through point V; and
$B =$ vertical distance from top of button to horizontal line through point V.

Now as HJ is the diagonal of a square, angle $Q = 45$ degrees. Then by trigonometry we have:

$$HJ = r \text{ cosec } 45 \text{ degrees} = 1.4142r$$
$$T = 90 \text{ degrees} - (45 \text{ degrees} + A) = 45 \text{ deg.} - A$$
$$Z = HJ \sin T = 1.4142r \sin T$$
$$S = HJ \cos T = 1.4142r \cos T$$
$$P = d \cos A \quad \text{and} \quad X = d \sin A$$

Now,

$$E = r + S + P$$

By substitution,

$$E = r + 1.4142r \cos T + d \cos A$$

Also

$$F = S + P - r$$

By substitution,

$$F = 1.4142r \cos T + d \cos A - r$$

Also

$$C = r - Z + X$$

By substitution,

$$C = r - 1.4142r \sin T + d \sin A$$

Now $B =$ the difference between $2r$ and C, so either $B + C = 2r$ or $B + 2r = C$, depending on whether or not the horizontal line through point V cuts the circumference of the circle representing the button. It will be seen that in this case $B + C = 2r$. Referring to the diagram, we have:

$$W = Y = X = K = r \sin A$$
$$M = r \cos A - X = r \cos A - r \sin A$$
$$M = r\ (\cos A - \sin A)$$

Solution for Case 4

In Case 4, we have an angular surface GG, Fig. 4, and a hole perpendicular to the given surface. The angle the surface GG makes with the horizontal is more than 45 degrees. A plug of radius d is placed in the hole that is perpendicular to the angular surface. A button of radius r is placed beneath the plug and in contact with the plug and surface GG. The known dimensions are:

A = angle that surface GG makes with the horizontal (in this case greater than 45 degrees);

r = radius of button; and

d = radius of plug.

It is desired to find:

E = horizontal distance from left-hand side of button to vertical line through point V;

F = horizontal distance from right-hand side of button to vertical line through point V;

C = vertical distance from bottom of button to horizontal line through point V; and

B = vertical distance from top of button to horizontal line through point V.

Now as HJ is the diagonal of a square, angle $Q = 45$ degrees. Then by trigonometry we have:

$$HJ = r \ \text{cosec}\ 45 \ \text{degrees} = 1.4142r$$

$$T = A - 45 \ \text{degrees}$$

$$Z = HJ \sin T = 1.4142r \sin T$$

$$S = HJ \cos T = 1.4142r \cos T$$

$$P = d \cos A \quad \text{and} \quad X = d \sin A$$

Now

$$E = r + S + P$$

By substitution,

$$E = r + 1.4142r \cos T + d \cos A$$

Also

$$F = S + P - r$$

By substitution,

$$F = 1.4142r \cos T + d \cos A - r$$

And

$$C = r + Z + X$$

By substitution,

$$C = r + 1.4142r \sin T + d \sin A$$

Now B = the difference between the dimensions $2r$ and C, so either $B + C = 2r$ or $2r + B = C$, depending on whether or not the horizontal line through V cuts the circumference of the circle representing the button. In this instance it is evident that $B + C = 2r$.

From the diagram we also have:

$$W = Y = N = K = r \cos A$$

and

$$M = r \sin A - K = r \sin A - r \cos A$$

$$M = r (\sin A - \cos A)$$

* * *

RESULTS OF STANDARDIZATION

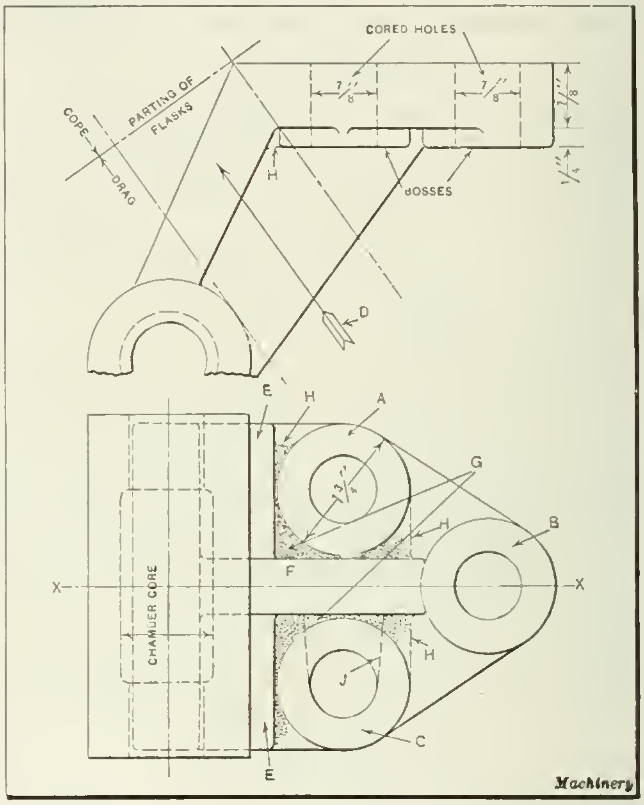
The great saving that can be made within a plant or a manufacturing organization by standardizing the parts used in the product has been well exemplified by the work accomplished in standardization and the elimination of needless costs by the General Motors Corporation. In an article in *Industrial Management*, D. G. Baird points out that this company in December, 1919, used 13,355 different parts in its products. This number was reduced to 2099 by simply standardizing similar parts that could be used for the different products of the company. The number of nuts used, for example, were reduced from 349 to 63, and even this number is said to be larger than is necessary. Duplication of effort causes more waste in the industries than is generally understood. Doubtless, before this standardization work was undertaken, it was believed that each one of the products of the General Motors Corporation had been reduced to its simplest form and that the manufacturing costs had been reduced to a minimum. In practically every shop and in every organization, there are opportunities for savings if a careful study is made with a view to eliminating all duplication of effort and all work that is not essential to the successful conduct of the business.

A MOLDING PROBLEM

By M. E. DUGGAN

Recently, while on a trip to the foundry, the writer noticed that one of the molders was having considerable difficulty in making a satisfactory mold from a bracket pattern. The job should have been a simple one for both the patternmaker and the molder. However, it had been made difficult, because the bracket had been designed with three bosses, as shown at A, B, and C. These bosses were unnecessary, and the bracket would have served its purpose just as satisfactorily if they had been omitted. Cored holes had also been specified, which further complicated the work. As only two castings were required, time would have been gained by drilling the holes instead of having them cored.

The direction in which the pattern was to be drawn from the drag flask is indicated by the arrow at D. The patterns for the three bosses were loosely pinned to the main pattern, and the core-prints for the ⅞-inch cored bolt-holes were fastened to these loose pieces. It was impossible to produce a satisfactory casting from this pattern, because the small spaces between the ribs E and F and the bosses A and C formed sand pockets at G. The molding sand would not stand up in the mold at these points, much less withstand the washing effect of the molten metal.



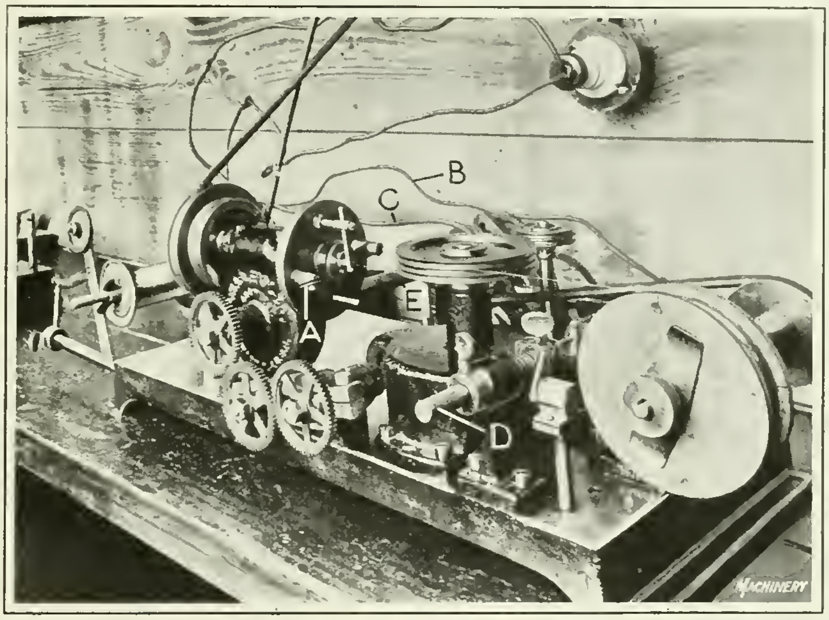
Bracket Pattern that presented Difficulties in Molding

By changing the pattern as described in the following, a satisfactory casting was produced. First the bosses or pads A and C were changed in shape, as indicated by the dotted lines at H, so that the sand pockets at G were eliminated. These pads or bosses were then fastened to the pattern, which was split along the center of rib F on line X–X. Tail core-prints of the shape indicated by the dotted lines at J were provided for the ⅞-inch cores. By changing the pattern in this manner, it could be molded half in the drag and half in the cope flask. Stock cores were used for the ⅞-inch cored holes, and the cavities left by the tail-prints were filled in. While a satisfactory mold was produced from a pattern constructed in this manner, it would have been much better and cheaper if the bosses or pads had been omitted from the design; also time would have been gained by drilling the holes instead of coring them.

INCANDESCENT LAMP MACHINERY

Developments in incandescent electric lamp manufacture have been quite extensive during recent years. The variety of styles of lamps having the filaments arranged differently has resulted in the evolution of a large number of automatic machines, some of which are of more than ordinary interest. In the lamp known as type B, the filament is zigzag and suspended from radial anchor wires at the top and bottom. This is the most common type lamp in present-day use. The filament used in this lamp is a plain tungsten wire, the manufacture of which was described in an article published in December, 1916, MACHINERY. The present article does not deal with the manufacture of incandescent lamps, except in so far as may be necessary in describing some of the more ingenious machines which have supplanted devices and methods formerly used, and which have been developed for the more modern types of lamps.

In the automobile lamp and what is known as the miniature lamp, both of which have globular bulbs, as well as in the type C lamp, the filament is a coil of very fine wire, closely wound. Some sizes of wire are as small as 0.0005 inch in diameter, the number of turns per inch running up to 850 with the inside diameter of the coil as small as 0.004 inch. The filament in the C lamp is attached to short anchor wires radiating from the center stem, as in the type B lamp, but it is arranged in a single horizontal plane near the large end, and not strung between anchor wires at both ends. There may be four or more of these anchor wires, and where they hook on the filament there must be a gap in the coil. The two ends of the coil filament are then electrically welded or clamped to the two lead wires that pass through the glass flare or bell-mouthed tube at the base of the lamp.



Machine for winding Coils of Filament for Incandescent Lamps

The machine illustrated in this article is made by Charles Eisler, Newark, N. J., and it is used for winding the filament either in a continuous coil or with intermittent gaps. The machine is automatic in operation, and thus it is possible for one operator to easily attend to five or six machines. Suitable speed changes may be made to obtain from 30 to 850 turns per inch and to provide for handling wire suitable for any size lamps from 10 to 1000 watts. The filament wire weighs from 0.90 to 270 milligrams per 200-millimeter length, which, converted into English standards, is from 1/31,500 to 1/105 ounce for 7⅞ inches of length. Expressed in inch measurements, the filament diameter is from 0.0035 to 0.0118 inch. The speed of the machine ranges from 500 to 4000 revolutions per minute according to the diameter of the filament being coiled. It is sometimes necessary to heat the filament electrically as it is being coiled, but this depends on the physical condition of the wire.

The coil is wound on a wire core, the diameter of which is from 0.004 to 0.035 inch, according to the requirements. This core wire is wound from a spool at the left-hand end of the machine, back over a V-pulley on a spring arm, and thence through a straightener directly in back of the driving pulley (not shown in the illustration). The core wire extends through the spindle, then through the spool attached to the faceplate on which the filament wire is carried, and around two grooved pulleys or drums, which provide tension for the core wire. It is wrapped twice around the drums, in the grooves, and then on a wooden spool or sheave at the right-hand end of the machine.

The larger of the two grooved drums is driven through change-gears, from the spindle of the machine, by worm-gearing inside a cover attached to the base of the machine. The filament from the spool on the faceplate passes over a V-pulley *A* and down behind a finger that guides it as the faceplate whirls it around. The tension on the core wire is what determines the uniformity of the spring windings. The flat brass spring between the sheave on which the coil is wound and the knurled nut that holds it to its shaft must be stiff enough to prevent the sheave from slipping and the core wire from slackening.

For continuous coils, this is all there is to the operation of the machine, except the heating of the wire, which is done by electric resistance, taking the current from a step-down transformer, one terminal of which is attached by wire *B* to the base of the machine as a ground, and the other by wire *C* to the post on which the smaller grooved drum rotates. The hub of the larger drum is insulated from the post on which it turns by a fiber bushing; and the nose of the spindle is similarly insulated. The (filament) tungsten wire is heated to a dark cherry red, discernible in daylight, at the portion extending from the faceplate where the winding occurs, and thus it becomes sufficiently pliable to be wound readily.

In winding coils intermittently, gaps are formed at predetermined distances between the closely wound coils. This is accomplished by momentarily turning the large grooved drum ahead quickly the correct amount, in order to increase the rate of travel of the core wire. The provision for accomplishing this movement makes it possible to revolve independently the vertical shaft for the larger grooved pulley, by means of a friction clutch arrangement within the worm-gear cover. Shaft *D* carries a shoe at its rear end that rides over a cam and causes the shaft to be pushed to the front against spring tension. This shaft carries a finger that engages the friction disk used to transmit motion from the worm-wheel to the drum shaft, so that when shaft *D* is pushed forward it rotates the drum shaft in advance of the speed of the worm-wheel. Collars on the shaft permit suitable adjustment for advancing the drum more or less, according to the length of gap required.

The camshaft extends at right angles to shaft *D*, and is driven by worm-gearing from a shaft in line with the worm-shaft for the drum. This second worm-shaft is driven, in turn, by a train of change-gears, similar to those shown at the front of the machine, but located at the rear. The driver of both gear trains is on the same shaft *E*, and this shaft is driven by worm-gearing from the spindle of the machine.

The sheave on which the coiled filament is wound is driven from a V-pulley on the worm-shaft by a round belt, which slips on the sheave shaft pulley during the time that the wire is being coiled, keeping it taut; the belt revolves the sheave as soon as the tension on the core wire is momentarily released by the finger on shaft *D*, as previously mentioned. As the speed of the machine spindle is increased for the smaller sizes of wire, it is, of course, necessary to increase the speed of the cam, which can readily be done by means of the change-gears at the rear of the machine. The normal speed of the drums around which the core wire is wrapped is very slow, and is increased with the size of the filament and the speed of the spindle (turns per inch) by selecting the proper change-gears.

Before the filament coil can be used, it is necessary to remove the core wire by using acid solutions. For steel and iron core wires, sulphuric acid and water are used in equal proportions; and for brass wire, a solution of nitric acid and water, mixed in equal proportions, is employed.

* * *

BUSINESS COURTESY

In the reception room of a machinery plant in Ohio, the management has placed the following announcement, addressed to salesmen visiting the plant: "Welcome salesmen. The manager of this business was for several years a traveling man. If you are obliged to wait more than ten minutes, ask our telephone operator to connect you with the manager's office." The industrial enterprises that make it a business to accord to traveling salesmen the same courtesy that is bestowed upon their customers have more boosters for their business than they are aware of.

* * *

In a recent address, Secretary Hoover called attention to the fact that the railroads of the country have improved their efficiency along with the industries, even if not at as rapid a rate. In the last ten years freight movements have been increased by 15 per cent, with an increase of only 3 per cent in personnel. Furthermore, the management shows great faith and courage in undertaking a large program of expansion in spite of the handicaps under which the railroads have been laboring in recent years.

BLANKING, DRAWING AND PIERCING DIE

By I. BERNARD BLACK

A sectional view of a sub-press die of the two-pillar type employed in a watch factory for blanking, forming and piercing the barrel drum of a watch is shown in Fig. 1. At the left in Fig. 2 is shown a sectional and plan view of the barrel drum. The diameter of the blank before being drawn or cupped is 0.825 inch. The stock used is Bessemer steel, 7/8 inch wide by 0.016 inch thick. Before the die shown in Fig. 1 was designed for this work, it was the practice to blank and draw the piece and then pierce and size it in a separate operation. Both of these operations were performed in sub-press dies of the cylindrical type; thus two operations were required to do the work accomplished in one operation by the new die.

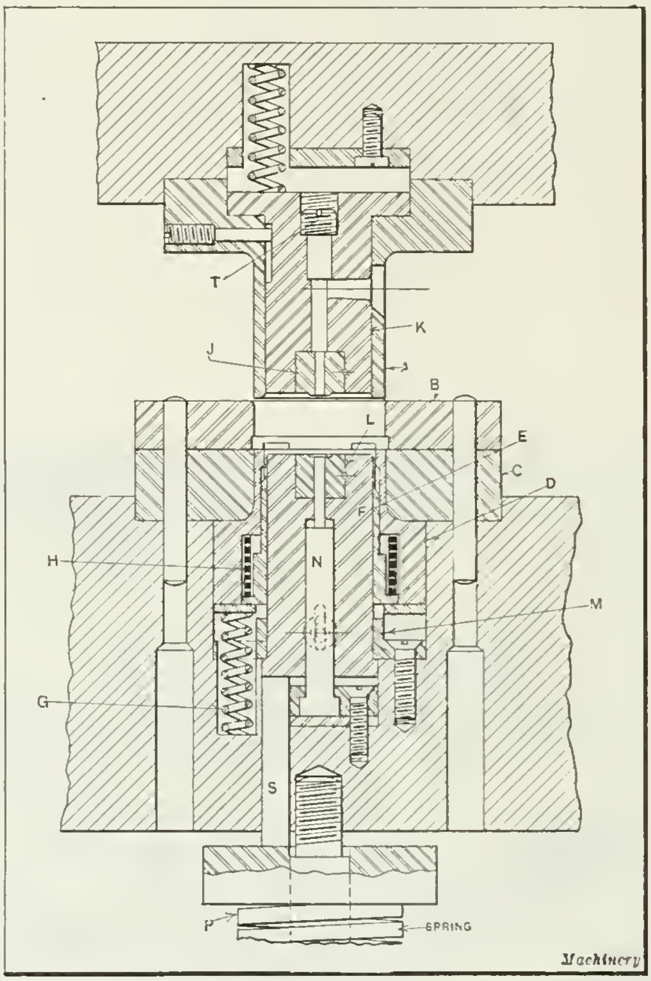


Fig. 1. Blanking, Drawing, and Piercing Die

The sectional view at the right in Fig. 2 shows the blanked, formed, and pierced barrel drum *W* in the position it occupies when the ram of the press has reached the end of its downward stroke. The construction of the punch and die, however, is more fully illustrated in Fig. 1. On the downward stroke of the ram, punch *A* passes through stripper *B*, and, entering die *C*, blanks the piece. Part *D* is forced downward by punch *A* as the latter turns down the outer edge of the blank. Parts *E* and *F* recede with part *D* due to the pressure of punch *A*, which acts against the pressure exerted by springs *G* and *H*. When the end of the downward stroke is reached, part *E*, having come in contact with part *M*, will have upset the flange, thus producing a square edge at the bottom. Piercing punch *N* will have entered piercing die *J*, and part *K* will have receded the required distance in punch *A*. At the right in Fig. 2 is shown a detail view of the most important members of the punch and die.

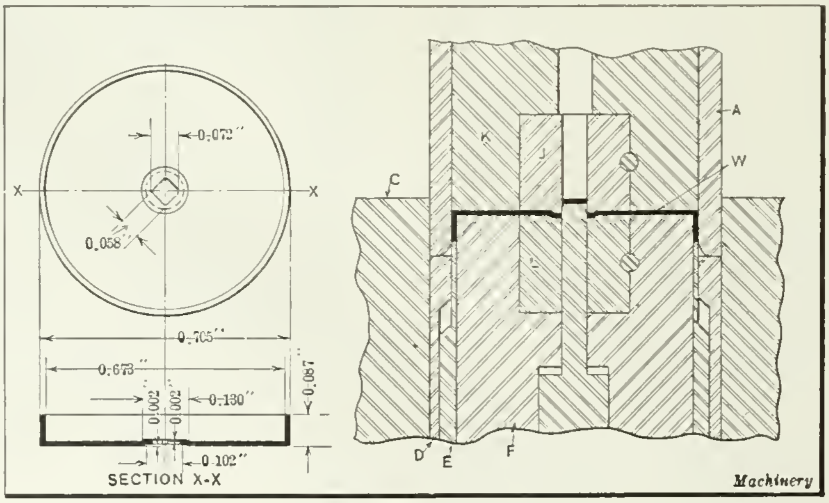


Fig. 2. Enlarged View of Work and Punch and Die Members

On the upward stroke of the press, the finished piece is pushed out of the die by the action of the heavy sub-press spring *P* and the springs *H* and *G*, which act against parts *D* and *E*. It will be noted that spring *P* exerts pressure on the die member *F* through pins *S*. In order to prevent interference of the work with the top of the stripper, the latter member is cut away, as shown at *X*, Fig. 3. The problem of ejecting the work was solved by the use of four spring-actuated pins, one of which is shown at *Y*. These pins are designed to raise the stock just enough to permit it to contact with the center of the rim of the finished piece at *Z*. The stock, when fed in for the succeeding stroke of the press, serves to push the finished piece out of the die. It will be noted that although the design of the punch and die is rather complex, the parts are all cylindrical in shape, which greatly facilitates machining.

A novel feature of the die is the method employed for ejecting the piercings produced by punch *N*, Fig. 1. From this illustration it will be clear that the piercings will be forced upward through die *J* and will eventually fall out through a slot cut through parts *A* and *K*. A container is provided on the press to receive these piercings as they fall through the slot. The set-screw *T* provides a means of knocking or forcing out part *J*, should it be necessary to replace this member. An air vent through screw *T* leading to the slots through *A* and *K* obviates the forming of an air cushion, which would prevent the die from operating satisfactorily. Parts *A* and *K* are prevented from getting out of alignment by means of a pin and keyway as shown. Parts *J* and *L* are pinned to prevent them from turning in their holding members.

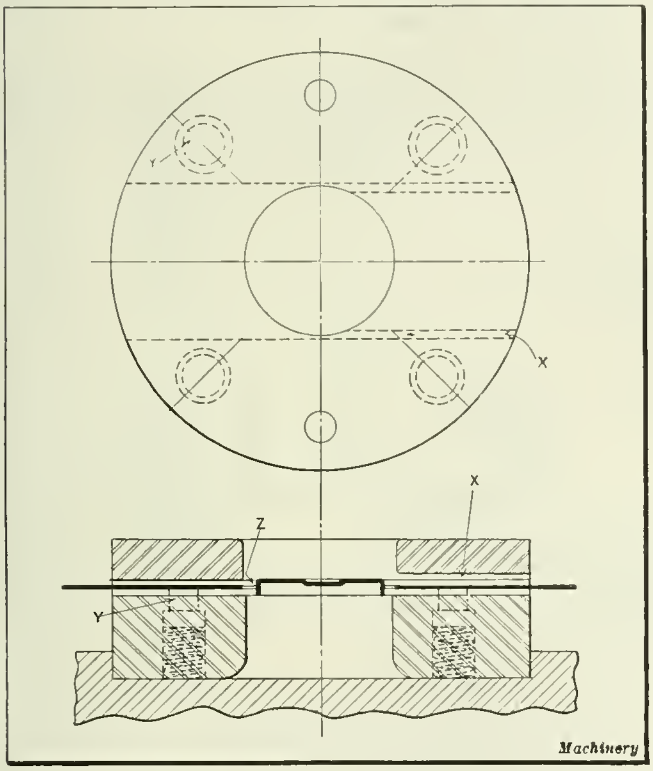


Fig. 3. Diagram showing Work in Position to be pushed from Die

* * *

THE INCREASING USE OF ALUMINUM

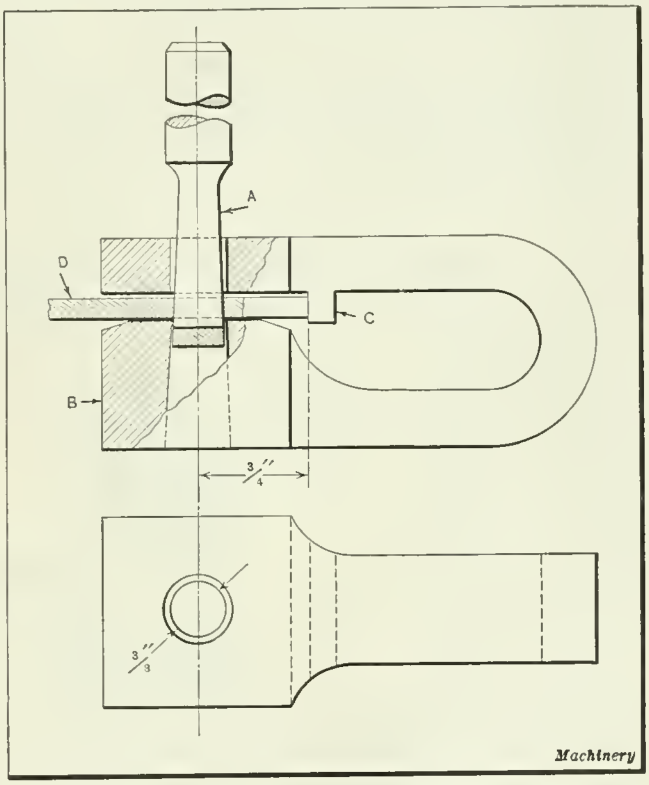
The development of the autogenous welding process and modern methods for making die-castings have greatly extended the application of aluminum in the industrial field. Sheet aluminum of all gages heavier than 1/32 inch are now readily welded by the oxy-acetylene flame, and the seam can be dressed off so well that it is difficult to locate the joint. Consequently, it is now possible to build aluminum tanks or containers of almost any size and shape, which, when welded, appear to be one piece. These tanks are practically leakproof, and for that reason have a marked advantage over riveted tanks. For a long time it was considered very difficult, if not impossible, to make aluminum die-castings, but at the present time several concerns are making such castings successfully.

PUNCHING EVENLY SPACED HOLES IN METAL SHEETS

By ANAK

The metal punching device shown in the accompanying illustration consists essentially of a punch *A* and a die *B*, with a guiding member for the punch and a stop *C* for locating the punch and die the correct distance from the edge of the sheet of metal *D* that is to be punched. The only tools available for making this punch and die were a small portable forge and a somewhat limited blacksmith's outfit. The punch was made up for a repair job that necessitated adding about 10 feet to a cupola shell which was 30 inches in diameter and made from 3/32-inch sheet metal.

For this job about 150 rivet holes, 3/8 inch in diameter, spaced 2 inches between centers at a distance of ¾ inch from the edges of the metal, were required to be punched. The die member was forged from a piece of rail steel and hardened. The punch was made from a piece of round carbon tool steel, ⅝ inch in diameter. The end of the punch was drawn down to a diameter of ⅜ inch and given a slight back taper.



Device for punching Holes in Metal Sheets

With this punch it was only necessary to locate one hole in each sheet by measurement. The stop *C* locates all the holes exactly ¾ inch in from the edge of the sheet. After punching the first hole, a short bolt was placed in the hole and a spacing block located against the head of this bolt. The die *B* was then brought into contact with the spacing block, which was made just thick enough to give a spacing of 2 inches between holes. This method of locating and punching the holes was found satisfactory, and no trouble was experienced after the sheets were bent and put in place ready for riveting.

* * *

In the tractor field it is said that a number of the larger makers will discontinue their smaller models, because the largest producer in the tractor field concentrates on a small size, and in view of his great production he is able to sell tractors at a price that makes competition very keen. The other manufacturers, therefore, are planning to build only the larger sizes.

Adjusting Milling Machines for High Speeds

Methods of Overcoming Difficulties Sometimes Met with when Milling Machines are Speeded up for Stellite Cutters

By C. W. METZGER, Haynes-Stellite Co., New York City

FROM time to time the Haynes-Stellite Co. receives complaints that properly ground stellite cutters fail to produce a good quality of finish and that the cutters are not uniform in quality. Investigation of such claims generally reveals the fact that the cutters are used on a machine that is improperly adjusted or that is not suited to high production work at the speeds and feeds used. In most instances of this kind the trouble can be easily located and remedied. It is the purpose of this article to outline some of the more common of these troubles that have come to the writer's attention, and explain how they were remedied, so that others who may be confronted by difficulties of a similar nature will know how to take steps to correct them.

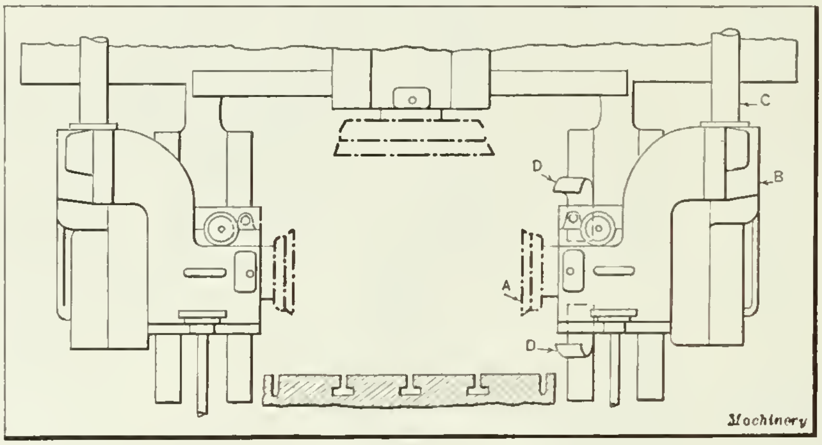


Fig. 1. Method of employing Shims D to realign Spindle Bearing

In one case, a customer who was using a planer type of milling machine, equipped with one vertical spindle and two horizontal spindles, complained that the stellite cutter used on one of the horizontal spindles did not give a good finish and did not remain sharp nearly so long as the cutter on the opposite spindle. On investigating this complaint, it was found that the spindle of the cutter that gave trouble, which is shown diagrammatically at *A*, Fig. 1, was so far out of alignment with the table and the vertical bearing *B*, that spindle *C* was running hot and binding so tightly in the bearing that the cutter could not be raised to the desired height.

In order to remedy this trouble, shims *D* were used to bring the horizontal spindle—on which cutter *A* was mounted—into the correct position. As a result, the vertical spindle *C* ran free in its bearing and gave no further trouble. The cutter *A*, which had previously required grinding after every 125 cylinder blocks had been milled, stood up so well that after this adjustment 330 blocks were milled before resharpening was necessary. Incidentally, it may be mentioned that the cylinder block machined in this case was 30 inches long, the table travel 18 inches per minute, and the depth of cut ¼ inch.

It is well to remember that, if the spindle of a milling machine is out of alignment with the table to such an extent that the back of the cutter is in contact with the work, a double cut will be taken. This condition results in a poor finish and in greatly reducing the efficiency of the cutter. In some cases, where the spindle is inclined at a slight angle with the table, a specially ground cutter is necessary if the best results are to be obtained. The shapes or forms to which the cutters are ground to meet this and various other requirements are dealt with in an article published in April MACHINERY, on page 589.

Trouble Caused by Worn Spindle Bearings

In some cases where complaints have been made about the quality of finish obtained, it has been found that the trouble is due entirely to a worn or improperly adjusted spindle bearing. A spindle bearing of the type shown at *B*, Fig. 2, has sometimes been found to be free or loose in the taper bushing *A*. This allows an up and down movement of the cutter, which may be caused by the bevel gear drive at the top of the spindle.

If the bearing *C* is badly worn or needs adjusting, it will allow shaft *E* to spring or be distorted, as indicated by the dotted lines at *D*. This shaft, which makes two revolutions to one revolution of the cutter, will then exert an uneven driving pressure on the bevel gear at the top of the cutter-spindle. This causes the cutter to move up and down, and in some cases to run out of alignment, with the result that a poor finish is obtained and the efficiency of the cutter greatly reduced. Obviously, the remedy in cases of this kind is to renew the bearings or readjust them, making sure, of course, that the driving shaft and spindle are straight.

In one case where the finish obtained was not satisfactory, a simple adjustment of the spindle bearing eliminated all trouble. In this instance, the work being performed on the milling machine consisted of finishing the cylinder heads for the engines used in one of the highest grade automobiles made in this country. After the spindle had been properly adjusted, the finish obtained was all that could be desired. For this work a table travel of 34 inches per minute and a peripheral speed of 169 inches per minute for the cutter were employed.

Chatter Produced by Worn Gears and Overhanging Cutter-arbor

A cutter-arbor with too much overhang, as shown in Fig. 2, is often found to be the cause of chatter, which, of course, results in poorly finished surfaces. Worn or loose driving gears at *F* and *G* have also proved in some instances to be the cause of chatter. In cases where either or both of these conditions are found to exist in an old machine that has seen much service, it is generally advisable to use speeds that are considerably lower than those ordinarily recommended for stellite cutters. Under these circumstances the use of specially ground stellite cutters, as described in the article in April MACHINERY is also advisable. If the cut is intermittent and there is chatter and vibration caused by machine conditions or widely spaced teeth in the cutter, it is best to have a generous 45-degree chamfer at the ends of the cutter blades. Stellite cutters used in the manner outlined on old or worn machines will prove a profitable investment in many cases, as they have a very long life. The high salvage value of the stellite blade stubs or short ends that cannot be used is a factor that should be remembered in considering the initial cost of a stellite cutter.

It may not be out of place to emphasize here the importance of carefully inspecting all milling cutters after they are resharpened or ground. Resharpened cutters should not be sent to the milling machine unless they have been inspected and found to run true and to have all their blades ground to the same height. Where a battery of milling machines is in operation on production work, it is a good plan to purchase an extra milling machine spindle and bearings complete, which can be mounted on a suitable fixture designed for indicating and inspecting the reground cutters. Then when a working spindle is in need of repair, it can be quickly replaced by the extra spindle. This allows production to continue uninterrupted, and sufficient time may be given to the repair and adjustment of the removed spindle to insure a high quality of work.

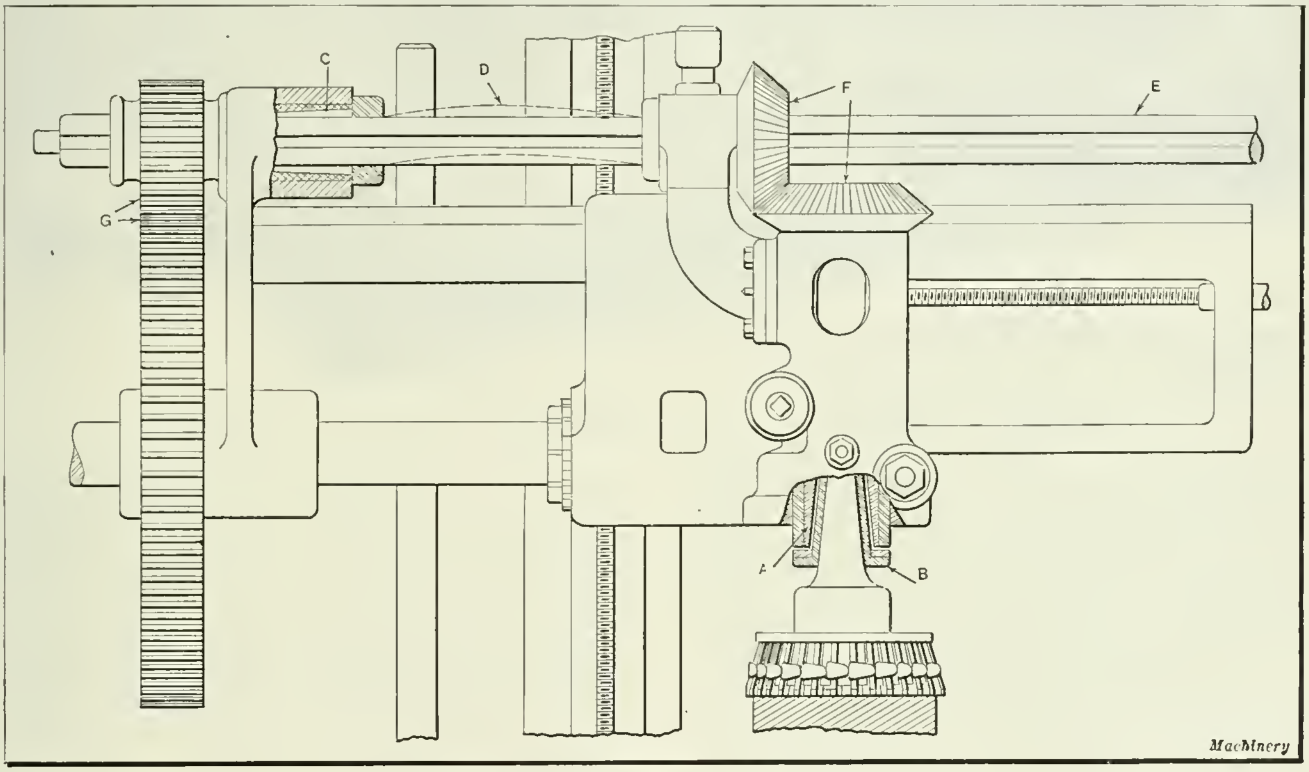


Fig. 2. Diagram showing Bearings or Members that must be properly adjusted

A word regarding the tolerances allowed on milling machine spindle bearings might also be included. The tolerances allowed should increase with an increase in cutting speed; for instance, it has been found that a tolerance of 0.005 inch on the spindle bearing is suitable when the cutting speed is 60 feet per minute, and 0.007 inch when the cutting speed is 100 feet per minute. At a cutting speed of 140 feet per minute a tolerance of 0.009 inch is suitable; and at a cutting speed of 180 feet per minute, a tolerance of about 0.011 inch may be allowed.

* * *

The decrease in efficiency of the workers in the German machine-building industry is indicated by some figures that are published in the report of the Association of German Machinery Manufacturers for 1922. The production per man is stated by giving the weight of the manufactured products per man. In 1910 the production per man, per year, was 6.9 tons; in 1912, 7.4 tons; in 1913, 7.7 tons; in 1921, this figure had decreased to 4 tons; and in 1922 it was only 3.9 tons.

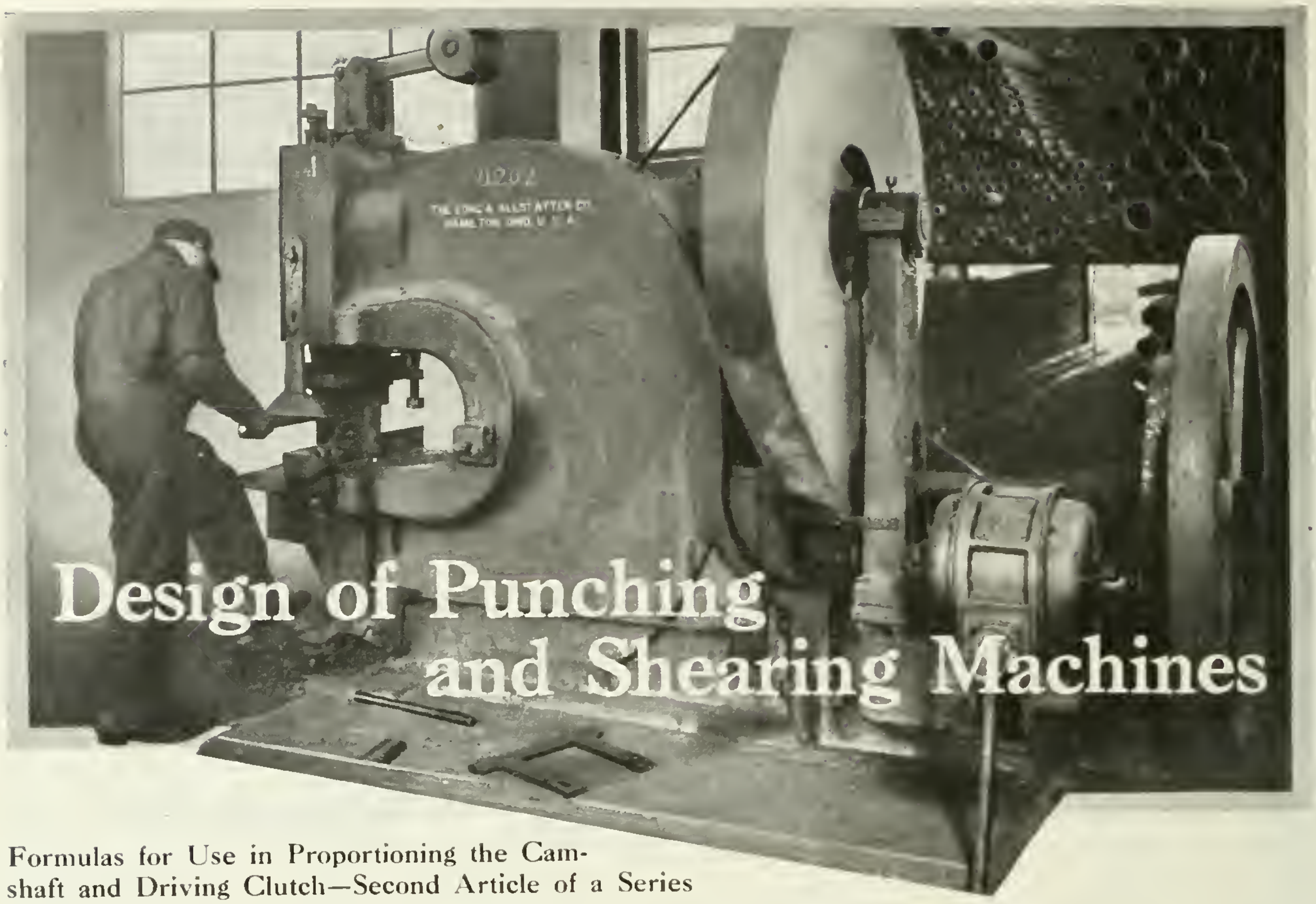
RECORDING PATENT LICENSES

A needless evil which should be remedied by patent legislation is pointed out by Professor Thomas A. Hill, counsellor at patent law, New York City. The fact that patent licenses and shop rights do not have to be recorded causes much needless litigation. Even patent transfers, except prior to subsequent assignment, need not be recorded. The result of this is that it is impossible for the prospective purchaser of any right under an invention or a patent to ascertain with certainty, in advance, the true state of the title. This incentive for fraud can and should be remedied by providing that every transaction affecting rights to a patentable invention be filed promptly for record in the Patent Office for public inspection, and those not so recorded should be held void as against any subsequently interested party adversely affected thereby.

As the law now stands, after a would-be patentee has exhaustively litigated his right to a patent for perhaps six to eight years in the Patent Office and Court of Appeals, he may have to litigate the question over again in the Federal Courts. This imposes unnecessary hardship, opens the way for fraud, and discourages legitimate progressive industry and invention. The merit of such laws is seriously questioned, and it is believed that steps should be taken to have them repealed.

As many patents are either invalid or of limited value, the Patent Office, when issuing them, should indicate the ascertained limitations, as notice to intending purchasers, licensees, and industry generally. This would involve practically no additional expense, and would obviate much fraud, misunderstanding, and subsequent litigation. The Patent Office is now made a source of revenue for the Government, and the public is left to the mercy of unscrupulous promoters, with no alternative except the hiring of patent lawyers, the expense of which is prohibitive to many people.

These are but a few of the bad features of our patent system, and until the investing public, the manufacturer, dealer, patentee, and technical fraternity realize these shortcomings and take the initiative many patent assets will remain of doubtful value.



Design of Punching and Shearing Machines

Formulas for Use in Proportioning the Camshaft and Driving Clutch—Second Article of a Series

By A. LEWIS JENKINS, Professor of Mechanical Engineering, University of Cincinnati

THE camshaft, or main shaft, of a punching and shearing machine is usually made of hammered steel of about 0.30 per cent carbon content. The most important variation in the details of this shaft is due to the different methods used in attaching the clutch. In some cases, the clutch is placed between the gear and the frame, and attached to the shaft by means of a feather key or by making the bore of the clutch sleeve and a portion of the shaft approximately square, as on the shaft shown at X in Fig. 1. In other designs, the clutch is on the opposite side of the gear from the frame, and is operated by a rod inserted in a hole through the shaft, as shown at Z, and connected with a sleeve placed in the opening in the frame and loose on the shaft.

The shaft illustrated at X is suitable for use with a clutch placed between the gear and frame. The gear fits on the extreme right-hand end, and the journals of lengths L_1 and L_3 fit in bearings in the frame. The cam is of length L and the faceplate journal of length L_4. The socket wheel or capstan is mounted on the extreme left-hand end. Diameter D of the cam is equal to the diameter of the eye in the pendulum, which was found in the first of this series of articles (published in July MACHINERY) to be

$$D = 3\sqrt{dt} + 1$$

in which d = diameter of hole to be punched, and t = thickness of plate. The length of the cam is equal to the width of the pendulum, the formula for which was also given in the preceding article. Thus,

$$L = 3.5\sqrt{dt} + 0.5$$

Some designers prefer to make the cam flush with the main journal, as shown at Y, in which case

$$D_1 = 2\,(e + 0.5D)$$

Value e was found in the previous article to equal $0.55\sqrt{dt} + 0.15$. Thus,

$$D_1 = 4.1\sqrt{dt} + 1.3$$

The decrease in the strength of the section between the cam and the main journal due to the sudden change in cross-section may be rendered less effective by joining the cam and journal with a fillet. In order to have a fillet, the diameter D_1 of the main journal should be increased about $0.4\sqrt{dt}$ which gives $D_1 = 4.5\sqrt{dt} + 1.3$.

Since the nearest eighths or sixteenths of an inch are used for e and D instead of the actual values given by the formulas, it is better to write this formula in the form,

$$D_1 = 2e + D + 0.4\sqrt{dt}$$

Another formula is obtained for this diameter by making $L_1 = 1.5\,D_1$ and allowing a bearing pressure of 4000 pounds per square inch. Then, assuming a load of 60,000 pounds per square inch of area punched,

$$D_1^2 = \frac{188{,}500\,dt}{1.5 \times 4000} \quad \text{and} \quad D_1 = 5.6\sqrt{dt}$$

This formula is satisfactory only for machines larger than for punching 1-inch holes through 1-inch plate. Its derivation will be understood by referring to the preceding article. Length L_1 of the main journal varies from $1.25D_1$ to $2D_1$. Making it equal to $1.5D_1$ gives

$$L_1 = 1.5D_1 = 6.75\sqrt{dt} + 1.95$$

When this formula is used, the bearing pressure varies from 2600 to 7000 pounds per square inch, the minimum applying to small machines and the maximum to very large machines.

Twisting and Bending Moments at D_2

That portion of the shaft of diameter D_2 is subjected to a twisting moment T, and also to a bending moment due to the thrust of the pendulum, reaction of the bearings, and the application of the load at the pitch circle of the gear, which makes it a continuous beam having three supports and two loads that are not applied in parallel directions.

The ordinary formulas for finding the bending moment of continuous beams apply only to beams of constant cross-section. In this case the cross-section is quite variable, making it necessary to introduce certain assumptions and make trial solutions, which result in a very long and laborious method. An actual working stress of about 8000 to 10,000 pounds per square inch should be used when bending is taken into consideration; however, it is better practice and about as accurate to neglect the bending moment and allow a unit shearing stress of 7000 pounds per square inch in the formula for torsional resistance. The twisting moment of the shaft is approximately equal to the product of the load W and the eccentricity of the shaft. Thus, $T = We$. Substituting this value of T in the formula for the diameter of a shaft subjected to twisting gives

$$D_2 = \sqrt[3]{\frac{5.1\ T}{q}} = \sqrt[3]{\frac{5.1 \times 188{,}500\ dt\ (0.55\ \sqrt{dt} + 0.15)}{7000}}$$

$$= 4.23\ \sqrt[3]{dt\ (\sqrt{dt} + 0.273)}$$

This formula is approximated by

$$D_2 = 3.75\ \sqrt{dt} + 1$$

Formulas for Finding Remaining Diameters and Lengths of Camshaft

That portion of the shaft between the diameters D_3 and D_1 of the shaft is sometimes made tapered. This may slightly reduce the cost of machining when the shaft is made from a solid bar having a diameter a little larger than the main journal, but in most cases it is considered good practice to remove the metal as shown, for the reason that it increases the resistance to shocks. It is not necessary to give this portion of the shaft as high a finish as is required on the journals. A fillet should connect diameters D_1 and D_2. Length L_2 depends upon the throat depth, and cannot be determined until the frame is designed.

Diameter D_3 is usually made slightly larger than D_2 to facilitate finishing the journal, but in some instances it is made smaller. Length L_3 is made from $2D_3$ to $2.25\ D_3$ which allows a bearing pressure of from 800 to 1200 pounds per square inch. An increase in the throat depth decreases the load on this bearing. For deep throats the total pressure is approximately equal to the force transmitted along the pitch circle of the gear. Diameter D_5 may be made equal to D_2. This portion is designed to receive the clutch, and if keys are used as shown at Y, it is desirable to place them either 90 or 180 degrees apart. The width of each key should be about $0.166D_5$; the depth, $0.28D_5$; the depth of keyway in the shaft, $0.133D_5$; and the length of the key should be sufficient to accommodate the clutch. The keys may be fastened to the shaft by machine screws.

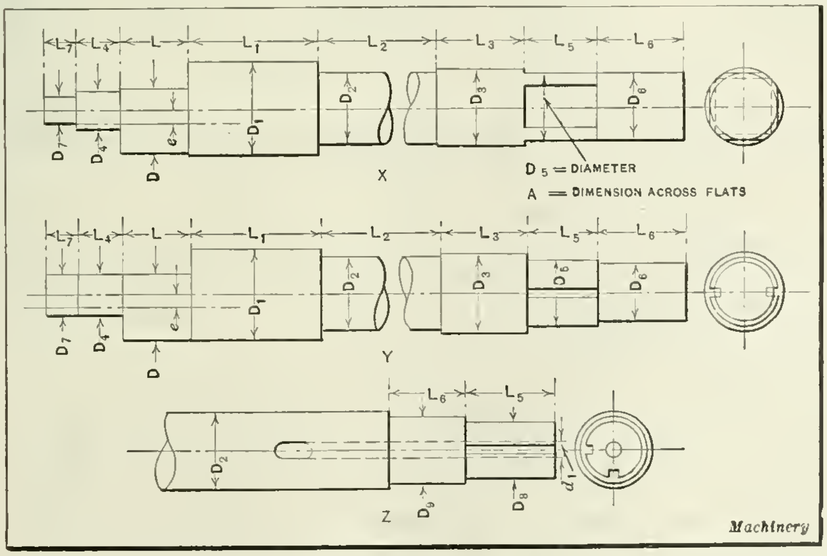


Fig. 1. Three Typical Designs of Camshafts on Punching and Shearing Machines

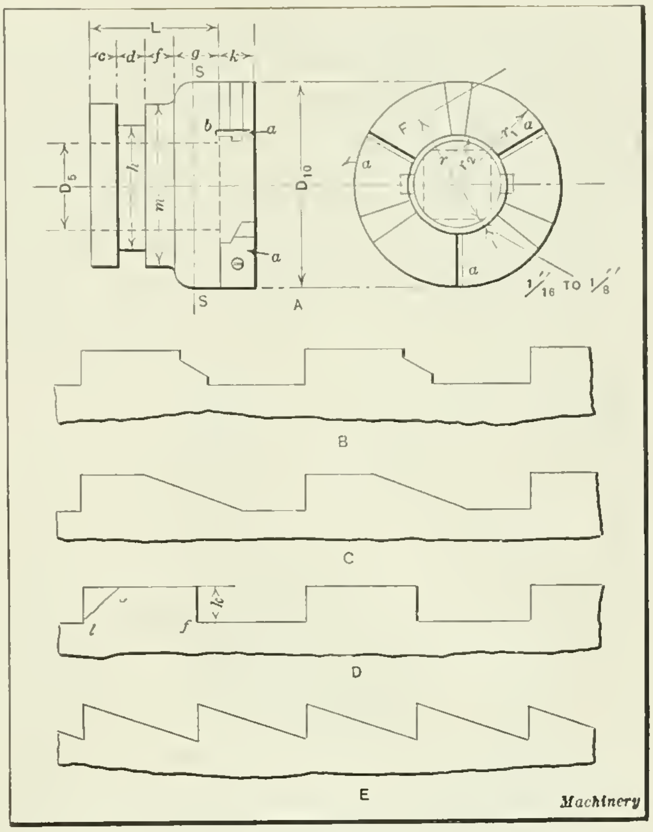


Fig. 2. Clutch Sleeve and Teeth commonly used on Punching and Shearing Machines

Many designers consider it better practice to make the shaft square for the clutch, with rounded corners, as shown at X, than to use keys. Distance A across the flats should equal $0.854D_5$. Diameter D_6 should equal A for a square clutch seat, and $0.9D_5$ when the seat is round, as at Y. Length L_6 should equal from $2D_6$ to $2.5D_6$, depending on the length of the gear boss. Diameter D_4 is found by a method similar to that used for D_1, and should be flush with D or only slightly smaller to allow for a fillet. Without a fillet,

$$D_4 = D - 2e = 3\ \sqrt{dt} + 1 - (1.11\ \sqrt{dt} + 0.3) = 1.89\ \sqrt{dt} + 0.7$$

Allowing for a fillet, $D_4 = 1.75\ \sqrt{dt} + 0.7$.

Length L_4 should be equal to D_4 to $1.25D_4$. Diameter D_7 fits into the bore of the socket wheel, and should be from $0.75D_4$ to D_4, the latter value being used by some designers for any size machine.

Length L_7 should be equal to D_7 to $2D_7$. When the clutch fits on length L_5 and the gear on length L_6, as at Z, the cam end and diameter D_2 should be the same as for the shaft at X. Other dimensions should be as follows: $D_9 = 0.85D_2$; $D_8 = 0.6D_2$; and $d_1 = 0.3D_2$.

The Socket Wheel

The socket wheel or capstan is fixed to the camshaft with a set-screw or key, being bored to fit diameter D_7, and it is provided with six holes for receiving the placing bar. Some capstans are connected to the shaft by a ratchet in order to prevent an accident in case the bar should be left in the capstan and the machine thrown in gear. A large handwheel instead of a capstan is provided on some machines.

Typical Clutch Operating Mechanisms

The simplest clutch operating mechanism consists of a sleeve similar to that shown at A in Fig. 2; this is moved into and out of engagement by two blocks which are segments of a ring that fits into a groove of diameter h and width d.

These blocks are attached by pivot screws *S*, Fig. 3, to a bellcrank which is operated by a link *K* connecting it with the treadle-lever. An automatic device for disengaging the clutch at any position of the slide is shown in Fig. 4. There is a face cam *F* attached to the clutch sleeve *A* by means of screws. The clutch is shown engaged, but when it rotates through nearly 180 degrees from this position, cam *F* strikes roller *B*, which is attached to the bellcrank *C*, pivoted at *G*, and causes the sleeve to move to the left and disengage. Engagement is effected by finger *E*, which is connected to bellcrank *C* through shaft *G*. When lever *D* is raised, the finger is pressed against sleeve *A*, forcing it to the right and engaging the clutch. Cam *F* may be so placed as to cause the clutch to disengage in any position.

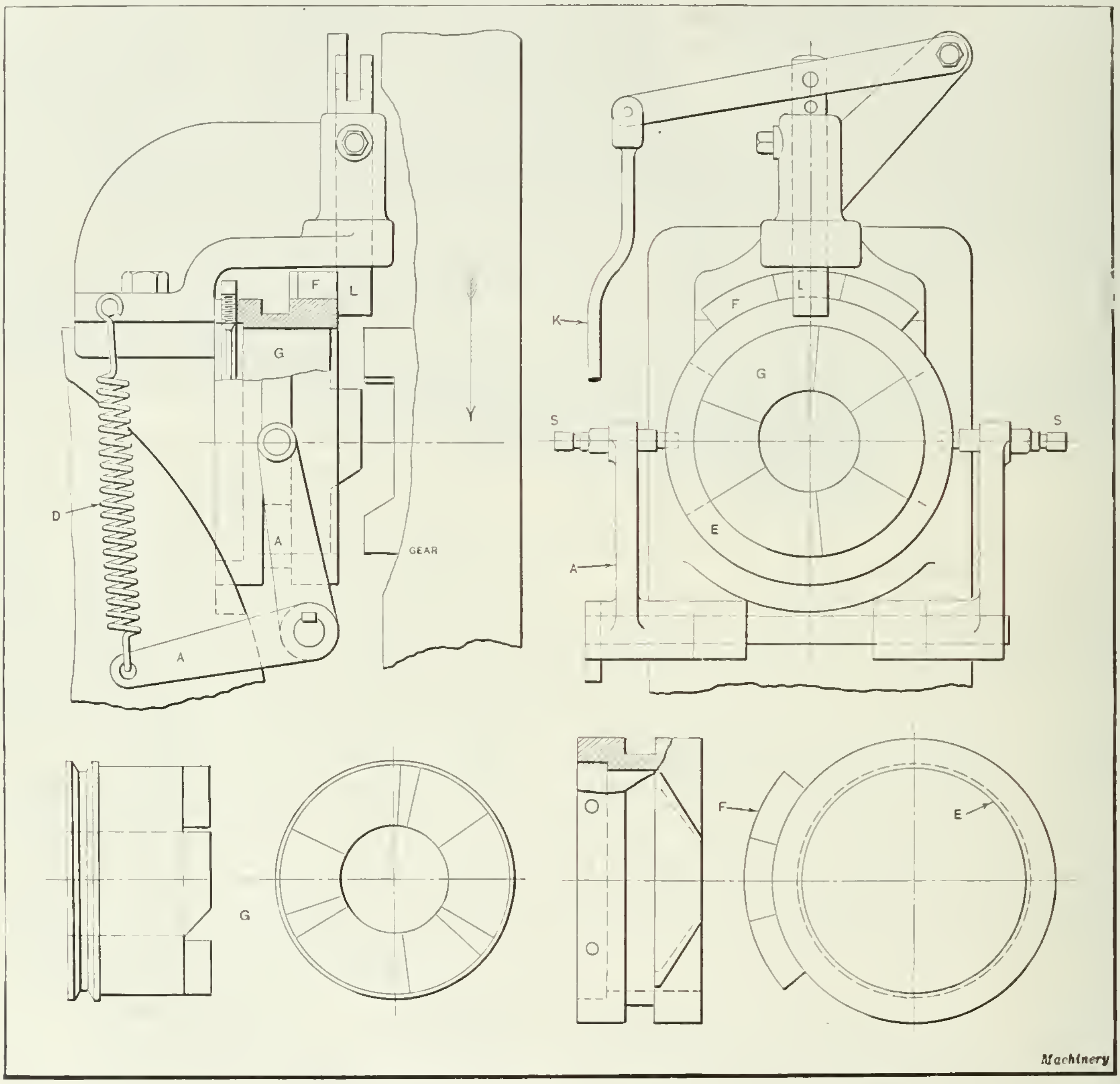


Fig. 3. Automatic Clutch Design in which the Clutch is engaged through the Action of a Coil Spring

In Fig. 3 the cam *F* is fastened to a sleeve *E* which is attached to the clutch sleeve *G* by set-screws. The clutch can be automatically disengaged and the slide stopped in any position by adjusting sleeve *E* on sleeve *G*. The clutch is engaged by raising link *K* attached to the treadle, which, in turn, raises plunger *L*, thus allowing spring *D* to swivel bellcrank *A* and force the clutch sleeve to the right. The lower end of plunger *L* then rests on the outer surface of sleeve *E* for one revolution, after which *F* strikes *L* and the sleeve is forced to the left and disengaged. A weight attached to lever *K* exerts sufficient pressure on plunger *L* to cause it to drop down on the face of sleeve *E*, as shown. On another clutch that functions on practically the same principle, a coil spring in the plunger bearing forces the plunger down against the sleeve face.

The automatic clutch shown in Fig. 5 is represented in the "out" position. To throw it into engagement, rod *R* is raised by means of a hand- or a foot-lever. This lifts plunger *P* carrying roller *L* and raises arm *A*, which allows spring *S* to move lever *B* to the left and press roller *E* against cam ring *F*. This cam is attached to the sliding element *C* of the clutch and forces it against the fixed element *D*. The end of roller *L* then rides on cam ring *F* until it passes cam *H*, when it drops on the right-hand side of the cam ring. At the same time cam *G* causes roller *E* to move to the left and lever *B* to the right, the latter movement stretching spring *S* and permitting arm *A* to lock lever *B*, as shown, when plunger *P* drops.

The clutch is thrown out of engagement at the proper time by cam *H* striking roller *L* and forcing the cam ring and sleeve *C* to the left. The machine may be safeguarded against being accidentally thrown into action while the operator is adjusting the dies, by raising lever *K* through 180 degrees. This releases the tension on the spring and there is then no force to throw in the clutch. Ordinary methods are used to connect sleeve *C* to the shaft and part *D*

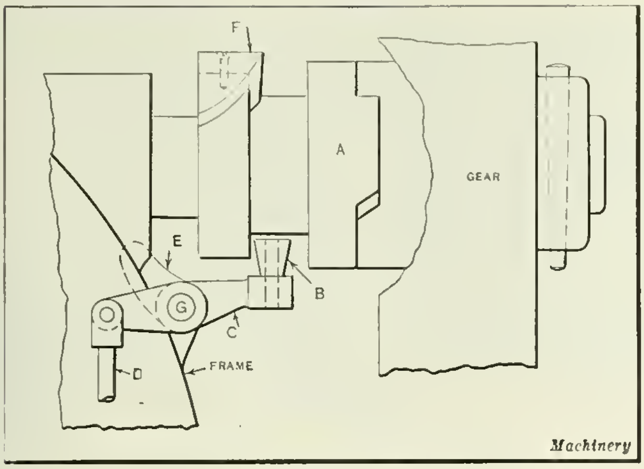


Fig. 4. Device for automatically disengaging the Clutch at Any Position of the Slide

to the gear. Cam ring *F* is adjustable on sleeve *C* by shifting set-screws *N* to the different holes *T*.

An example of a clutch on the end of the shaft instead of between the gear and the frame is shown in Fig. 6. The gear is loose on the shaft, but is prevented from moving to the right by a small collar *M* fastened to the shaft by set-screws. The clutch sleeve *A* may have a square bore or be provided with keyways to fit a sliding key or splines. Sleeve *A* is connected to sleeve *D* by a small rod which passes through a hole in the center of the shaft. The rod is held by nut *B* to a plate, and is fastened to sleeve *D* by means of keys or screws which pass through longitudinal slots in the shaft and cause sleeve *D* to turn with the shaft. Weights *K* act through bellcrank levers and tend to engage the clutch. The clutch is disengaged when a face cam on sleeve *D* strikes plunger *H*. By raising rod *E*, lever *F* is rotated, causing link *G* to draw plunger *H* away from the cam, and thus allowing weights *K* to engage the clutch.

Location and Teeth of the Clutch

The clutch may be placed between the gear and the frame, as shown in Figs. 3, 4 and 5, or on the end of the shaft, as shown in Fig. 6. The clutch teeth in most cases are the same, the only appreciable difference being in the operating mechanism. The clutch shown in Fig. 6, of course, requires a hole in the shaft and an opening in the frame, which makes it cost more to construct, but it brings the gear nearer the bearing in the frame and thereby decreases the bending moment on the shaft. The part that mates with the sleeve at *A*, Fig. 2, is attached to the gear, and may be either cast to it or fastened by means of screws or bolts and lugs similar to those used in connecting the faceplate to the frame, as described in the preceding article. If made separately, it will be the same as if the sleeve at *A* were cut off along line *S–S* and provided with lugs and bolt holes. It is apparent that the teeth on the piece that fits on the gear are not identical with those on *A*, but are opposite.

The working faces of the teeth at *A* are made of hardened steel plates *a*, which are assembled by means of screws and lugs, the width of the plates being a little greater than dimension *k* to allow them to set into the clutch at *b*. The plates are made symmetrical so that they may be turned around when worn. Some types of teeth used on these clutches are shown at *B*, *C*, *D*, and *E*. The teeth shown at *D* are frequently used, but unless there is considerable clearance or backlash, they will not engage readily at high speeds. This objection is somewhat overcome in the teeth at *B* and *C* and entirely so in the teeth at *E*. From this it may be seen that the shape of the teeth should depend upon the speed at which the clutch must engage. Proper engagement is satisfied with the teeth at *C*, but the clutch may not be as strong as one having teeth such as shown at *B*. The advantages of the latter type are that they have sufficient strength, can be readily engaged at speeds up to 50 revolutions per minute, and permit of turning the machine backward by hand.

Clutches with teeth as shown at *B*, *C* and *D* should have from $\frac{1}{8}$ to $1\frac{1}{4}$ inches clearance or backlash between the teeth, depending on the size of the machine. This means that the space between any two teeth should be greater than half of the circular pitch of the teeth. Another consideration is the strength of the teeth. If the clutch is made of cast iron, each tooth will tend to fail along a line lo at *D* unless lf is less than about $1.5k$. In the strongest clutch lf would probably be made almost equal to k, which would require a greater number of teeth and thereby decrease the delay in engaging, but it has been found unnecessary to have more than four teeth on clutches for punching and shearing machines, and a greater number is less likely to give an equal distribution of the load.

The number of teeth depends upon the size and speed of the machine. It is good practice to use two teeth on machines for punching 1-inch holes through 1-inch plate or less; three teeth on machines between that size and the size for punching 3-inch holes through 1-inch plate; and four teeth on larger machines. There should be from 1/16 to $\frac{1}{8}$ inch clearance between the inside of the teeth and the shaft; hence, the inside radius is:

$$r_2 = 0.5D_5 + 0.0625 \text{ to } 0.125$$

The outside diameter of the clutch is:

$$D_{10} = 2D_5 + 1$$

Dimension *k* should be as small as is consistent with strength, since large values of *k* require too great a travel for engagement and disengagement, and may decrease the strength of the teeth; too large values of *k* also require that the gear be placed too far from the rear bearing in

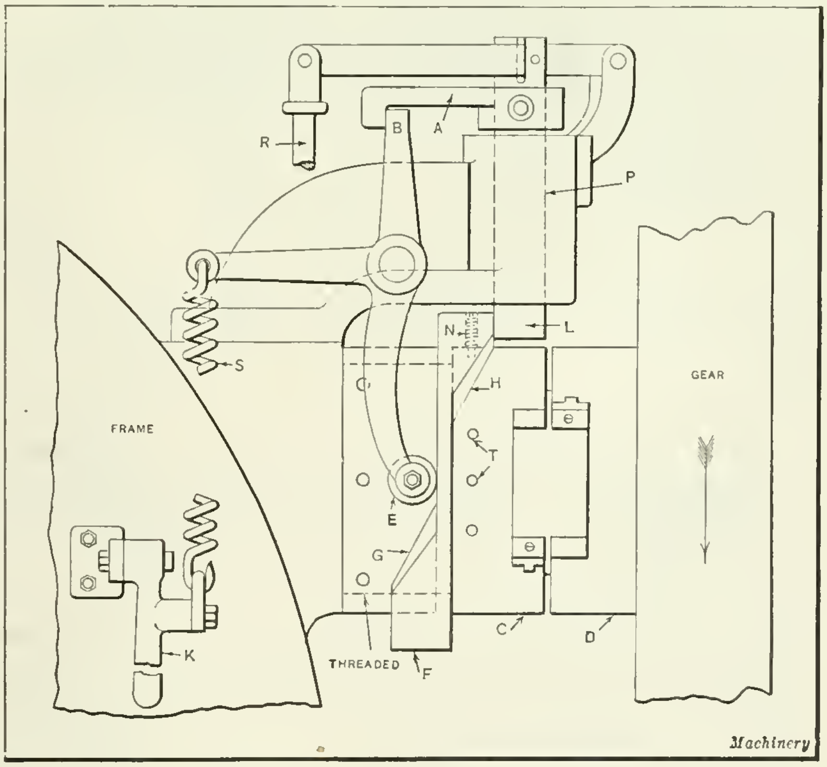


Fig. 5. Automatic Clutch which is engaged and disengaged by Means of Two Rollers contacting on Opposite Sides of a Cam Ring

the frame when the clutch is placed between the gear and the frame.

The twisting moment T on the shaft may be taken as equal to the pressure between the teeth times their mean radius r. Hence

$$T = Fr = F \times \frac{(r_1 + r_2)}{2} \quad \text{and} \quad F = \frac{2T}{r_1 + r_2}$$

in which F = force acting tangent to pitch circle of teeth. The total area of the tooth bearing surface is $n\ (r_1 - r_2)\ k$, where n is the number of teeth.

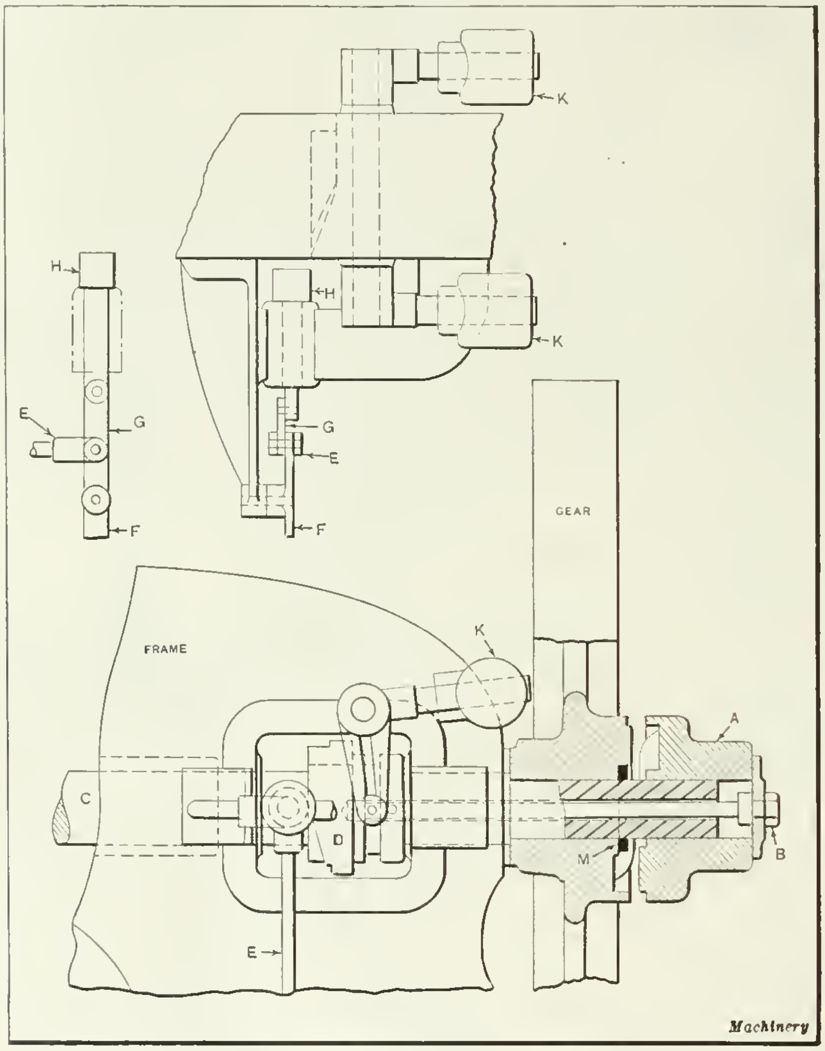


Fig. 6. Design in which the Clutch is located on the Opposite Side of the Gear from the Frame

The unit pressure p on the teeth is

$$p = \frac{\text{load}}{\text{area}} = \frac{2T}{(r_1 + r_2)\ (r_1 - r_2)nk} = \frac{2T}{nk\ (r_1^2 - r_2^2)}$$

and

$$k = \frac{2T}{pn\ (r_1^2 - r_2^2)}$$

Substituting the values of T, r_1, and r_2 gives

$$r_1 = \frac{D_{10}}{2} = \frac{2D_5 + 1}{2} = \frac{2(3.75\ \sqrt{dt} + 1) + 1}{2} = 3.75\ \sqrt{dt} \times 1.5$$

$$r_2 = \frac{D_5}{2} + 0.125 = 1.875\ \sqrt{dt} + 0.625$$

Then assuming a load of 60,000 pounds per square inch of area punched,

$$k = \frac{(188{,}500dt\ (1.11\ \sqrt{dt} + 0.3)}{(10.5dt + 8.9\ \sqrt{dt} + 1.8)\ np}$$

The value of p may be 3500 pounds per square inch for three teeth, and 4500 pounds per square inch for two teeth; however, values as low as 2000 pounds per square inch are used on small machines.

The operating clutch piece or sleeve may be provided with keyways for feather keys or splines, or have an approximately square bore, as shown dotted in Fig. 2 at A. The size of the square hole would be the same as dimension A, Fig. 1. When only one key is used, it should have a breadth equal to $0.25D_5$, and a thickness equal to $0.3D_5$. The depth of the keyway in the clutch should equal $0.175D_5$. When two or more keys are used, the breadth should equal about $0.166D_5$; the depth, about $0.28D_5$; and the depth of the keyway in the clutch, $0.147D_5$.

Length L (Fig. 2) of the clutch should be sufficient to allow a shearing stress of from 5000 to 6000 pounds per square inch on the key or a crushing stress of from 7000 to 8000 pounds per square inch. When two keys are used, the shearing stress per square inch is usually about 4000 pounds and should not exceed 6000 pounds, while the crushing stress per square inch should not exceed about 5000 pounds. If a square shaft is used, L_5 should be made equal to $1.25D_5 + 0.5$. Dimensions c, d, f, g, h, and m have no rational basis of calculation except that g should equal at least $1.5k$ if m is appreciably less than D_{10}. The attaching of automatic stopping devices changes these proportions considerably, and so none are standard. The following values may sometimes be used: $h = 1.5D_5 + 1$; $c = d = 0.1875D_5$; and $g = 0.3D_5 + 0.3$.

The Camshaft Collar

When the clutch is located between the frame and the gear, it is necessary to use a plain collar on the end of the shaft to hold the gear in place. The inside diameter, of course, is made to suit the diameter of the end of the shaft, while the outside diameter may equal $1.5D_6$ and the width, $0.5D_6$. The collar is fastened to the shaft by means of set-screws (preferably headless) having a diameter equal to about one-fourth the collar width or by means of a taper pin having a taper of ¼ inch per foot.

* * *

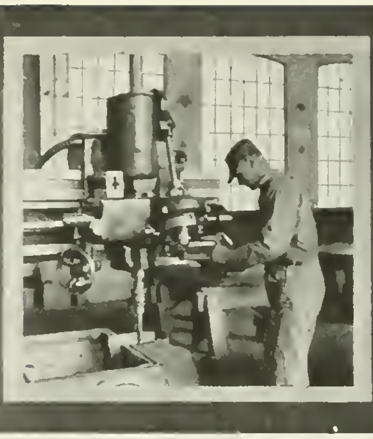
A SALESMEN'S SCHOOL

A salesmen's school is being conducted by the Link-Belt Co. of Chicago, in which the new men added to the company's sales force, regardless of their previous experience or training, are instructed in the company's policies and standards of practice, educated in regard to the design and construction of the machinery and equipment built by the company, and thoroughly trained in the company's sales methods. The salesmen from the company's branch offices are taken to visit one of its factories, where they can see and inspect the methods of manufacture, as well as to interchange ideas among themselves. The course takes but a comparatively brief time, but a complete schedule is covered during the few days devoted to the training.

* * *

According to an article by E. E. Rohrer of the Coatesville Boiler Works, appearing in *Chemical and Metallurgical Engineering*, the efficiency of the lapped and single-riveted joint is approximately 50 per cent. The lapped and staggered double-riveted joint has an efficiency of about 70 per cent. The butt-strapped, double-riveted joint has an efficiency of about 82 per cent; the butt-strapped, triple-riveted joint, an efficiency of about 87 per cent; and the butt-strapped, quadruple-riveted joint, about 93 per cent.

Letters on Practical Subjects



RADIUS MILLING FIXTURE

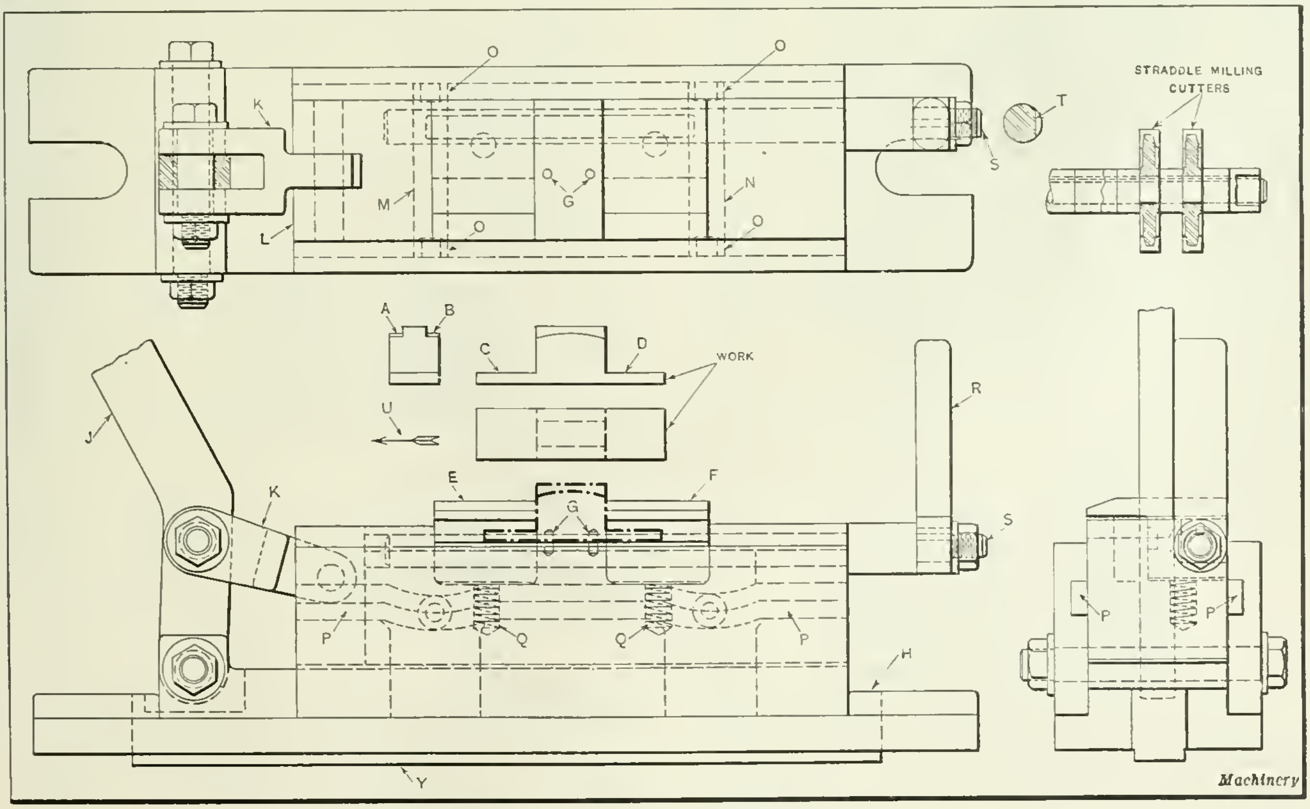
While milling machines are not usually fitted for doing radius milling with straddle cutters, it is nevertheless possible to equip them with special fixtures that will permit such work to be economically and conveniently done. A fixture designed for a case of this kind is shown in the accompanying illustration. The part to be machined is shown by heavy dot-and-dash lines. The surfaces *A* and *B*, as indicated in the end view of the work, are the ones to be radius-milled by the straddle cutters which are shown in the upper right-hand corner of the illustration. The work is clamped in place by blocks *E* and *F*, which are tightened on the flanges *C* and *D*. The raised central part of the work is located between the clamping blocks. When the fixture is being loaded, the work is slid back until it comes in contact with stop-pins *G*.

The cast-iron base *H* is clamped in position on the milling table after being located in the correct position under the cutters. The entire milling operation is performed by operating the lever *J* on the fixture, which is connected to a link *K*, the latter, in turn, imparting a longitudinal movement to block *L*. Mounted in this block is a pair of studs *M* and *N*, fitted with rolls *O* at each end. These rolls travel in grooves *P*. As parts of these grooves are milled concave, or to a radius corresponding to that to be milled on the work, the block *L* is given the vertical up and down movement necessary to mill the work to the required radius when the block *L* is traversed in its slide.

Two springs *Q* are provided to hold the clamping blocks *E* and *F* in a raised position so as to facilitate sliding the work into the fixture. A lever *R*, keyed to a shaft *S* which has a flattened portion, such as indicated at *T* in the sectional view, actuates the clamping blocks *E* and *F*. A downward movement of lever *R* causes the clamping blocks to grip the two flanges *C* and *D* of the work. This clamping device holds the work securely in position and can be operated very quickly.

After clamping the work in place, the operator presses down on the long lever *J* which has a handle (not shown) at its upper end. This causes the block *L* on which the work is clamped to slide in the direction indicated by the arrow *U*. This feeding or sliding movement starts from a point to the extreme right of the position shown. As the work is thus passed under the revolving cutters, the part is formed to shape, due to the vertical movement imparted to the work-holding block by the guide grooves *P*. Fixtures of the same general nature can be used successfully for a large variety of work.

F. Server



Fixture employed in performing a Radius Milling Operation with Straddle Cutters

TRIMMING DIE FOR METAL COVER

The die shown in the accompanying illustration is used for trimming the flange *A* from the lower edge of hexagonal shaped covers, such as the one shown by the dot-and-dash lines at *B*. The lower cutting die *C* is a hardened tool-steel ring, which is located on the cast-iron base *D*, and held in place by the pad *E* and the fillister-head screw *F*. The trimming die was originally made in the form of a hardened tool-steel block, which was screwed to the baseplate. The objection to this arrangement was that the die had to be annealed, upset, rehardened, and reground whenever it became dull. The ring type of die is made with straight sides, so that when one edge is dulled, the die can be reversed, thus making it necessary to sharpen it less frequently. The upper die *J* is made of toughened tool steel, and when it becomes dull, it can be upset while in place and a new cutting edge sheared on its end.

A half-cover *G*, with a handle soldered to it was used at first to put the work on the locating pad. This served to keep the hands of the workman away from the die, but slowed up production considerably. As a result, this safety device was often laid aside by those engaged in piece-work. In order to avoid accidents, the double-deck chute, consisting of slides *H* and *L*, and the feed-slide *I* were attached to the die. The feed-slide proved to be a practical safety device, and it also served to increase production. With this equipment, the operator could use one hand to keep the chute filled with pieces, and control the feeding of the pieces into the die with the other hand. This arrangement permits the press to be run at a speed of 90 strokes per minute.

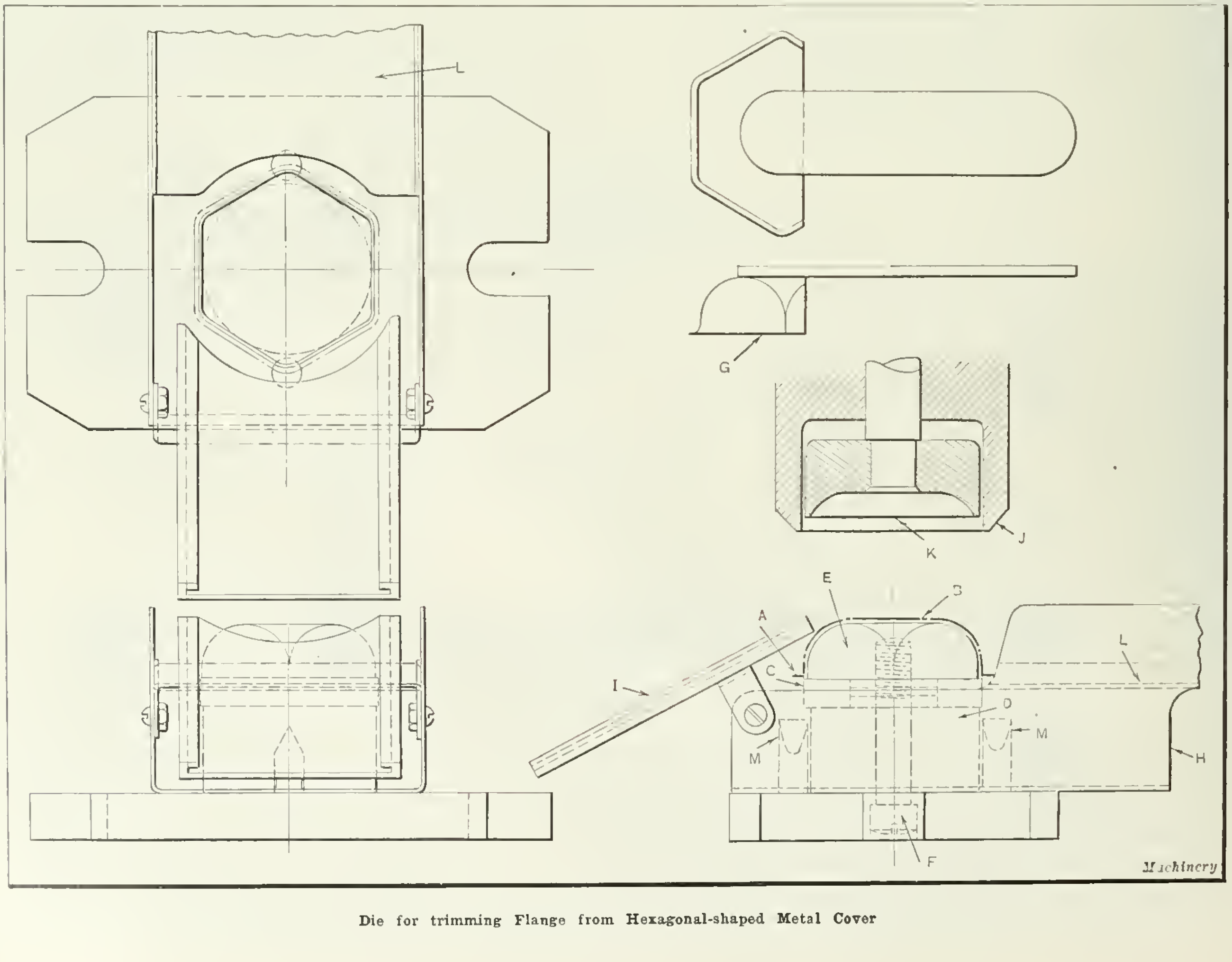
When the operator liberates a cover, it slides down the chute *I* and locates itself on the pad *E*. The press is, of course, inclined at the proper angle to permit feeding the work into place in this manner. When the upper cutter *J* descends, it performs the trimming operation, and as it ascends it picks up a trimmed cover. When the upper cutter is near the end of its upward stroke, the knock-out *K* pushes the cover into the upper chute, so that it slides down into a receptacle at the back of the press. As the operation continues, the trimmings accumulate on the base of the lower die, until they have become packed so tightly between the two cutters *M* and the cover being trimmed that they are split in two, so that they drop into the lower chute *H* and from there slide into a scrap-box.

Brooklyn, N. Y. S. A. McDonald

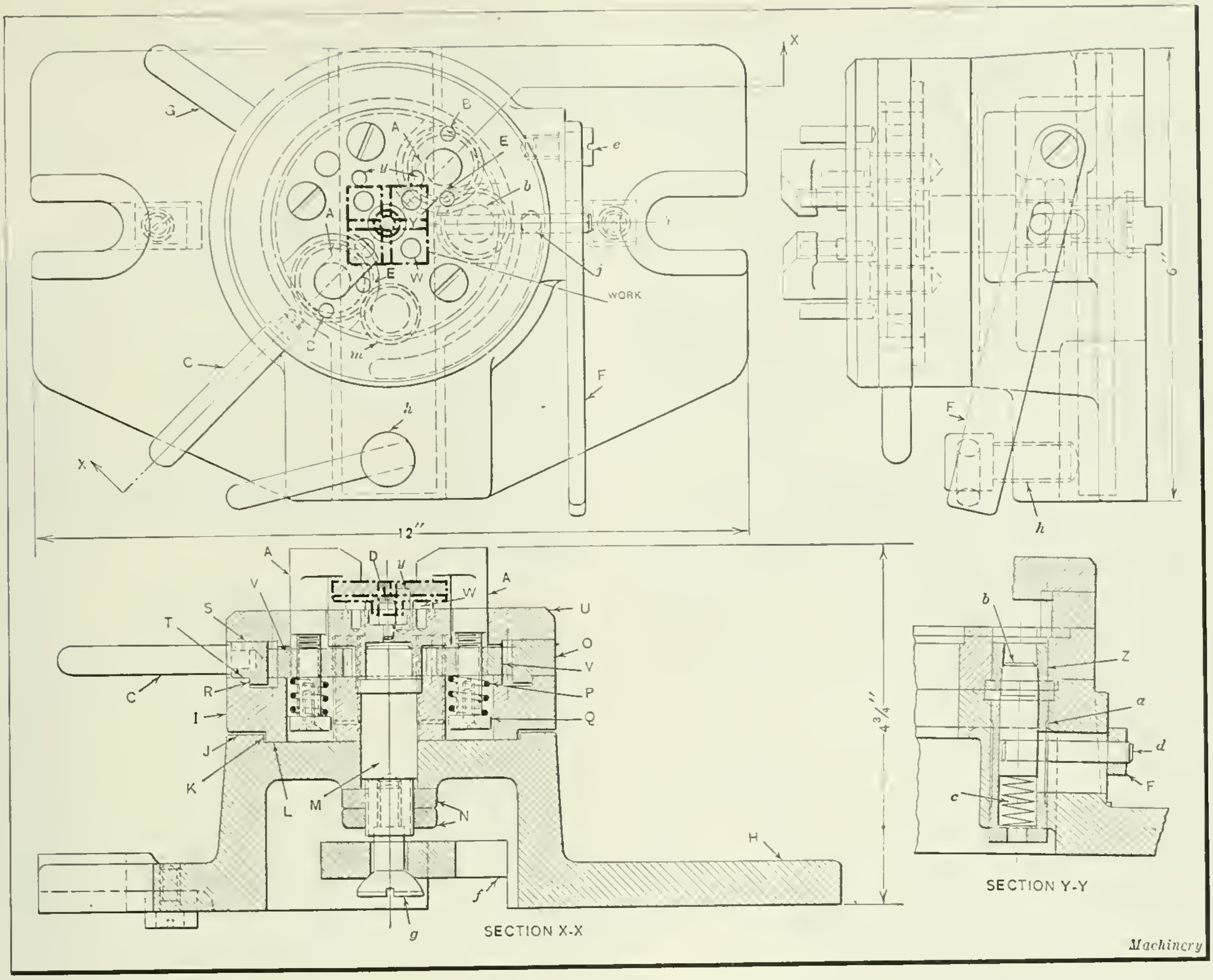
INDEXING FIXTURE FOR MILLING GENEVA STAR-WHEELS

The milling fixture illustrated herewith is employed in the production of star-wheels for Geneva movements. The operation performed in this fixture is the milling of the track slots for the propeller pin. The wheel—shown by dot-and-dash lines—comes to this fixture with the front face, sides, rear face, and hub machined to finished dimensions. The two hook-bolts *A*, which clamp the work in place, are swung on their shanks until stopped by pins *B*, when lever *C* is swung in a clockwise direction in order to release the work. This opening movement of the jaws of the hook-bolts permits a new piece of work to be readily put in place over the pilot-pin *D*.

A movement of lever *C* in a counterclockwise direction swings the clamping ends of the hook-bolts back into place, where they are stopped by pins *E*. A further movement of lever *C* serves to draw the hook-bolts down, so that the work will be clamped in place. After one track slot has been milled in the star-wheel, the lever *F* is depressed to disengage the index-pin. The work-holding member of the fixture is then revolved 90 degrees in a counterclockwise direction by means of lever *G*, which is attached to the index-ring *I*. The index-pin is then raised to lock the fixture by an upward movement of lever *F*.



Die for trimming Flange from Hexagonal-shaped Metal Cover



Indexing Fixture employed in milling Geneva Star-wheels

Part *H* of the fixture is a cast-iron base having a circular recess in which the index-ring *I* rides. This ring has a clearance at points *J* and *K* and bears on the face *L*. In the center of the ring is a hardened and ground pilot-stud *M*, which is a press fit in the index-ring and a running fit in the base. It is held in the base by the two threaded collars *N*. On the upper face of the index-plate is an annular recess which receives the internal ring gear *O*. Two clearance holes are bored to receive the springs *P* and the spring caps *Q* which are made a sliding fit in the holes in the index-ring. The ring gear is made a close fit at point *R*, but clearance is allowed at points *S* and *T*.

To the top of the ring gear is fastened the cover plate *U*, which has a recess on its under side to receive the ring gear. There are also two circular pockets in the cover plate to receive the two spur gears *V* which engage the teeth of the ring gear. Sufficient clearance is allowed between the cover plate and the index-ring for the spur gears and the ring gear. The cover plate is fastened in place by suitable screws and dowels. The holes in the spur gears are threaded to receive the threaded ends of the hook-bolts *A*, and the body part of the hook-bolts is made a sliding fit in the two holes in the cover plate. In the center of the cover plate is a pilot-pin *D* on which the part to be milled is located. Four supporting pins *W* and two gage pins *y* are provided to support the part and locate it squarely in the fixture.

The indexing arrangement is shown in the partial sectional view in the lower right-hand corner of the illustration. Two holes 90 degrees apart are bored in the index-plate to receive the tapered index-pin bushings *Z*. Directly below bushing *Z* a hole is bored in the base to receive the plunger bushing *a* in which is inserted the plunger *b* and the plunger spring *c*. On the side of the plunger bushing *a* is an elongated slot through which passes plunger pin *d* which is connected to lever *F*. Lever *F* is pivoted on pin *e*. To the bottom of the pilot-stud *M* is fastened a clamp *f*, which is held in place by the spherical head of stud *g*. The clamp has a spherical depression in it to correspond with the spherical head of stud *g*. A clamping screw *h* shown in the view in the upper right-hand corner of the illustration bears on the front end of this clamp, while the back end of the clamp has a bearing on the base of the casting and is prevented from sidewise movement by a recess cut in the base.

The method of operating the fixture is as follows: In loading, a movement of lever *C* serves to turn or pivot the hook-bolts until their clamping ends are stopped by the two pins *B*. The part to be milled is then inserted over the pilot-pin *D*. The work is squared up in the fixture by the two gage pins *y*, so that it rests on the four supporting pins *W*. The operator then grasps the handle *C* and turns or rotates the gear ring *O* in a counterclockwise direction so that the two pinions *V* will be rotated in the same direction. The pressure applied by springs *P* causes the hook-bolts to turn with the pinions until they strike the stop-pins *E*. Any additional movement of lever *C* will cause the pinions to rotate, and as they are threaded on the hook-bolts *A*, the latter will be drawn down so that their hooked ends will clamp the work firmly in place.

The clamping screw *h* is then tightened to insure rigidity of the indexing part of the fixture, after which the first slot in the star-wheel is milled. For milling the second slot, screw *h* is released and lever *F* pressed down with the right hand, while the handle *G* is swung around in a counterclockwise direction until the bushing *m* is directly above the plunger *b*. At this position the plunger enters bushing *Z*, thus locating the work for the second cut in the star-wheel, which is exactly at right angles with the first cut. Then the clamping screw *h* is again tightened, and the second cut taken. In order to release the piece after the milling operation, handle *C* is swung in a clockwise direction, causing the hook-bolts to rise and swing outward, so that the operator can easily remove the finished part and insert a new piece.

The indexing movement of the fixture is limited to 90 degrees by the pin *j*, which projects into a circular slot cut in the under side of the index-ring. A greater indexing movement would cause the plunger to drop into the holes which provide clearance for the hook-bolts. Chips are prevented from entering the internal mechanism of the fixture by the cover plate. It will be noted that the complete operation of unclamping the hook-bolts and swinging them out of the way is accomplished by a 90-degree movement of handle *C*.

Brooklyn, N. Y. JOHN A. HONEGGER

FORMULA FOR FINDING CREST RADIUS OF WHITWORTH THREADS

A formula for finding the radius at the top of a modified Whitworth thread is presented in this article with the hope that it will prove useful to many readers of MACHINERY. The formula and its derivation can best be explained by considering its application to a tap with Whitworth threads, but it is equally useful when applied to hobs, cutters, etc., that have Whitworth threads or threads of a similar form.

All taps are made with a greater limit on the outside diameter than on the pitch diameter. In fact the outside diameter should be large enough to cut a clearance so that the sides of the assembled screw and nut will be in contact without any interference at the top and bottom of the threads. If this clearance is considerable, the radius at the top of the thread on the tap must be reduced. The problem in this case is to find the required radius *R* (see illustration) so that a suitable forming tool can be made.

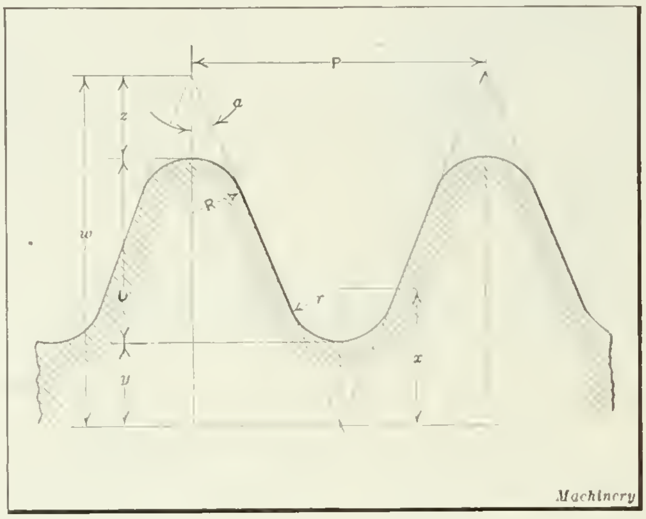


Diagram used in Derivation of Formula for finding Crest Radius

For this problem we have given the following values:

a = one-half the thread angle;
r = standard radius for given pitch;
P = pitch; and
D = depth of thread.

We also have:

$$x = \frac{r}{\sin a} \qquad y = x - r$$

$$w = \frac{P}{2 \times \tan a} \qquad z = w - (D + y)$$

The value of *R* can now be found by trigonometry and algebra. Referring to the illustration, we have:

$$\frac{R}{R + z} = \sin a$$

$$R = R \sin a + z \sin a$$

$$R - R \sin a = z \sin a$$

$$R\ (1 - \sin a) = z \sin a$$

Thus

$$R = \frac{z \sin a}{1 - \sin a}$$

The latter formula also applies in the case of a roughing tap where the depth of thread is decreased. It has proved very useful to the writer in finding the radius of standard Whitworth thread taps where the threads are cut at such a steep helix angle that the form of the tool for threading the tap must be corrected. HARRY BURTON

DRAWING IRREGULAR CURVES

Many draftsmen employ a large assortment of fixed curves or celluloid templets in making various kinds of drawings. The writer has found that in some cases the common soldering metal used by electricians can be employed to good advantage in place of the fixed curves or templets. This soldering metal can be obtained in round wire form, about $\frac{3}{32}$ inch in diameter, and is very flexible. It can be bent to any desired curve within certain limits with the fingers. Provision for holding the wire solder is made by drilling a small pin hole through the wire about $\frac{1}{4}$ inch from the end for a swivel point. The other end can be held in place with the fingers, thus leaving one hand of the draftsman free to use either a ruling pen or a pencil.

The wire solder may be so bent or formed that it can be used in connection with the T-square. For instance, after a portion of the solder has been formed to some desired curve or series of curves, the remaining portion can be so bent that it can be guided or located by the T-square in different positions, the same as a triangle. When the wire solder becomes kinked, it is an easy matter to straighten it by drawing the wire through the hands and then rolling it between two boards. Aluminum wire can also be used for the same purpose, but it is more difficult to straighten when it has become kinked. The round section of the wire facilitates the use of a ruling pen and eliminates the danger of blotting.

North Andover, Mass. CHARLES P. THIEL

SEPARATING STEEL CHIPS FROM OIL

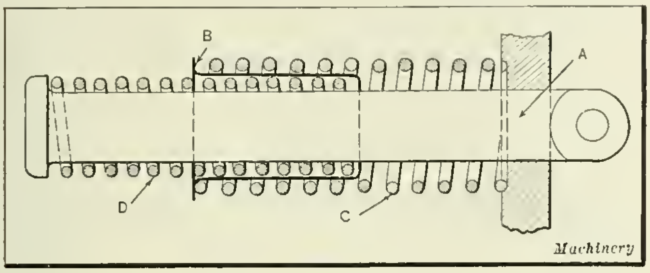
In a plant engaged in the manufacture of an automotive accessory, it was found that there was a considerable waste of oil in one of the processes. This oil was used for burnishing and for maintaining an even temperature while the product was being gaged for size. Large quantities of dust and fine steel chips were picked up by this oil, so that it could not be used over again without being filtered. As the chips were so fine that they would not settle or separate from the oil readily, representatives of various companies selling mechanical filters were called in to deal with the problem, but all failed to filter the oil successfully. The members of the works laboratory were finally given the job, and they solved the problem by using a wick to feed the oil into an ordinary laboratory filter paper. The filter worked automatically and the only expense involved was the use of two sets of filter papers a week. About 2500 gallons of this oil were purchased a year, and 2184 gallons were taken from the filter and used again. This represented a saving of $340 a year on this one item.

Philadelphia, Pa. ARTHUR L. COLLINS

Shop and Drafting-room Kinks

DUPLEX COIL SPRING

The coil spring here illustrated was devised by the writer for use under conditions where the longest possible movement of rod *A* was desired. The part *B* is a piece of steel tubing over which the outer spring *C* fits loosely, the end of the tube being spun over to form a flange having a diameter equal to that of the outside diameter of the larger spring. The opposite end of this tube is spun inward so that it retains the smaller spring *D* which slides easily within it. Rod *A* moves freely in the hole in the small end of the tube. The size of the springs and the diameter of the wire used should be such that about the same amount of pressure will be required to compress fully either the larger or the smaller spring. The writer has found this type to be more durable and longer-lived than a conical spring. It also exerts a more even pressure on rod *A*. A third and fourth spring could be added in the same manner if necessary.



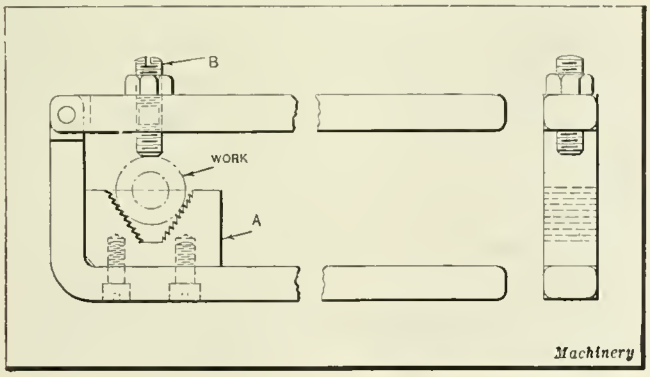
Coil Spring designed for Long Stroke

Holbrook, Mass. Frederic W. Blanchard

ADJUSTABLE REAMING CLAMP

The clamp shown in the illustration was designed to hold small round collars while reaming out burrs produced in a tapping operation. As there were about a thousand pieces to be reamed daily, it was necessary that the clamp be so designed that it would have a firm grip on the work without the operator being required to exert much pressure on the handles of the clamp.

The angle of the vee in the clamping block *A* is 60 degrees. It will be noted that fine teeth are cut on the sides of the vee so that the clamping action is similar to that of an alligator wrench. With this type of V-block, only a very light pressure on the clamping handles is required. The V-block is the only part subjected to much wear, and it can be easily replaced when necessary. The operator can adjust the spread of the handles to suit his grip or for any size of stock by means of the set-screw *B*.



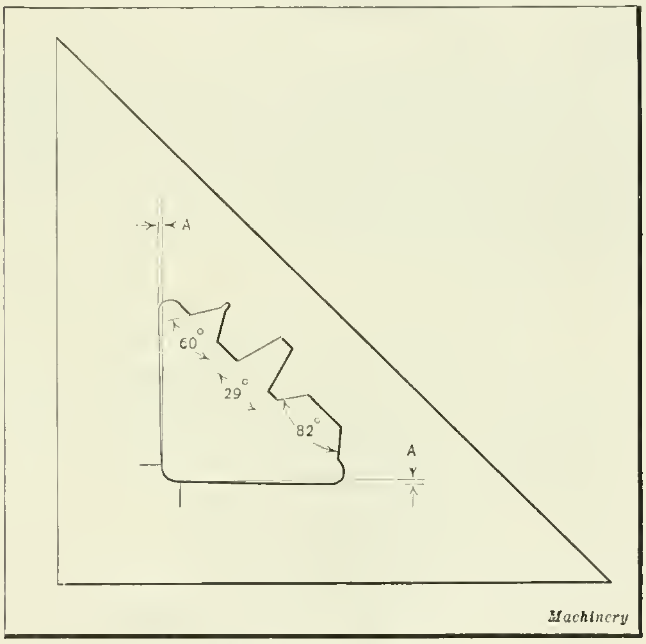
Clamp for holding Small Round Pieces of Work

Eastwood, N. Y. Elmer C. Cooley

DRAFTSMAN'S TIME-SAVING TRIANGLE

A designer or draftsman frequently must draw taper pins, heads for countersunk screws, Acme standard screws, and standard screw threads. To draw these without the proper tools or instruments requires considerable time, and to have a tool for each purpose results in littering up the drawing-board. A 45-degree transparent triangle is invariably kept on the drawing-board, as it serves many purposes. This triangle can be made to include means for drawing all the previously mentioned details, if modified as shown in the illustration.

The 60-degree cut is for use in drawing U. S. standard threads, V-threads, and any 30-degree angle. The 29-degree cut is for drawing worms or Acme screw threads. The 82-degree cut is for drawing countersunk head machine screws, while the two slight tapers are for drawing pins having a taper of 1/4 inch per foot. The angles *A* are, of course, made to a taper of 1/8 inch per foot in order to have the included angle correspond to the 1/4-inch per foot taper. It will be noted that the guiding edges used in drawing taper pins are so located as to require only a 90-degree movement of the triangle to permit drawing both sides of the pin.



Triangle designed to save Time

Takoma Park, D. C. G. W. Nusbaum

* * *

The largest alternating-current motor for steel mill use ever made in this country is being designed by the General Electric Co. for use at the River Rouge plant of the Ford Co., at Detroit, Mich. This motor will develop 8000 horsepower with a speed of 240 revolutions per minute. It will be used to drive a large blooming mill at the River Rouge plant, where installations are now being made to manufacture steel.

Questions and Answers

PROBLEM IN GAGE DESIGN

B. A. H.—In designing the gage shown in Fig. 1 a mathematical problem is involved in determining the distance x, which gives the location of the line of intersection of the spherical and conical surfaces. How can distance x be found?

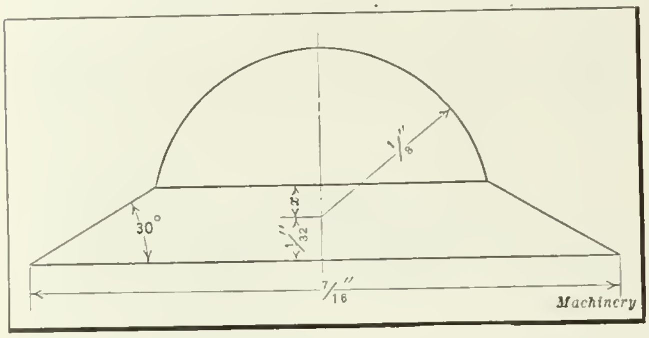


Fig. 1. Gage having Spherical Surface involving Mathematical Calculations

ANSWERED BY GUSTAF E. NORDSTROM, WORCESTER, MASS.

In the following is presented a solution to the problem in gage design which appeared on page 730 of May MACHINERY. The present solution does not involve the angles D, E, and X, as shown in Fig. 2.

Referring to Fig. 2, we have

$$AM = \sqrt{3}(a + x)$$

Now by geometry,

$$r^2 = x^2 + [b - \sqrt{3}\,(a + x]^2$$

$$= 4x^2 - 2x\,(b\sqrt{3} - 3a) + (b - a\sqrt{3})^2$$

Substituting the known values in this equation, we have

$$\left(\frac{1}{8}\right)^2 = 4x^2 - 2x\left(\frac{7\sqrt{3}}{32} - \frac{3}{32}\right) + \left(\frac{7}{32} - \frac{\sqrt{3}}{32}\right)^2$$

Simplifying and uniting terms we have,

$$4x^2 - 0.5703x = -0.01148$$

and

$$x = \frac{0.5703 \pm \sqrt{0.5703^2 - 16 \times 0.01148}}{8} = 0.0243 \text{ inch}$$

ANSWERED BY MICHAEL A. HICKEY, ROCHESTER, N. Y.

The problem in gage design presented in May MACHINERY may be solved in the following manner:

In Fig. 3, angle $CAF = 30$ degrees, and the perpendicular CF dropped from C to $AG = 1/32$ inch. Therefore,

$$AF = \cot 30 \text{ degrees} \times 1/32 = 0.05413$$

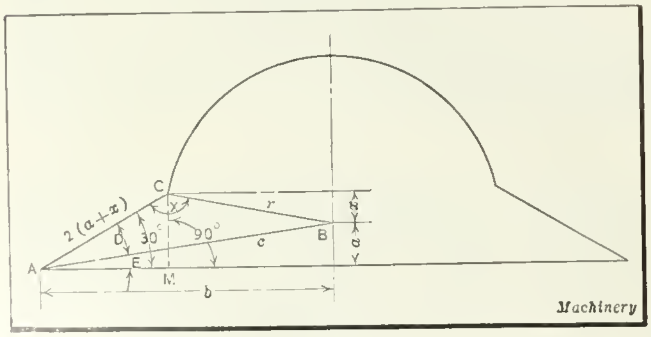


Fig. 2. Diagram used in the Solution of the Gage Problem

Also

$$FG = AG - AF = 0.16462$$

It is evident from the illustration that

$$CO = FG = 0.16462$$

Next a perpendicular is dropped from point D to line CO. In triangle DCE we have $CE = \cot 30 \text{ deg.} \times x = 1.73205x$

Now

$$EO = \sqrt{DO^2 - DE^2} = \sqrt{0.125^2 - x^2}$$

It is clear from the illustration that

$$CE + EO = CO$$

Substituting numerical values in this equation, we have

$$1.73205x + \sqrt{0.125^2 - x^2} = 0.16462$$

Simplifying and uniting terms we have,

$$4x^2 - 0.57026x + 0.01147 = 0$$

or

$$x^2 - 0.14257x + 0.00287 = 0$$

Adding 0.00221 to both sides of the equation to complete the square we have

$$x^2 - 0.14257x + 0.00508 = 0.00221$$

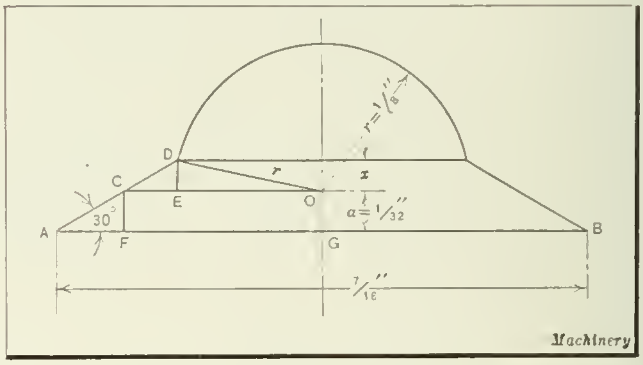


Fig. 3. Diagram used in Another Solution of the Gage Problem

Solving for x we have,

$$x - 0.07129 = \sqrt{0.00221}$$

and

$$x = 0.02428 \text{ inch}$$

APPLYING FOR A DESIGN PATENT

G. S. P.—I wish to make an application for a design patent, and would appreciate your informing me as to the length of time for which design patents are granted and the fees charged by the Government for filing and issuing design patents.

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

Design patents are granted for three and one-half years, seven years, and fourteen years, as the applicant may elect in his application, after payment of the fee required by law and an examination as to its novelty. If the application is originally for one of the shorter terms, the applicant at any time before the allowance of the application and upon payment of the additional fee, may amend his application and request that the patent be issued for a longer term. The procedure in applying for design patents is substantially the same as in applying for other patents. The Government fee is $10 for the three and one half year period, $15 for the seven-year period, and $30 for the fourteen-year term.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, July 16

THE general feeling in the metal-working industries is that conditions are improving steadily, if slowly. The trend of the unemployment figures points in this direction, but beyond this, definite and unmistakable signs of increasing activity are few and far between. Machine tool builders are plodding along steadily; several shops in the Midlands have a fair amount of both standard and special work in hand, and in this area, the special machinery demand keeps designing and patternmaking departments busy.

The activity in inquiries that has been such a constant feature throughout the barren period of many months past is unabated. There are still many machines of the general-purpose class that are held by dealers who purchased them at almost scrap prices a year or more ago at government auction sales, and the present owners can afford to hold their purchases until they get definite inquiries for the particular class of machines they have in stock. Although the number of machine tools of this type is not large, compared with the numerous obsolete and generally useless special machines sold from government stock, the number is sufficient to make itself felt in the present strong competition. The inquiries reported from nearly all the machine tool areas point undeniably to a wide need for new equipment, and a small general trade improvement will probably prove a sufficient stimulus to induce would-be purchasers to buy on a much heavier scale. The inquiries are not confined to the home market; India is prominent, and South Africa, after a period of quietness, is beginning to show an interest in new machines.

There is a fair proportion of work in the shops on behalf of Colonial railways, but new orders for this class of machine tools are not now so easily obtained as was the case a few months ago. A good demand, however, is expected from South America, where the prices to which American machine tools have recently been advanced is a factor that favors the British machine tool builder, who has to some extent reached stabilization in labor costs. In Victoria and New South Wales, great promise is held for British machine tools, and these districts are generally thought to be on the eve of a trade boom. The Commonwealth government imposes high import duties to protect its own industries, and although machine tools are not yet made to any extent in that country, their manufacture will no doubt be taken up as the demand increases.

The Iron and Steel Industry

The iron and steel industries are not making the progress that was expected, and both home and export demand has dwindled. There are, however, very small stocks in most markets and any general improvement will be reflected at once. Although for the month of May the export figures in the iron and steel industries were an improvement on anything since pre-war times, the average for the first six months of the year is not good, and the June exports showed a considerable falling off from those of May. The uncertainty of the results that are to be reached in the Ruhr no doubt has a strong effect on the iron and steel field, and until some tangible settlement has been arrived at, commercial confidence cannot be expected. Continental makers are offering cheap iron and steel in British markets, and several small buyers are now filling their wants from Belgian blast furnaces and steel mills.

Midland foundries are fairly well employed in both iron and malleable castings, but moderate stocks of raw materials were purchased by these manufacturers before the general rise in prices, and this activity has not yet been felt in the pig iron market. In the Sheffield open-hearth steel branches, a rapid tapering off of new business is shown. This section of the steel industry has had a very good business during the last six months, but the general opinion on the situation is that prices will have to recede again to the low level ruling some months ago, in order to revive the interest of buyers and insure the placing of long-time contracts. The crucible and other steel trades continue to be depressed by the further offer of large government surplus stocks at very low figures. In the light manufacturing industries, the position is much brighter; stampers and press workers in the Midland district are fairly well employed, and a few firms in the industry are working over-time.

Railways and Shipbuilding

In Sheffield, railway axles, springs, tires, and wheels are in great demand for Australia, Egypt, India and South America, and there is a fair production of these articles for home railways. One Birmingham firm has obtained an order for 500 cars for the Indian railways and a further order of 100 cars for South Africa. Although not large, it is expected that these orders will prove the forerunners of much heavier business, as these countries have many new lines under construction and rolling stock will be needed in proportion.

On the Clyde, shipbuilding is in a decidedly unprosperous state, and this has a serious reflex effect on the many allied trades in the Glasgow area. The boilermakers' strike is having an adverse effect, and there are reports on all hands of the suspension of shipbuilding orders. How work in the yards is being affected by the lock-out may be seen from the May statistics of tonnage launched. The Clyde total consisted of ten vessels of only 17,210 tons, which was much lower than that of any previous month this year, and the lowest for April since 1908. There are no new prospects of an agreement over the boilermakers' trouble, but the men are to reballot on the question. It is not generally expected that shipbuilding can revive before the fall.

The General Engineering Industries

Depression hangs over the gas and oil engine industry, and the absence of orders from Russia and the Near East is seriously felt.

The activity in the automobile industry continues, the interest in light cars being unabated. One well-known maker of the latter class, although producing a record weekly output, disposes of his product to waiting buyers. The present year has restored a considerable amount of confidence in the industry. There is already a substantial and steady inquiry for next year's output, and big-scale developments in production are promised.

Makers of motorcycle engines are very busy, and the export trade is active in this branch of the industry; Australia, in particular, is buying freely, while Japan is buying on an increasing scale. Exports to the latter country are expected to increase rapidly when present Japanese plans for motorcycle building from imported parts have been completed. In the small tool industry, there is very little change. Most works are well employed.

HOLDERS FOR SQUARE TOOL BITS

By MARTIN H. BALL

Single-piece forged tools are used in some instances only because it is believed that tool bits held in a standard type of holder would not be rigid enough. One of the advantages gained by using tool bits is that the heat-treatment given the bits by the maker generally results in better and more uniform tools than the varied heat-treatment given tools made from bar stock by the user. No claim is made that the rigidity of a tool bit held in the holders here illustrated and described is as great as that of a single-piece tool. However, it is believed that tool bits held in the holders here shown have much greater rigidity than those held in some types of holders now in common use.

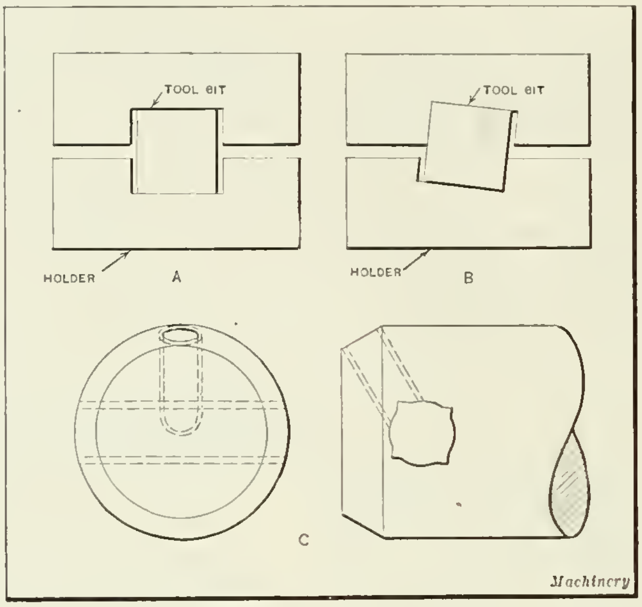


Fig. 1. Holders for Square Tool Bits

At *A*, Fig. 1, is shown a tool bit held in a horizontal position with the holding pressure applied in a vertical direction. In this case the tool bit is seated in the groove with a clearance at each side. The side pressure exerted by the work on the bit will have a tendency to make the tool spring away from the work. This usually causes the tool bit to change its position in the holder until it has a bearing on the sides of the groove.

Although the difference between the width of the channel or groove in the holder and the width of the tool bit is purposely exaggerated in the view at *A*, there is necessarily some clearance in practically all equipment of this kind. When the holding pressure is applied by a set-screw which bears directly on the top of the tool bit, the latter will have a tendency to pivot at the point where the set-screw bears upon it until its sides are in contact with the sides of the groove. Under a light side pressure, such as results in taking a very fine cut, the tool bit will sometimes spring back and forth, thus producing chatter marks.

The conditions referred to in the preceding paragraph can be much improved by carefully setting the tool bit against the sides of the groove, preparatory to taking a cut. However, most operators cannot be depended upon to take such precautions. With the equipment here shown, the proper setting of the tool is automatically provided for by designing the holder so that the tool is clamped in place as shown at *B*. This principle is embodied in the planer tool shown in Fig. 2, and also in the boring-bar shown at *C*, Fig. 1, where the set-screw bears on the corner of the tool bit and forces it against the lower corner of the slot that is opposite the cutting side.

The end of the boring-bar shown in Fig. 1 is chamfered to facilitate drilling and tapping the set-screw hole. The accompanying table gives the drill and broach sizes that may be used in producing the holes in which square tool bits are to be held. Holes produced in accordance with this table afford bearing surfaces having a total area equivalent to about 50 per cent of the entire area of the hole. The bearing surfaces thus provided will not permit the tool bit to rock, even though its sides are slightly convex, as is often the case.

The planer tool when assembled as shown in Fig. 2, can be fed from the operator's side of the table. By reversing the position of the top and bottom washers *A* and *B*, the tool can be fed in the opposite direction. By swiveling the turret-head of the holder 60 degrees to one side, so that the tool will be in the position shown at *C*, and setting the

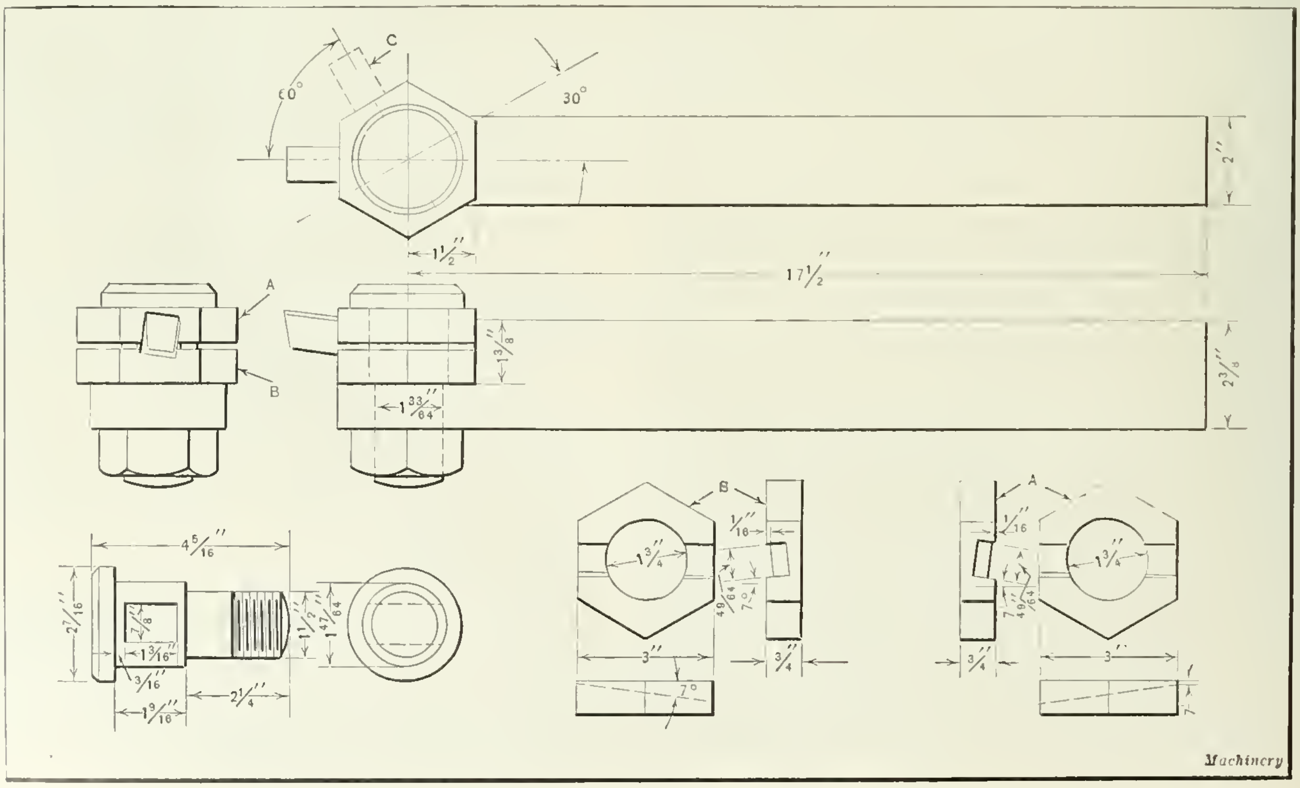


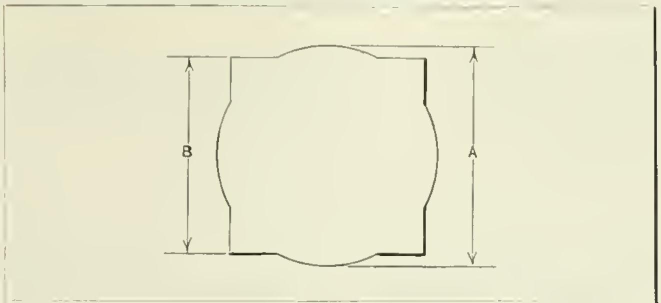
Fig. 2. Details and Assembly View of Square Tool Bit Holder for Use on Planer

clapper-box of the planer at an angle of 30 degrees, the tool bit will be in the proper position for a down feed, such as is obtainable with the regular cross-rail head.

When tool bits are held in the manner described, they are ground for side rake only This leaves the tool bit somewhat stronger than if it were ground down on two or more sides. For machining materials that require a tool with a negative top rake, the extreme edges of the tool bit may be flattened slightly like the lips of a twist drill that is to be used for drilling brass.

* * *

DRILL AND BROACH SIZES FOR SQUARE TOOL BIT HOLES



B Size of Broach, Inches	A Size of Drill, Inches	B Size of Broach, Inches	A Size of Drill, Inches
1	1 1/8	7/16	31/64
7/8	63/64	3/8	27/64
3/4	27/32	5/16	11/32
5/8	45/64	1/4	9/32
1/2	9/16	.....	.....

Machinery

FIXTURE AND CUTTER EQUIPMENT FOR MILLING A SPECIAL SLIDE

By S. A. McDONALD

There is a tendency on the part of many jig and fixture designers to overlook the ordinary milling machine vise in considering a method of holding a piece of work that is to be machined. As a result, jigs and fixtures of elaborate designs are often developed for work that could readily be held in the vise. This makes the cost of the tool equipment unnecessarily high. In designing the fixtures shown in the accompanying illustration, for machining the special slide *A*, an effort was made to combine quick-acting features with simple construction.

The slide, as originally designed, did not have the relief cut in the base, but at the tool designer's request, this refinement was added, as it did not affect the functioning of the slide and was of considerable assistance in providing a suitable means of locating the work in the second milling operation. All burrs or lumps were removed from the castings by hand-grinding previous to the machining operations. The first operation on the slides, that of machining the bottom surfaces *b*, proved to be one of those jobs for which the milling machine vise could be used with as good results as could have been obtained with any type of special fixture. The work was set up as shown at *B*, and milled by a set of plain milling cutters *c*.

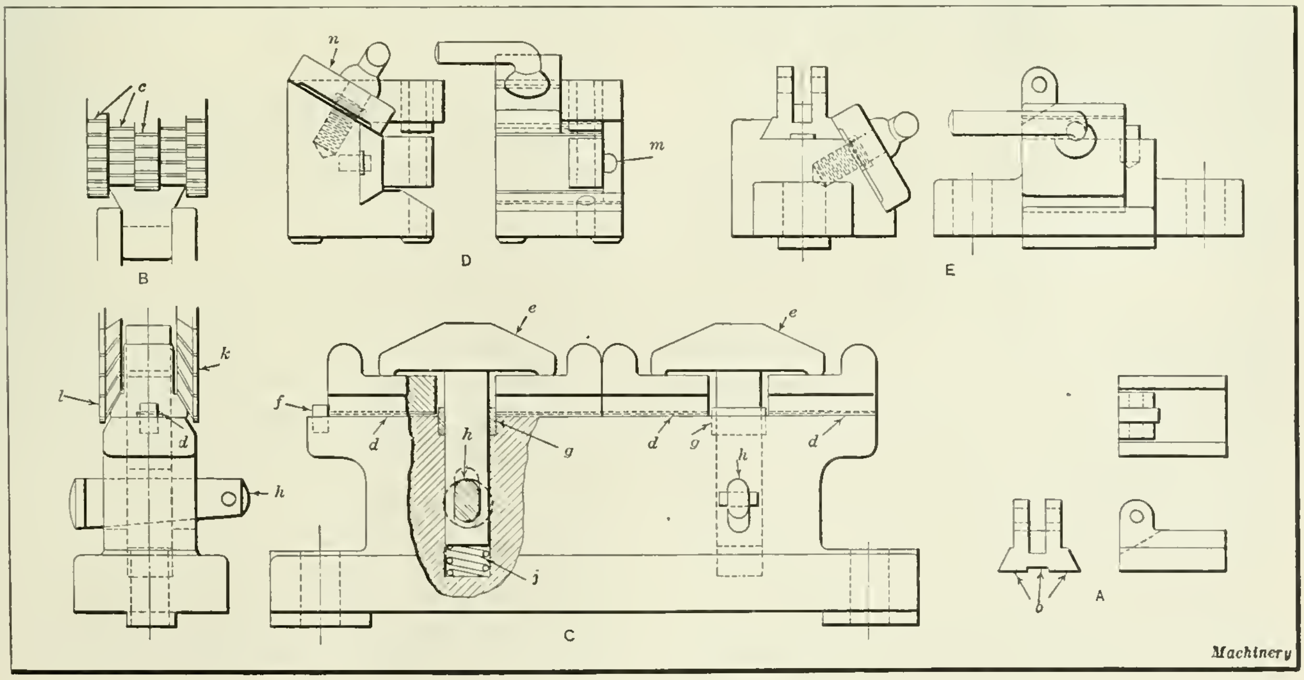
The fixture used for the second milling operation was designed to hold four pieces of work. The slides in this case were located on the fixture as shown in the view at *C*. Keys *d*, machined on the top of the fixture, serve to locate or align the work properly. The clamping bolts *e*, each hold two slides, while the pin *f* and the collars *g* take the thrust imparted to the work by the milling cutters. The wedges *h* are tightened or loosened by the tap of a hammer. The clamping bolts are nominally held up by springs *j* to facilitate loading or unloading the fixture. Right- and left-hand 60-degree milling cutters *k* and *l* are used to mill the sides of the slides.

The drill jig used for drilling the hole in the lugs is shown at *D*. The body of this jig was made from a block of cast iron, so that no pattern was necessary. The work is located by one side of the dovetail and a pin *m*. The clamp *n* is provided with a coil spring, which leaves it clear of the work when the latter is released. A quarter turn of the clamping bolt is all that is necessary to lock the work in place.

The fourth and last operation, that of milling the slots in the lug, is performed with the work held in the fixture shown at *E*. A slotting cutter is used for this operation, and a stop on the milling machine regulates the depth of the cut.

* * *

Cast-iron pipe that is centrifugally cast must be heat-treated, because the molten metal is chilled to some extent when it is thrown against the rapidly revolving water-cooled metal mold, and when the pipes are removed from the pipe-casting machine, they are brittle on the surface. Pipe cast in sand mold does not need this heat-treatment.



Equipment used in machining the Slide shown at A

The Machine-building Industries

GENERAL business conditions throughout the country remain normal, although it appears that the peak of the slight boom experienced in many industrial fields has been passed. In the machine tool industry there has been a slight decrease in demand, and the average percentage of unfilled orders is now higher than the percentage of new orders. Some manufacturers think that this is merely an indication of the usual falling off of business during the summer months; others believe that the peak apparently reached by other industries early in the spring was also reached by the machine tool industry at the same time, and that business in the fall will remain at about the present level.

One of the machine tool builders who is in close touch with the automobile industry states that there is a considerable amount of planning being done in this field, with a view to improving manufacturing methods for next year's production. "It is a well-known fact," says this manufacturer, "that a great deal of the equipment now being used in automobile plants is practically worn out, and will have to be replaced; and it is likely that there will be a fair demand for special machinery and for machines that will insure greater production." In spite of the great output of the automobile shops this year, competition has been very keen, and the manufacturers realize that low prices for cars, coupled with quality and reliability, are the prime requisites for continued good business.

The textile machinery manufacturers, as well as the electrical concerns, are well occupied, and a considerable amount of machine tool business has come from these industries. Although the general industrial demand fell off in June and early July, those machine tool builders that supplied the railroad trade have experienced a fairly active demand. Some orders of considerable proportions have either been placed, or are likely to be placed in the near future, by some of the larger railroads, especially in the West.

The foreign trade in machine tools is slowly improving, although it is very small, as compared with three and four years ago. The total exports of machine tools now amount to nearly $400,000 a month, while small tools are exported at the rate of about $250,000 a month, and other metal-working machinery at the rate of about $400,000 a month. In July, 1920, the machine tool exports were valued at about $1,850,000 and the exports of all other metal-working machinery at $1,823,000.

The small tool business continues at a normal rate, with a satisfactory volume of orders. Quick deliveries are generally required, indicating that the tools are going into direct use as fast as they are delivered and that buyers have no stocks of tools on hand.

The Automobile Industry

The automobile production during June did not fall greatly below the record set during May; it was the greatest production for the month of June that has ever been recorded. The figures for July will show the usual seasonal decline, but the industry is in a good position financially, and as there are no large supplies of surplus material on hand, and practically no stock of finished cars, the stronger companies, at least, look forward to the fall months with confidence.

The output of automobiles during the first six months of the year slightly exceeded 2,000,000 cars, of which 1,800,000 were passenger cars and somewhat over 200,000, trucks. The June production of passenger cars was 331,000, as compared with 350,000 in May, and 344,000 in April. The largest production of trucks during the year was in June—a total of 44,000—exceeding the May production by about 1000. The Ford company alone produced about 171,000 cars and trucks in June, and built 1,428,000 during the first six months of 1923. A new high production record for the Ford plants was made on June 30, when 6884 cars and trucks were completed. The Willys-Overland Co. has turned out its millionth car. The automobiles that have formerly passed the million mark are Ford, Buick, and Chevrolet.

Generally speaking, practically all plants have somewhat reduced their schedules, as compared with their peak production. Steel products for automobile parts are easier to obtain, and parts manufacturers have reduced their output to meet the lighter demand during the fall months. While there has been a falling off in the passenger car business, there has been an increased business in trucks. One of the largest concerns in the field states that sales are in excess of production, and the one difficulty is to fill orders on time. The sales of Pierce-Arrow trucks during the first five months of this year have been more than double those for the same period in 1922. The railroads are becoming an important factor in truck demand, as some of the roads are buying trucks for terminal work to be used in place of shuttle trains. There is a healthy demand for the smaller sizes of tractors, and the two largest producers are setting new records for production.

The Iron and Steel Industry

A slight decline has taken place in the unprecedented production of the iron and steel industry. The pig iron production in June was about 6 per cent less than in the record month of May. The production of steel in the early part of July showed little change, with the industry in general working at about 89 per cent capacity and the U. S. Steel Corporation continuing at 92 per cent. There is a sufficient stock of iron and steel for the country's needs, and recent price reductions indicate that more iron and steel has been produced than the country has actually consumed. While the industry absorbed the large output during the spring months as soon as it was produced, all of this material has not been used up yet in the shops of the buyers, and at present, shipments are considerably in excess of the new business booked.

On the other hand, the demand for iron and steel is more diversified, and the decline in prices has had the effect of inviting business that would otherwise have hesitated. The railroad buying of steel rails is keeping up, but the slump in the building industry is reducing the demand for structural steel. Buyers of pig iron are cautious, as some of them expect still lower prices.

The main facts in this basic industry are that buying is more conservative, that prices tend downward, and that new orders are less than shipments, which will bring about a more normal situation, permit earlier deliveries, and check the tendency toward high premiums paid for quick deliveries. A very favorable sign in the present situation is that there have been practically no requests for cancellations or for deferred deliveries, which indicates that buying has been done on a conservative scale and the material is actually needed in present production.

The Federal Reserve Bank, in summarizing its reports on the general industrial situation, finds that there is an evident determination on the part of business to watch for the earmarks of unhealthy expansion, and a preference for a normal level of activity. Business, therefore, is now moving forward carefully, watching the road ahead.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Hall Planetary Thread Milling Machine

A THREAD milling machine in which the work is held entirely stationary for cutting both external and internal straight or taper threads is built by the Hall Planetary Thread Milling Machine Co., Inc., Bridesburg, Philadelphia, Pa. The distinguishing feature of this machine is that while the milling cutter revolves on its own axis, it also travels in an orbit relative to the work. In cutting external threads, the cutter completely surrounds the work, as shown diagrammatically at *A*, Fig. 2, and in cutting internal threads, the cutter revolves within the work, as shown at *B*. This planetary feature is said to considerably reduce the time necessary for reloading the work. Cutters without lead are employed, lead being given to the thread by feeding the cutter longitudinally along the work while the cutter is revolving around it.

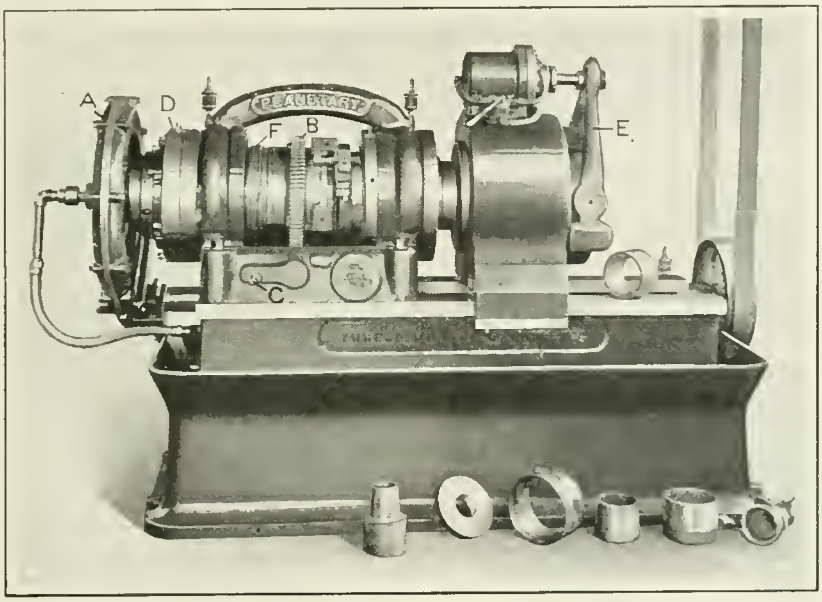


Fig. 1. Hall Planetary Thread Milling Machine in which the Work is entirely Stationary

This machine is intended for quantity production use, and is especially adapted for producing threads on a number of automobile parts, such as rear differential housings, and nuts, couplings, nipples, etc. Although a single-head machine is shown in Fig. 1, a double-head style is also built for cutting threads simultaneously on opposite ends of parts. . The various types are built in several sizes, and may be automatic or semi-automatic in operation. There is also a portable style. The particular machine illustrated in Fig. 1 has a capacity for work ranging from ¾ to 18 inches in diameter.

The machine consists primarily of three units—the bed, head, and chuck, and each of these is generously proportioned so as to hold the cutter firmly against the work during the operation and permit high cutting speeds. Threads can be milled within plus or minus limits of 0.001 inch, and the portion to be milled need not be machined to the exact diameter, but only roughly, leaving a small amount of metal to be finished smoothly by the thread milling cutter. Power is delivered to the machine through the single pulley at the right-hand end, which may be driven from a countershaft lineshaft, or a motor on a base at the rear of the bed. For motor drive, a motor of 5 horsepower is recommended. The pulley shaft runs the length of the bed, and at the head end carries a sprocket which, through a silent chain, drives a large sprocket in casing *A*. The large sprocket is keyed to the cutter-spindle, which is hollow. The spindle speed is such as to give an average cutter speed of 100 feet per minute.

Planetary rotation of the cutter-spindle relative to the axis of the work is accomplished by means of two hollow eccentric containers or sleeves, one within the other. The spindle is journaled in bearings in the inner one. When work is being reloaded, the cutter-spindle simply revolves on its own axis, which is in line with that of the work, and the containers remain stationary, but in cutting the thread, the two containers are revolved as one unit to give the planetary movement to the cutter. The diameter of the orbit about which the work revolves, which controls the depth of the cut, depends upon the distance between the axes of the two containers, which is readily adjustable. The bearings of the head in which the outer container revolves are of a collet type, and are conveniently adjustable to compensate for wear.

The complete thread is cut in the work in one and a fraction revolutions of the containers, which are driven through the bronze worm-wheel *B*, mounted on the outer container. At the beginning of the worm-wheel rotation the cutter is fed to depth, and it moves around the work for an entire revolution to complete the thread, at which time the drive to the containers is reversed, to return them to their original positions. The forward and reverse rotation of the containers is controlled by means of stops.

Worm-gear *B* is driven by a worm which receives power from reduction gearing contained in an enclosed gear-case at the rear of the machine, which is kept filled with oil. The drive is transmitted to this reduction gearing from the pulley shaft by a pair of spiral gears. Power is delivered to the containers when knob *C* is pulled forward to operate a clutch. The containers then rotate in one direction until the thread has been completed, at which time the clutch is automatically tripped and a second clutch is engaged to drive them in the reverse direction, as previously mentioned. When the containers have been returned to the starting position, the second clutch is also disengaged automatically. The reverse rotation is accomplished at about ten times the forward speed. A brake is provided for the containers at *F*.

The containers and hollow spindle are fed longitudinally during a threading operation by means of a threaded master ring mounted on the outer container, which engages master nuts attached to the head at *D*. The master ring and nuts are necessarily different for each different thread lead,

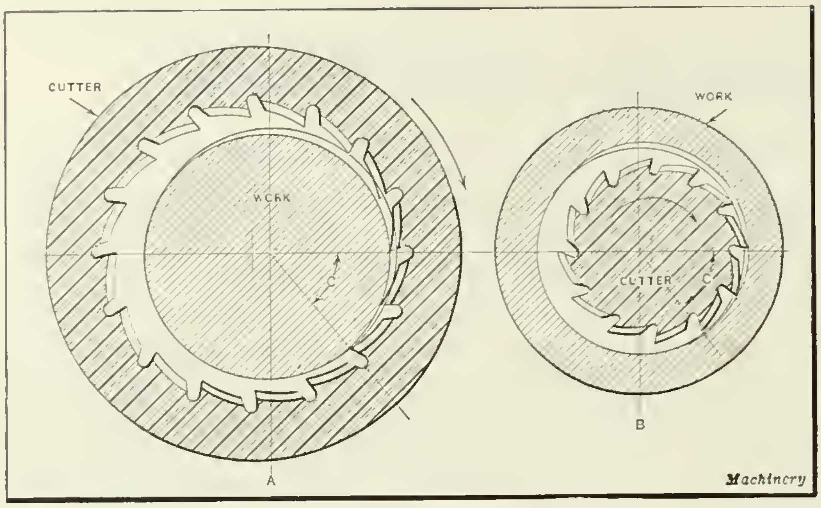


Fig. 2. Diagrams which show Relation of Both External and Internal Cutters to Work

but as the machine is intended for production work, changing of the ring and nuts would seldom be required. The cutting of taper threads is made possible by means of a device which causes the cutter to be fed radially the necessary amount during its planetary rotation around the work. Lubricant is supplied to the cutter through the hollow spindle from a pump in the base, which can deliver up to 40 gallons of lubricant per minute. The pump is driven direct from the driving shaft, and delivers the lubricant to the left-hand end of the spindle through a pipe. The base of the machine serves as a reservoir for the lubricant.

For firmly holding the work during threading operations, there has been provided an amply proportioned pneumatic chuck which weighs 3000 pounds, and has a gripping power of approximately 30,000 pounds, with an air pressure of 100 pounds per square inch. The chuck is of the push-in collet type, the split sections being brought in contact with the work at a uniform pressure when air is supplied to the cylinder to swing yoke *E* and force the collet-controlling member forward. The chuck shown in the illustration is used for holding oil-well tool joints. Chucks of different designs are used for other classes of work. After the chuck has been positioned for a given job, it is bolted to the bed and not disturbed until the class of work is changed. Thus neither the head nor the chuck has a longitudinal movement during an operation, and the work does not rotate.

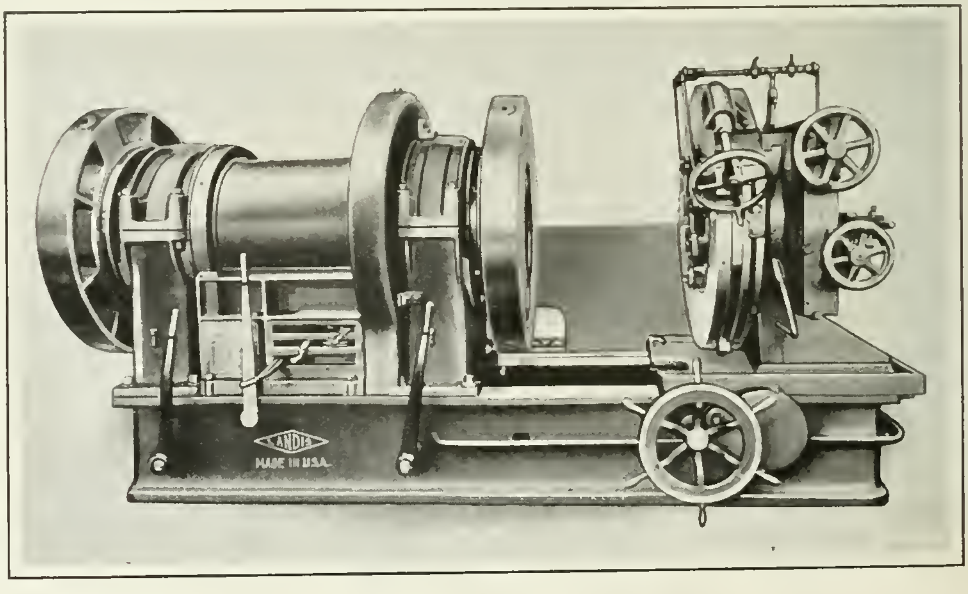
Cutters for producing external threads are about 20 per cent larger in diameter than the work, and are equipped with chaser blades so that they resemble a die-head. Instead of the cutting edges of both the external and the internal cutters being ground radially, they are given a generous rake. The planetary rotation of the cutters results in an unusually large sweep of the cutting edges, as indicated by angle *C* in Fig. 2. There are always two or more edges in contact with the work at the same time. Where a cutting edge begins contacting with the work, a finishing cut is taken, and where it leave it, a roughing cut is taken, the result being that a fine smooth finish is obtained on the threads. Ring-oiled bearings are provided throughout the machine, and all gears are made of steel or bronze. The weight of the machine illustrated is approximately 13,000 pounds.

LANDIS PIPE THREADING AND CUTTING MACHINE

A machine that handles pipe from 8 to 18 inches in size has been added to the line of pipe threading and cutting machines built by the Landis Machine Co., Waynesboro, Pa. In many respects this machine is similar to the 12-inch size described in March, 1922, MACHINERY. The entire range of the machine is covered by one die-head and one set of chasers. It has a single-pulley drive, eight variations in speed being obtained by means of a speed-box located beneath the main spindle. When driven by motor, a chain sprocket is substituted for the driving pulley, and the motor is mounted on a base placed over the gear-box. A friction clutch is mounted on the main driving shaft with the pulley for controlling the operation of the machine. The operating cone of the clutch is moved by either of two levers which are located at the ends of the headstock within easy reach of the operator. The forward lever is used for starting and stopping the machine when threading pipe, and the lever at the rear for starting and stopping when machining flanges. The lever at the middle of the headstock is manipulated for reversing the operation of the machine.

All gears are fully enclosed, and with the exception of the main driving gear and its pinion, run in an oil bath. The main bearings of the hollow spindle are lubricated by means of flat-link chains which carry oil from large reservoirs in the base. The driving pinion shaft and the reverse shafts are lubricated by sight-feed oilers. At each end of the hollow spindle there is a three-jaw independent chuck for holding the pipe during the operation. The rear chuck is equipped with grips for holding flanges.

The carriage that supports the die-head and the cutting-off and reaming tools is moved either by power or by hand. The power movement is both forward and backward, and is controlled by a lever located on the operating side of the carriage. In advancing the carriage toward the right-hand chuck, the lever is pulled and held until the threading position of the die is reached. Automatic stops prevent the die-head from coming in contact with the chuck in the forward movement, and prevent the carriage from running off the guides of the bed in the backward movement. The reaming tool is quickly set in position and locked by means of a



Landis Pipe Threading and Cutting Machine lever. This machine employs the Landis "long-life tangential chaser." The length of the machine is 12 feet 2 inches, and its height is 6 feet. The extreme width of the belt-driven machine over the belt pulley is 5 feet 10 inches, and of the motor-driven machine over the motor plate, 6 feet 8 inches. It weighs about 22,000 pounds.

CRESCENT METAL PARTS WASHING MACHINES

Two improved automatic machines of the type illustrated in Fig. 1 for washing metal parts are being introduced to the trade by the Crescent Washing Machine Co., 83 Second Ave., New Rochelle, N. Y. These machines are the same in all respects except size, the model 1A receiving parts up to 18 inches wide by 14 inches high, and the model 2A, parts up to 26 inches wide by 14 inches high. Smaller pieces are placed on the conveyor in racks. The model 1A is a high-speed machine particularly fitted for installation in small metal-cleaning departments at the end of a line of automatic screw machines or in other locations where floor space is limited. The model 2A is best suited to meet the needs of the average metal-parts cleaning department.

The main improvements in these machines as compared with the older types built by this company, are that the wash tank has been increased in size to give added capacity for the cleaning solution, and that cleaning-out doors are now furnished so as to make it an easy matter to clean both the upper and the lower part of the machine. The motor and pump are both mounted on the outside where they are readily accessible. The conveyor unit has also been simplified by using a completely enclosed set of gear-reducers instead of the original system of chain reducers. By making minor changes in the shape of the wash arms and in their location, the machine has been made faster and more thorough in operation. The weight of the model 1A equipment is approximately 2250 pounds, and the model 2A machine weighs 2550 pounds.

Composite type machines are also built in various lengths for a number of purposes. One of these machines in use in an automobile plant for cleaning fenders prior to enameling is illustrated in Fig. 2. This is considered a particularly difficult job, because the fender surfaces must be thoroughly clean if the enamel is to hold without pitting or stripping. The fenders are placed on the conveyor at one end and carried through the machine at a speed of about 20 feet per minute. They are washed, rinsed, and delivered at the opposite end. In addition to washing and rinsing the parts, these machines may also be used for drying, lacquering, and slushing.

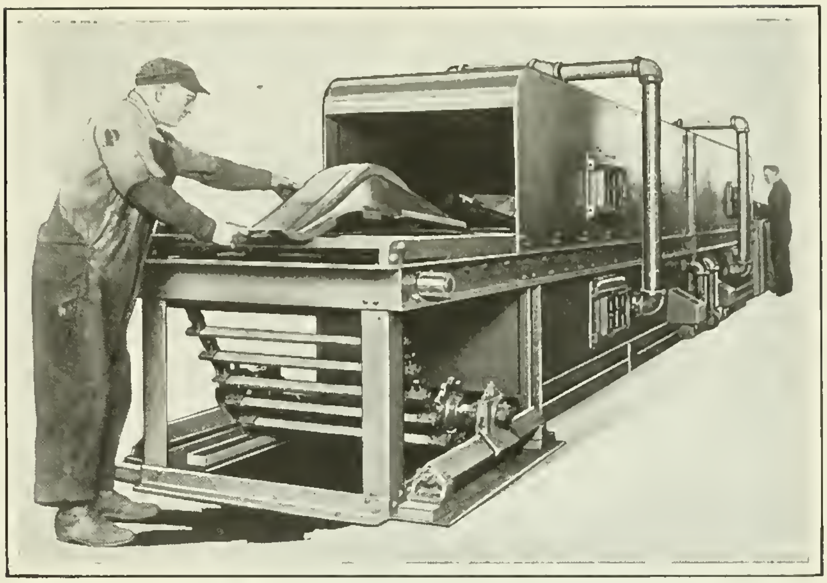


Fig. 2. Composite-type Machine used to clean Automobile Fenders

PEERLESS UNIVERSAL SHAPING SAW

A 13- by 13-inch universal shaping saw similar in construction to the smaller machine described in March, 1922, MACHINERY is being placed on the market by the Peerless Machine Co., 1611 Racine St., Racine, Wis. The new machine embodies several features that the smaller machine did not have. The frame accommodates blades from 14 to 21 inches long, and as before, the blade-clamping apparatus is designed to permit a 10,000-pound tension in the blade. In addition to provision for holding the blade rigid and straight under this tension, a thrust plate has been added above the blade to take the upward thrust, and hold the blade tooth points in a straight line so that all the teeth will do the same amount of work. The thrust plate is 4 inches wide and 0.048 inch thick which corresponds closely to the thickness of No. 18 gage saw blade stock. The plate is made of blade steel, and is also placed under tension by the use of two clamping straps. Two set-screws permit fine vertical adjustments to bring the plate to the blade for careful alignment.

Another improvement intended to cut down the handling time is a dual-control feed mechanism. In engaging the feed, the operator uses his right hand to manipulate a lever on the right-hand side of the machine, and with his left hand, lowers the blade and frame to the approximate cutting position just prior to engaging the feed. The left-hand side of the machine is also equipped with a feed-lever, so that the machine can be started from either side. The belt-shifting mechanism is connected to the starting lever on the left-hand side, so that in one motion the belt is shifted on the tight pulley to put the saw frame in motion and also engage the feed. This arrangement is said to considerably reduce the time taken in resetting stock for a new cut, and also saves time

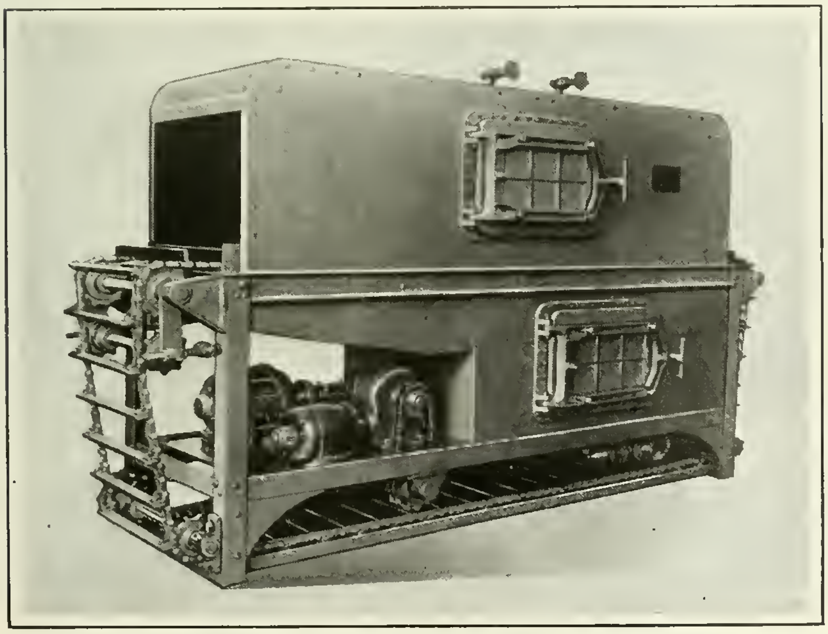
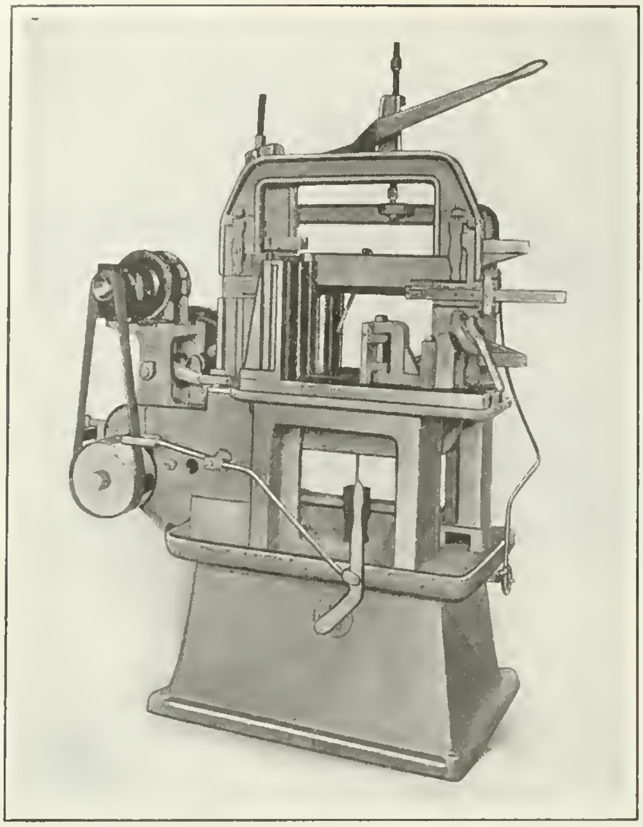


Fig. 1. Crescent Automatic Washing Machine for Metal Parts



Peerless Universal Shaping Saw of Larger Size and Improved Design

when the operator stops the machine to see how near a line the cut is going to be.

A rod for automatically stopping the saw at the completion of a cut or at a predetermined depth of cut is part of the saw-frame mechanism, and depth and height gages are also provided. The height gage is brought down after a cut just sufficiently to permit the blade to clear the work. The releasing of the feed, the upward return of the saw frame, the stopping of the frame, and the preliminary approach to the new cut are all automatically controlled. Special fixtures can be provided for holding forgings in sawing the ends to length, and for similar work. Stroke speeds of 125, 80, and 45 per minute are obtainable. The saw frame, which is located on the right-hand side of the arch in the 6-inch machine, is located on the left-hand side of the new machine. This design brings the reciprocating member inside the machine for safety, and makes the work more readily accessible. Long structural steel beams and pipes can be clamped at an angle without interference from the arch. The weight of this machine is about 2200 pounds.

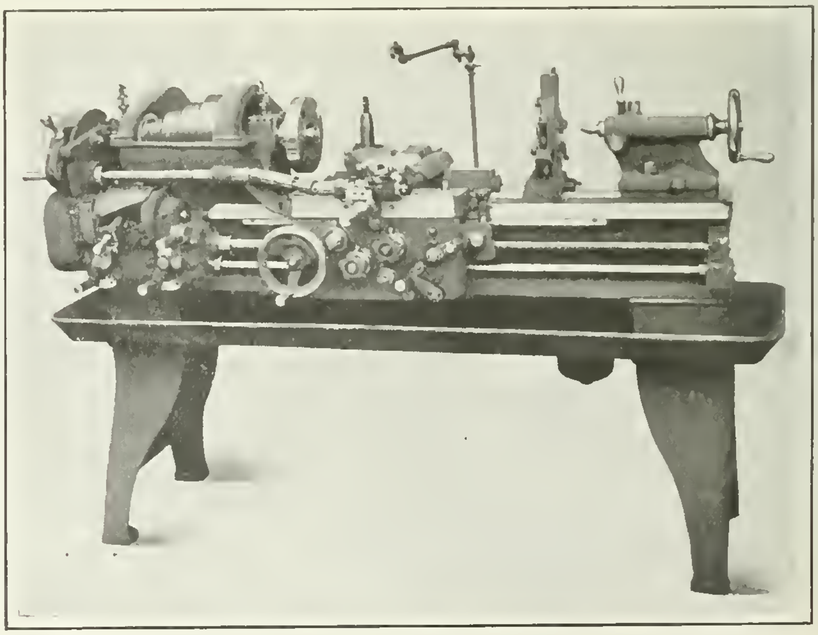
AMERICAN TOOL-ROOM LATHE

A tool-room lathe built by the American Tool Works Co., Cincinnati, Ohio, in six sizes, from 12- to 24-inch swing, inclusive, is shown in the accompanying illustration. Except for the taper, relieving, and draw-in attachments, this machine is of the same construction as the lathe described in June Machinery. Up to and including the 18-inch size, the machine is regularly equipped with a single back-geared head having a four-step cone, while on the larger sizes a double back-geared head provided with a three-step cone is furnished. In addition, the following heads can be supplied: A three-step cone friction double back-geared head; a twelve-speed geared head with single-pulley drive; a twelve-speed geared head arranged for either a geared or belted constant-speed motor drive; and a four-speed geared head for either a geared or belted variable-speed motor drive.

The taper attachment can be changed to suit taper or straight work by simply loosening one bolt and tightening another. There is a rigid connection between the tool-rest and the sliding shoe, which lessens the load on the cross-feed screw, and prevents any looseness or backlash in the screw, nut, or journal from being transmitted to the work. The use of a dovetail type of taper bar and a sliding shoe equipped with a taper gib adjustment also obviates inaccuracy due to looseness, and prevents lifting tendency under heavy cuts.

The relieving attachment is built in two types—plain and universal. The plain attachment is designed for external and internal cylindrical work only, while the universal attachment is intended for relieving or backing off the flutes of rotary cutters, taps, reamers, end-mills, hollow mills, dies, etc. End and internal relieving can also be performed. The change-gear mechanism of the attachment is supported by a bracket located at the front of the headstock, on top of the quick-change gear-box. A small quadrant carries the change-gears, and this is used to disengage the drive when the attachment is not required. Power is taken from a spur gear located on the spindle, and is transmitted through the change-gear mechanism to the driving shaft of the attachment, which is journaled in the supporting bracket on the gear-box and in a bracket fastened to the left-hand side of the carriage. Between the latter bracket and the tool-rest are located knuckle joints which permit cross movements of the tool-slide.

The driving shaft revolves in one direction until the spindle rotation is reversed, at which time the driving shaft ceases to reciprocate the tool-slide. With this arrangement, the tool-slide remains stationary when the direction of the carriage travel is reversed, and the tool can be withdrawn from the work and run back for a new cut, as is the practice in tap and hob making, without any waste motion of the parts and with safety to the cams. There is a clutch connection between the cam and the drive which is operative in only one direction, and therefore a reversal of the driving shaft causes the clutch, which is held in engagement by means of a spring, to be withdrawn from the cam. The result is that the cam remains stationary and imparts no motion to the tool-slide. In order to obtain the entire range



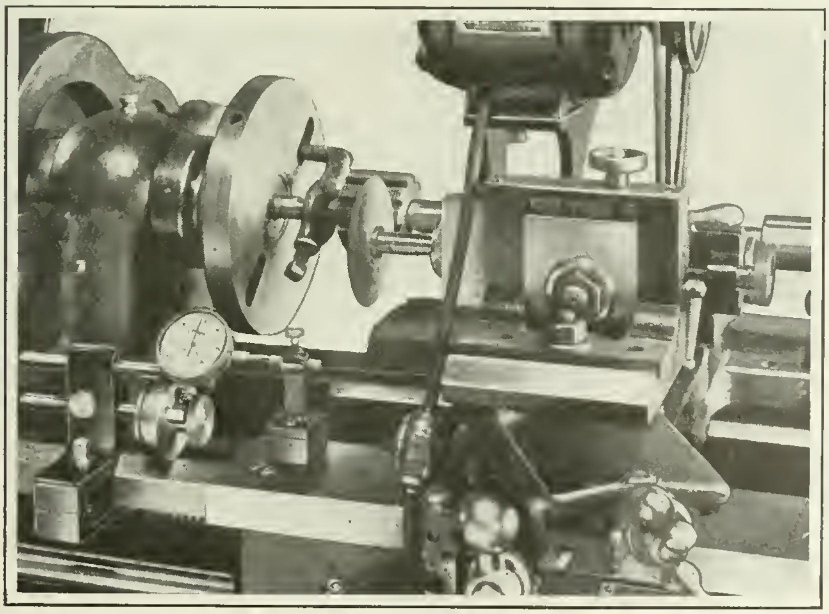
American Tool-room Lathe which is built in Six Sizes from 12- to 24-inch Swing, Inclusive shown on the index-plate, three cams of one, two, and four lobes, respectively, are provided, in addition to the change-gears. This attachment permits of operating the tool-slide every 30 degrees, and thus provides twelve operating positions within a circle.

The plain relieving attachment consists primarily of a top and bottom slide and an intermediate nut lock controlled by a cam on the driving shaft. The draw-in attachment consists of a long, hollow steel bar, a hardened and ground steel taper bushing, and collets for holding different diameters of work. Collets are furnished for stock up to ⅞ inch in diameter on the small sizes, and up to 1 inch on the large sizes.

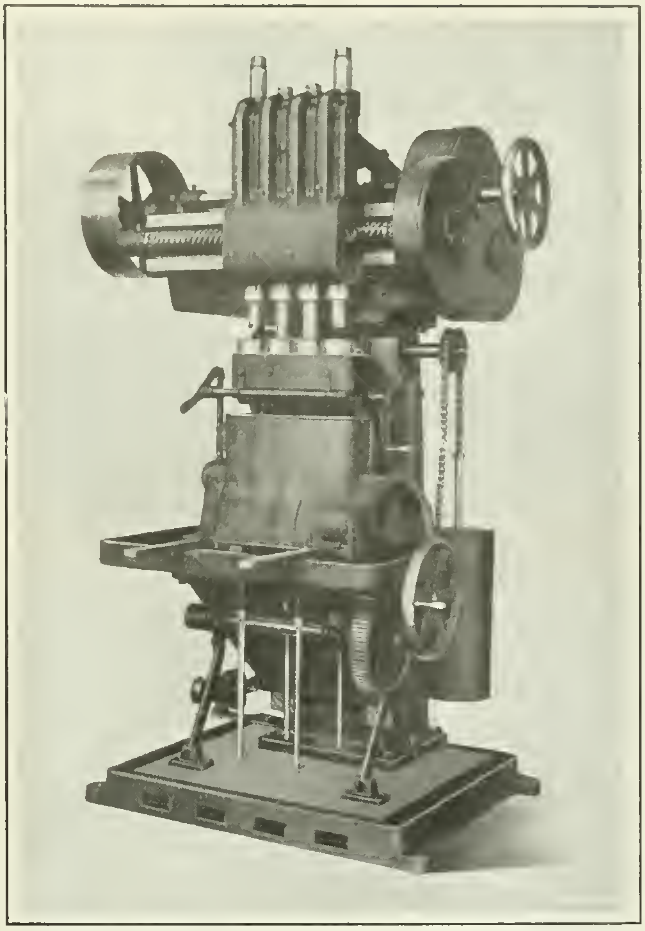
FRICK SPACING INDICATOR

A spacing indicator which is especially designed for use in grinding "no-lead" hobs, but which also facilitates boring shouldered holes by affording a means of accurately measuring the different depths, has been brought out by the Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa. The instrument consists of a cast-iron base, a clamp for attaching the base to the ways of a lathe bed, a fine-pitch screw, a micrometer dial graduated to 0.0001 inch around its periphery, an indicator dial, and a stop-pin and bracket for mounting on the lathe carriage. The micrometer dial may be used to rotate the fine-pitch screw, but by loosening the thumb-screw, the dial may be revolved freely on the screw. When the screw is revolved, the rod that supports the dial indicator is moved in or out, depending upon the direction in which the dial is turned. The accompanying illustration shows the application of this spacing indicator in connection with the multi-graduated precision grinder manufactured by this concern. The equipment is being employed for grinding "no-lead" hobs used in milling die-head chasers having eleven threads per inch, which necessitates accurate spacing from center to center on the threads of 0.0909 inch.

At the beginning of an operation on these chasers, the micrometer dial is revolved from zero until the reading is 0.0909 inch; then the lathe carriage is advanced until the stop-pin, by contacting with the plunger of the dial indicator, causes the needle of the indicator to register zero. To advance the grinding wheel another space after one thread has been ground, the micrometer dial is released on the screw, turned back until it registers zero, again locked in place on the screw, and revolved to the 0.0909-inch graduation, after which the carriage is advanced to bring the stop-pin against the dial plunger indicator as before.



Frick Spacing Indicator being used in grinding a "No-lead" Hob



Moline Multiple-spindle Automobile Cylinder Lapping Machine

MOLINE CYLINDER LAPPING MACHINE

A multiple-spindle machine designed for simultaneously lapping or honing all the bores of an automobile cylinder has recently been put on the market by the Moline Tool Co., Moline, Ill. This machine has the same general characteristics as the "Hole-hog" multiple-spindle drilling and cylinder boring machines built by this company, the principal difference being that the spindles can be reciprocated up and down as rapidly as desired while the laps are being revolved. This machine can be adapted for handling any type or size of cylinder by simply changing the center distance of the heads and the length of the stroke.

The machine is built with a stationary rail and a vertically sliding table. The crankshaft and connecting-rods that reciprocate the spindles are those provided on the automobile built by the customer. This arrangement gives nominally the same stroke as that of the automobile engine; however, a greater or lesser stroke can also be given to the spindles. The cylinder block is mounted on a fixture on the table while the latter is in a lowered position, and after loading, the entire unit is raised to the working position. In raising the table, the lap-closer block is also raised above the laps to permit the latter to enter the cylinder bores. Elevation of the table is regularly accomplished by revolving a handwheel which actuates spur gears and a rack pinion, but power elevation can be provided. The relation between the rotation and reciprocation of the spindles is controlled through slip gears.

There are two opposite opinions as to the best method of lapping, one being that rapid rotation and slow reciprocation of the laps is the preferable method, and the other that rapid reciprocation and slow rotation or even indexing is better. The design of this cylinder lapping machine is such that any desired relation between reciprocation and rotation is obtainable. The rotation of the spindles is obtained through spiral gears, in the same manner as on the standard machines, and their reciprocation is accomplished by means of a rack and pinion, bevel gears, and clutches. Any stroke or position of stroke with respect to the cylinder block may be had by setting stops to suit. When an operation is completed, the laps or hones are withdrawn automatically. The machine is furnished with a pump and piping for supplying lubricant to the work. It is arranged with a clutch pulley that can be driven from a countershaft, lineshaft, or direct from a motor.

WATERBURY-FARREL SCREW SLOTTING MACHINES

Three standard sizes of automatic machines for slotting the heads of screws up to ½ inch in diameter and 4 inches in length are built by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn. The smallest size is illustrated in Fig. 1. The blanks are fed automatically from a hopper into an inclined chute *A*, Fig. 2, from which they are delivered to a notched carrier dial *B*, which indexes automatically to transfer the screws to the slotting position. The saw is mounted in a swinging frame *C* by means of which the depth of cut can be regulated. The swinging feature is also convenient in changing the saw. In Fig. 2 the frame is shown thrown back to permit a more complete view of the carrier dial and the adjacent parts. When in the operative position, the saw is well guarded. Adjustments are provided for centralizing the saw. Motion is transmitted to the saw frame through a rod *F* which is connected to the adjustable block *G*. The saw-driving pulley has a heavy rim which serves as a balance wheel, and a buffer spring beneath the frame steadies the cut and obviates chatter. On the two smaller sizes of this machine the saw is driven by belt, and on the largest by a chain.

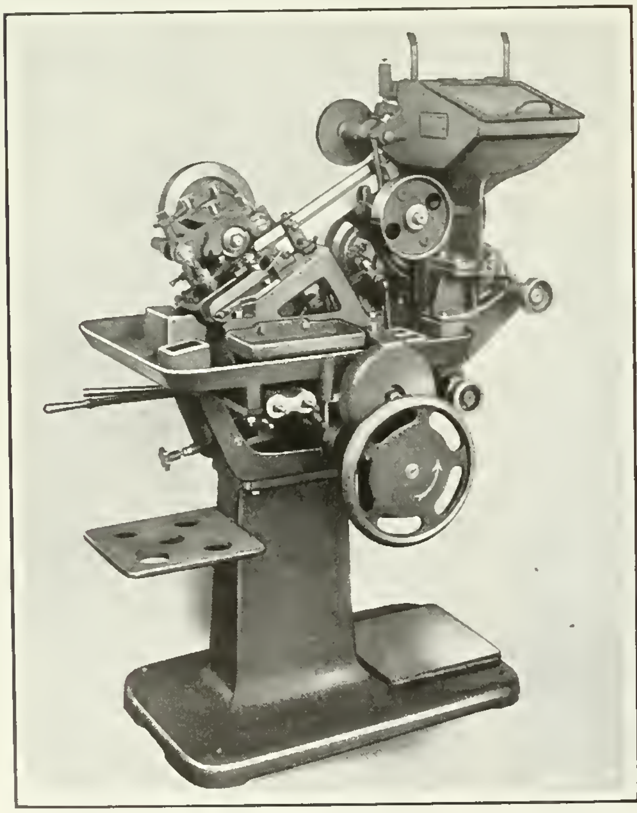


Fig. 1. One of a Line of Waterbury-Farrel Automatic Screw-slotting Machines

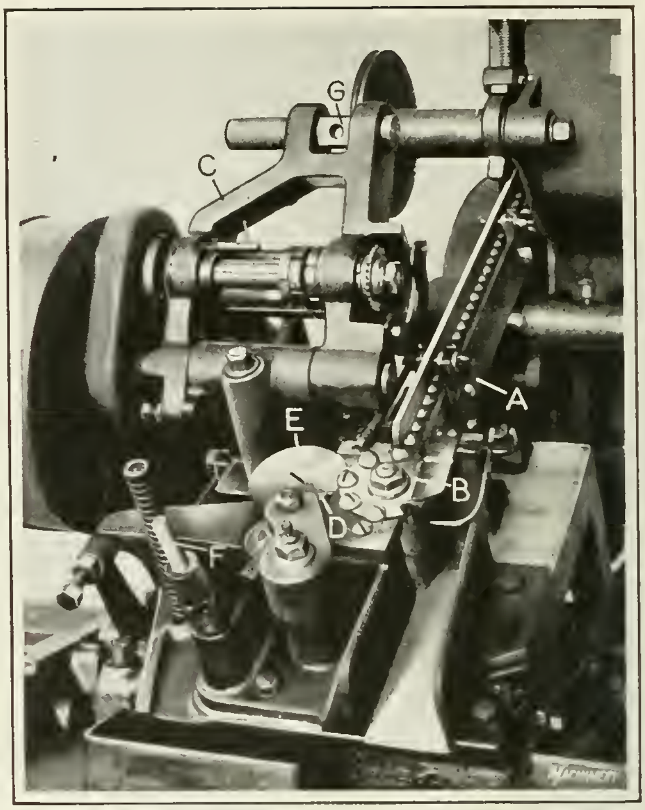


Fig. 2. Close-up View of the Saw Frame, Carrier Dial, Clamping Disk and Burr Remover

Burrs produced on the screw heads by the saw are clipped off by the auxiliary form tool *D*, which conforms to the shape of the head on the screw and is timed with the indexing mechanism of carrier dial *B*. The action of the arm that controls the functioning of the burr remover is sudden; it is snapped forward by a stiff spring and drawn back positively by a cam.

During the slotting and burring, the screw shank is firmly clamped by means of a disk *E*, attached to the short arm of a bell-crank lever which is actuated through the medium of a cam and an adjustable set-screw, causing the disk to bind against the screw shank which extends just beyond the periphery of the carrier roll. When the clamping disk becomes worn, its position may be easily changed to present a new clamping surface. As soon as the operation is finished, the work is released and the carrier dial indexed to the next position. This transfers another blank to the operative position and advances the slotted screw toward the point of release where the screw drops from the dial, and falls down a trough and into a receptacle beneath.

In the hopper there is a vertically operating slide or pick-up blade which reciprocates through the blanks and in its uppermost position forms an angular pocket into which the chute extends. The upper end of this blade is beveled toward the pocket, so that blanks which are lifted by the blade fall into the pocket. Some fall into the chute, while others fall against a cam-operated device which throws them back until they also become correctly located in the chute. Attached to this "kicker" there is a templet provided with an opening through which the screw heads pass. This is the only unit in the hopper-feeding mechanism that requires changing to adapt it to all sizes and styles of heads for a given sized screw shank.

On the belt-driven machine there is a belt shifter, operated by a handle extending to the front of the machine within easy reach of the operator, and on the motor-driven machine the motor switch may be correspondingly located. A feature of these automatic screw-slotting machines is the simplicity of adjustment and set-up. Cutting compound is delivered to the saw by a small pump from a tank supported on trunnions at the rear of the pedestal.

SUNDSTRAND RADIUS, INTERNAL AND SURFACE GRINDING MACHINE

A distinctive feature of the radius, internal, and surface grinding machine developed primarily for railroad shop use by the Rockford Milling Machine Co., Rockford, Ill., is that the long radius-bar employed in grinding the finished curved surfaces of locomotive radius-links is in the vertical position, and so the space occupied by the machine is reduced to a minimum. The machine is adapted to many typical railroad shop operations; for surface grinding operations, it is simply necessary to remove the vertical table and use the standard wheel-spindle for light and medium work or a special spindle for heavy work. In Fig. 2 the machine is illustrated set up for surface-grinding the cheeks of radius-links, the special extra heavy spindle being used. A planetary motion can be imparted to the spindle and an oscillating motion to the spindle head, to permit the machine to be used for grinding holes, as illustrated in Fig. 4, where a hole is being ground in one end of a locomotive side-rod.

Surfaces can be ground at radii of from 18 to 100 inches by means of the vertical radius-bar; such an operation is shown in Fig. 3 being performed on a radius-link. An oscillating movement is imparted to the grinding spindle and a swinging movement to the work. A special fixture is employed for holding the link on the vertical table. The pendulum mechanism is entirely independent of the rest of the machine, and when not required can be detached, or the radius-bar can be swung out of the way to facilitate surface and internal grinding operations. Other operations in railroad shops for which the machine can be conveniently applied are surface-grinding the sides of link-blocks, grinding the hole in link-blocks, and face-grinding the ends of these blocks.

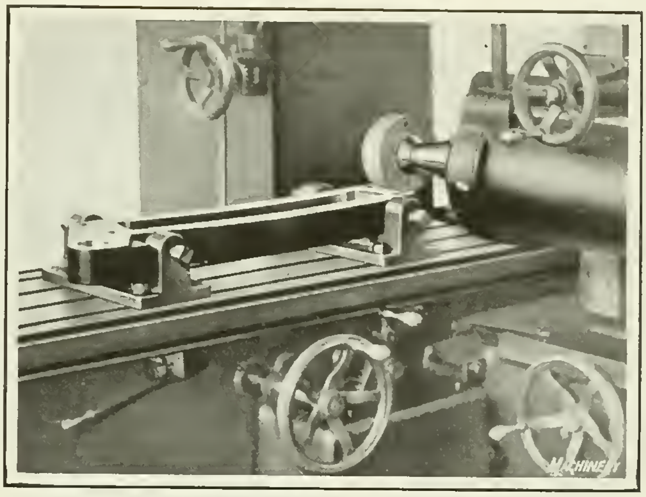


Fig. 2. Surface-grinding the Cheeks of Locomotive Links, using the Heavy Wheel-spindle

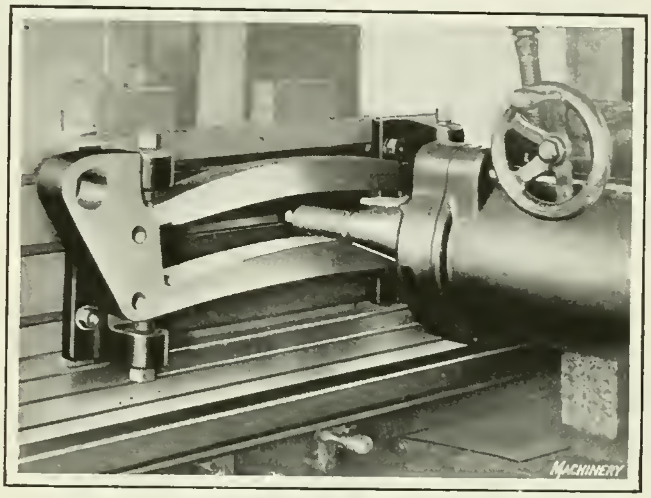


Fig. 3. Set-up employed in grinding the Curved Surfaces of Radius-links to the Desired Radii

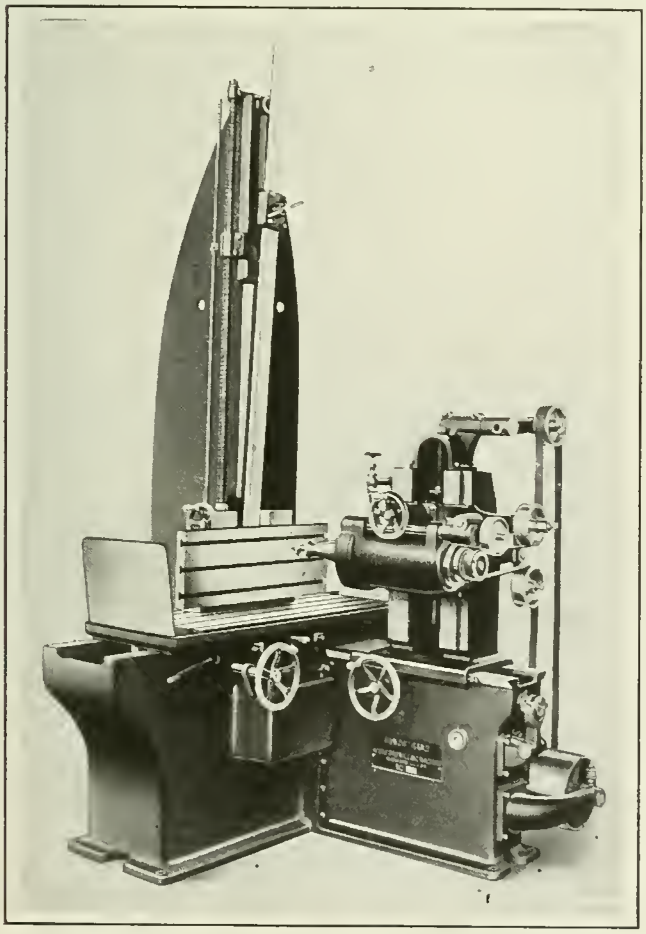


Fig. 1. Sundstrand Heavy-duty Radius, Internal, and Surface Grinding Machine

The base of the machine consists of two heavy ribbed castings provided with bearing surfaces for the horizontal table and the spindle column, and secured at right angles to each other. The vertical column for the radius-bar is bolted to the rear of the main base, and to this column is attached the motor when the machine is arranged for a motor drive. The column is an iron casting about 10 feet 10 inches high, and is equipped with a radius-bar 1 inch thick by 3 inches wide which has ¼-inch graduations. The radius-bar is adjustable by means of a handwheel conveniently located relative to the operating position. The vertical table to which the work is attached in radius-grinding is secured to the radius-bar and controlled in its reciprocal motion by the horizontal table to which the vertical table unit is clamped. An automatic longitudinal feed is provided for the horizontal table in both directions, with either hand or power feed. The length of travel is controlled by two adjustable dogs. The hand starting lever is located at the front of the machine.

The spindle column is supported on wide bearing surfaces on the base, and the adjustable spindle head is mounted on dovetail bearings on the spindle column. Practically the entire driving mechanism is contained in the base below the spindle column. Horizontal adjustment of the column is regularly obtained by hand, but a power feed can also be furnished. The wheel-spindle runs in ball bearings and is provided with means for taking up wear, the necessary adjustments being made by turning a single nut. The spindle construction is such that sleeves of different sizes can be applied for various grinding jobs. An eccentric spindle provides, through gearing, the planetary motion to the spindle necessary for internal grinding. The planetary path may be up to 1¾ inches larger in diameter than the wheel.

A motor drive is recommended for the machine, but it may also be driven from a line-shaft or jack-shaft. A 7½-

horsepower motor running at 1200 revolutions per minute is specified. An oil-pump delivering coolant to the wheel through a flexible tube is located below the spindle column and draws the coolant from a reservoir in the base.

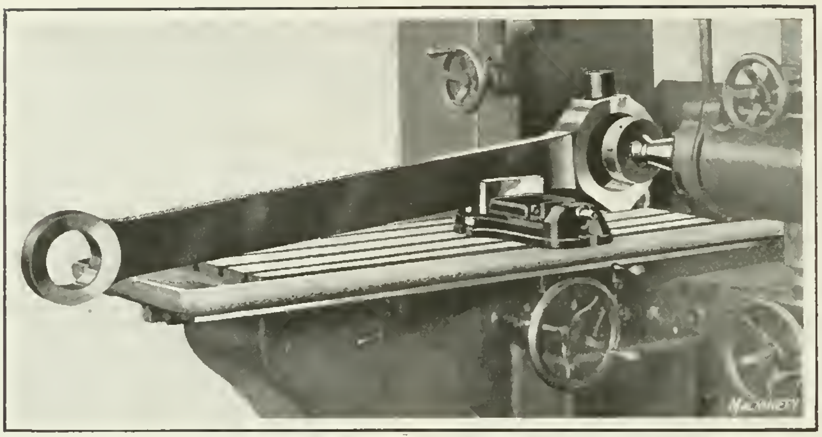


Fig. 4. Grinding a Hole in a Locomotive Side-rod on the Sundstrand Grinder

Some of the principal specifications of this Sundstrand grinding machine are as follows: Working surface of vertical table, 12 by 36 inches; working surface of horizontal table, 16 by 48 inches; longitudinal feed of horizontal table, 50 inches; vertical feed of wheel-spindle, 20 inches; cross-feed of wheel spindle, 14 inches; total height of machine, 12 feet 2 inches; floor space required, 81 by 114 inches; and net weight, approximately 6800 pounds. Manning, Maxwell & Moore, 119 W. 40th St., New York City, are the exclusive selling agents for this machine in the middle-western, eastern and southern states, and the Herberts Machinery & Supply Co., Los Angeles and San Francisco, Cal., in the Pacific Coast states.

ROLLWAY "MAXIMUM-TYPE" BEARINGS

A new series of bearings known as the MDW, which represents "maximum double width," has been brought out by the Rollway Bearing Co., Inc., Syracuse, N. Y. These bearings are intended for use under heavy load conditions combined with severe shocks, where there might be a tendency for a narrower standard inner race to cut into the shaft, and are the result of many years of experience in designing bearings for heavy-duty service. They are especially suitable for installation in railway car motors and journals and in heavy gear and chain drives. The use of a wider inner race also permits a lighter press fit, which is appreciated when bearings must be removed from a shaft.

The bearing is self-contained, having outer and inner races of a heavy channel cross-section, which serves the double purpose of providing both bearing and guiding surfaces for the rollers, and thus eliminates the necessity of a retainer. The diameter of the bore and the over-all diameter of the MDW type is standard, as is also the width of the outer race, but the inner race is of a standard double-row width. The material used in making this bearing is a heat-treated, high-chrome, high-carbon steel. In the different sizes manufactured, the bore diameter ranges from 0.7874 to 10.2363 inches.

In addition to the bearings described, this company has enlarged its regular line of standard sizes to include all the commonly used sizes, and has added a complete line of single- and double-direction roller thrust bearings of both aligning and flat washer types. Fig. 2 shows a double-acting aligning type thrust bearing of the metric interchangeable series.

ANDERSON HOPPER FEED FOR TAPPING MACHINE

The dial-feed multiple-spindle tapping machine built by the Anderson Die Machine Co., Iranistan Ave., near Admiral St., Bridgeport, Conn., which was described in February, 1922, MACHINERY, may now be equipped with an automatic hopper feed. The hopper is mounted on a bracket fastened to the under side of the pan in which the dial rotates, and it is driven by an independent motor. This independent motor drive is used to fill the chutes or runways leading from the hopper to the dial with work previous to starting the machine for tapping the pieces. Three chutes lead from the hopper to the dial, the mouths or exits from the hopper being so arranged that the parts are permitted to be fed only in one way; that is, they are turned upside down for the tapping operation. The hopper feed illustrated is used in tapping knurled battery nuts. In the event that a nut lodges in a hopper exit with the opposite side turned up, hooks or ejectors arranged on the inside of a rotary plate that forms the bottom of the hopper will dislodge it.

At the lower end the chutes are adjusted to such a position that when the dial is stationary while the tapping is

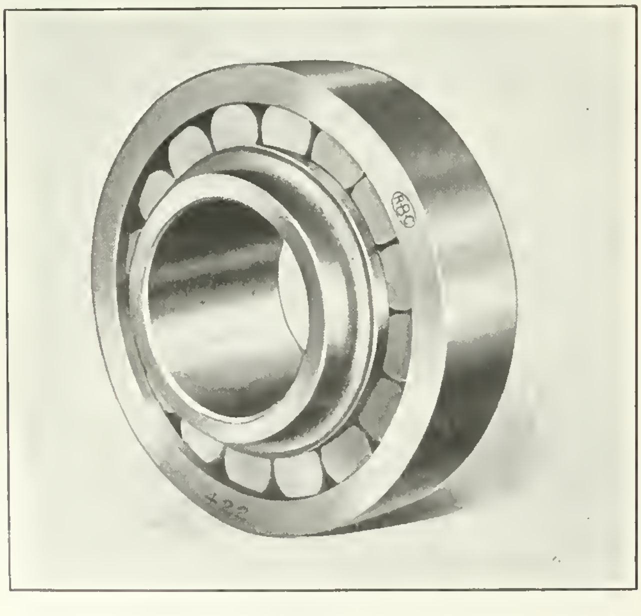


Fig. 1. Rollway MDW Bearing intended for Heavy-duty Service

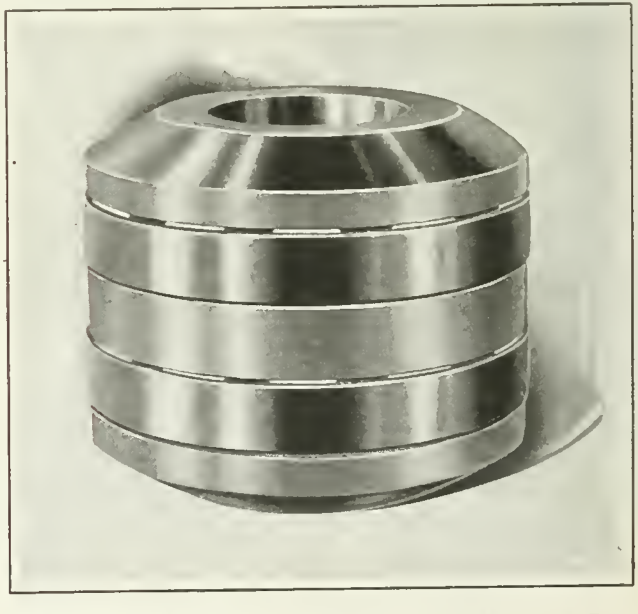
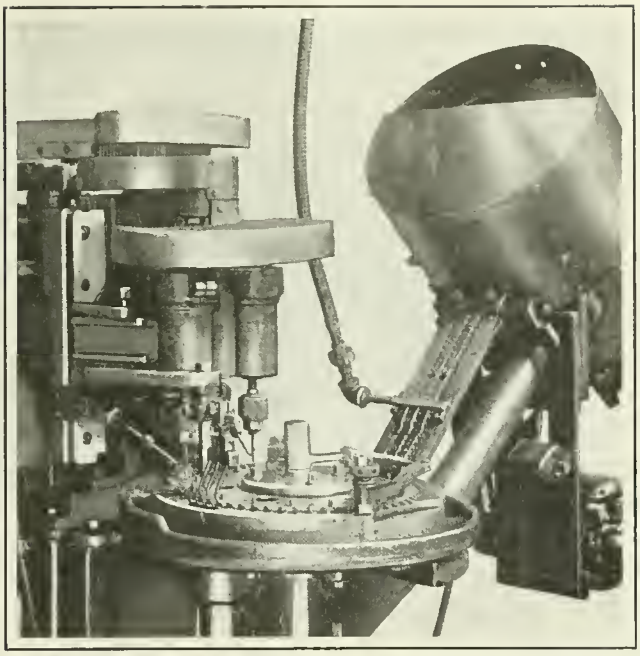


Fig. 2. Extra Heavy Thrust Bearing of Double-acting Aligning Type

being performed, the openings in the dial align with the three runways. Through the action of gravity, the parts then force themselves into the openings in the dial. As the dial indexes, a stop or gate closes the lower end of the three runways and prevents the nuts in the chutes from projecting and interfering with the rotation of the dial.

The ratchet that controls the dial feed has eighteen teeth, and for each of these there are three openings in the dial, so that at each stroke of the machine three nuts are tapped. The nuts are clamped in the tapping position by means of a cam mounted on a vertical shaft. Variations in the diameter of nuts are provided for. Three fingers mounted on a bracket which moves up and down with the taps, and which is so constructed as to swing outward, force the nuts out of the dial after tapping, when this is necessary. This ejection, must be positive, as a nut remaining in the dial would prevent proper indexing. The machine is timed to run at 40 strokes per minute, and on actual production three machines running on a 20-hour day schedule have tapped from 375,000 to 421,000 nuts.



Automatic Hopper Feed for Anderson Dial-feed Multiple-spindle Tapping Machine

DANLY STANDARD LEADER AND DOWEL PINS AND BUSHINGS

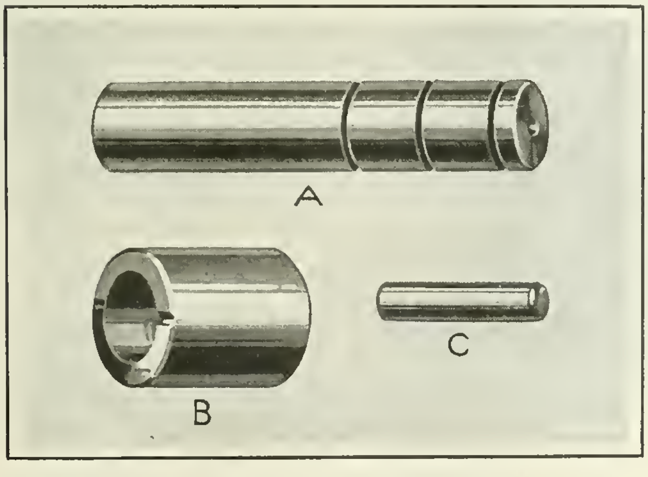
Leader and dowel pins and bushings have been added to the line of standard die parts manufactured by the Danly Machine Specialties, 4911 Lincoln Ave., Chicago, Ill. The leader pins are made of steel, carburized, and hardened and ground on centers to within plus or minus 0.0002 inch of the nominal diameter. Care is taken in carburizing to insure that the leader pins will have a heavy case, and they are given a double quenching to refine and toughen the core. Irregularities left in grinding are removed by lapping to give a full wearing surface for the bushing. These leader pins are made in various diameters from ½ to 1½ inches, and in lengths from 4 to 9 inches. The allowance for a pressed fit ranges from 0.00125 to 0.002 inch.

Standard bushings are made in both straight and shoulder types, in various sizes ranging from ½ to 1½ inches inside diameter. The length of standard straight bushings ranges from 1½ to 2 inches, but extra long bushings having a length of 3¼ inches are made in sizes of from ⅞ to 1½ inches inclusive. The bushings are made of steel, carburized and hardened and ground to within minus 0.0002 inch of the listed inside diameter to provide an allowance for lapping. There is a pressed fit allowance of 0.002 inch on the outside diameter. The dowel-pins are made of drill rod, hardened, tempered, and ground to within plus or minus 0.0001 inch of the listed diameters. They are also carried in stock 0.001 inch over-size for repair or renewal work, where holes have become enlarged, or where a reamer has cut oversize. It is claimed that these hardened pins can be driven in or out of holes without upsetting or bulging. The diameters range from 3/16 to ½ inch, and the lengths from ⅞ to 2¾ inches. The illustration shows a leader pin at *A*, a straight bushing at *B*, and a dowel-pin at *C*.

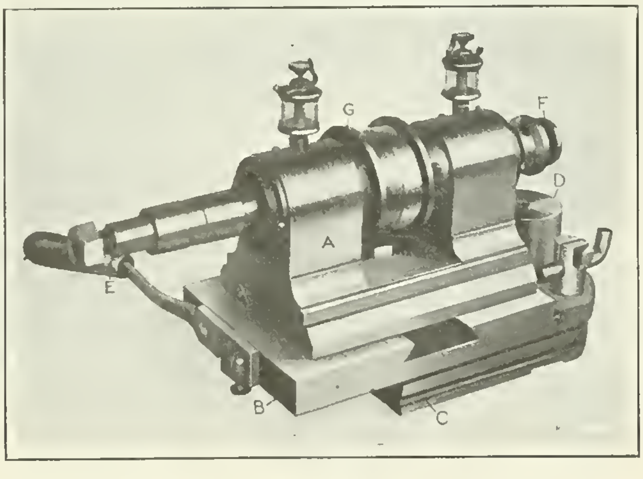
SCHWAGEL RADIUS GRINDING FIXTURE

An attachment primarily intended for use in grinding circular or other surfaces at a radius, but which may also be employed for milling operations, etc., has been placed on the market by Nicholas Schwagel, 123 E. Third St., Dayton, Ohio. From the illustration it will be seen that the device consists of a spindle head *A*, a pivoted base *B* on which the spindle head is mounted, and a main base *C* clamped to the machine on which the fixture is used. The pivoted base *B* may be swung on a large-diameter taper stud, which is screwed into a tapped hole in the base *C* and has a bearing in cap *D*, the latter being screwed into the pivoted base. The base is swiveled by means of handle *E*.

Either the work or a grinding wheel may be mounted on the end *F* of the spindle; assuming that a piece of work is placed on the spindle and that the fixture is positioned relative to a grinding wheel, as base *B* and the spindle head are swung about the taper stud, the work will be ground at a radius equal to the distance between the point where the work contacts with the wheel and the center of the taper stud about which the fixture is swung.



Danly Standard Leader and Dowel Pins and Straight Bushing for Die Sets



Schwagel Fixture for Use in grinding Circular and Other Work

Circular parts are ground to a radius by driving the spindle with a belt connected to pulley *G*. Head *A* has a longitudinal dovetail slot, and base *B* has a transverse dovetail slot. By means of a stud on which there are two opposite taper or conical disks, each of which fits one of the dovetail slots, the head and base are clamped together. With this arrangement the spindle head may be located in various longitudinal, transverse and angular positions, the different positions providing for handling a large range of work.

Base *C* has three rectangular grooves on the upper side, which radiate from the taper stud, and base *B* has a corresponding slot on the bottom which may be brought into line with any one of the slots in base *C* and a bar inserted in the slots to lock the bases together for such operations as plain, cylindrical, bevel, or taper grinding. For other classes of work, as for example, irregular or rectangular pieces, spindle head *A* may be replaced by a plain base having a T-slot by means of which an ordinary machinists' vise or a special jig or fixture may be attached for holding the work.

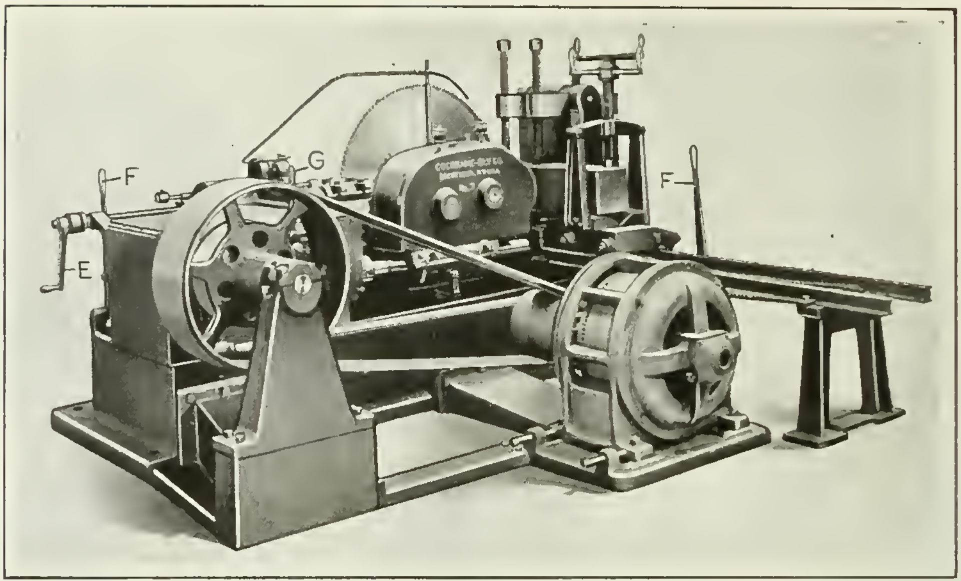


Fig. 2. Rear View of the Sawing Machine, showing the Motor Drive

COCHRANE-BLY METAL-SAWING MACHINE

A cold-sawing machine known as the No. 7, which has sufficient capacity for cutting 13-inch round, 12-inch square, or 10- by 15-inch rectangular stock, has recently been placed on the market by the Cochrane-Bly Co., Rochester, N. Y. When the machine is equipped with a 60-degree fixture for multiple cutting, two hundred and twenty-nine ½-inch bars, fifty-three 1-inch bars, nineteen 2-inch bars, or four 5-inch bars can be held in the fixture at one time. The bed of the machine is set in a deep pan which catches all oil and chips falling from the work, the oil being drained into a reservoir from which it is again delivered to the work by a geared pump. The surfaces of the bed to which the saw carriage is fitted are scraped to surface plates to insure an accurate assembly of the two units. The saw arbor is hardened and ground and fitted into a solid bearing.

The feed-screw is located directly in line with the center of the saw arbor and as close as possible to the saw blade so as to bring the feeding pressure as nearly as possible in line with the saw. The nut on the feed-screw is split and adjustable endwise to permit the elimination of all lost motion in the screw, and adjustable hardened steel nuts provide for taking up lost motion between the screw and the gear-box. The feed-screw is driven by worm-gearing and compound spur gears, a tumbler operated by means of handle *A* providing six feed changes; additional changes are provided through sliding gears operated by knob *B*. The sliding gears mesh with gears on the worm-shaft. Eleven feeds are obtainable in all, ranging from ½ to 2½ inches per minute.

The feed is started, stopped, and reversed from either the front or back of the machine, by means of levers *C*. A double pawl holds the clutch-block in a neutral position, in engagement with the feed gear or allows it to engage with the reverse gear. The pawls are lifted by means of a rack and pinion mechanism operated by levers *C*. A movement of either lever to the left raises the feed pawl and trips the machine into neutral; further movement of the lever raises the neutral pawl and trips the machine into reverse, automatically returning the saw carriage at high speed to a point determined by the setting of an adjustable stop-collar on trip-rod *D*. Another adjustable stop-collar lifts both pawls at the same time, automatically tripping the machine from feed to reverse. Levers *C* are moved to the right to release the reverse clutch and engage the feed clutch. The carriage can be adjusted to or from the work by means of cranks *E* located at each end of the machine.

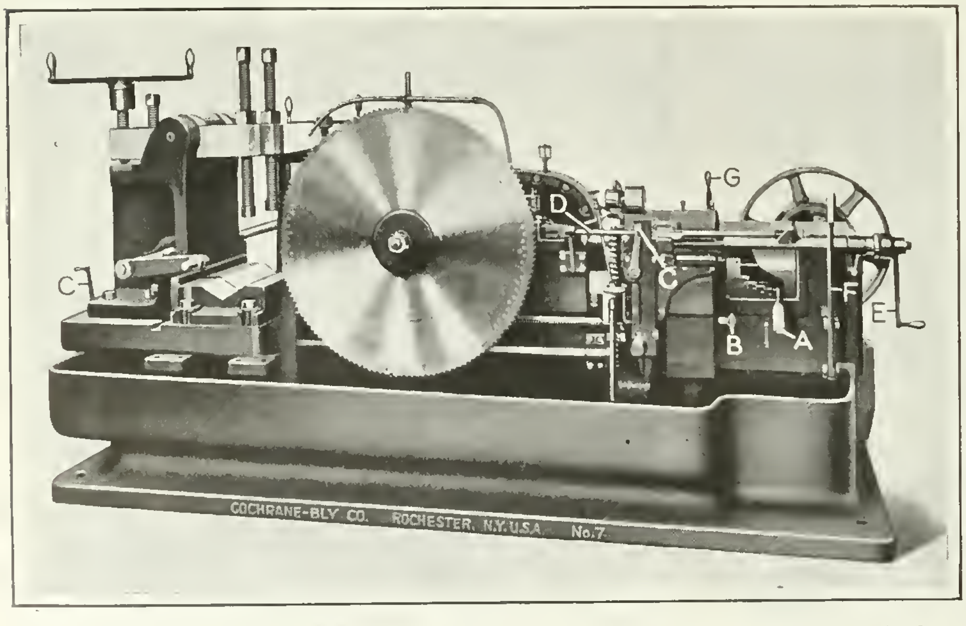
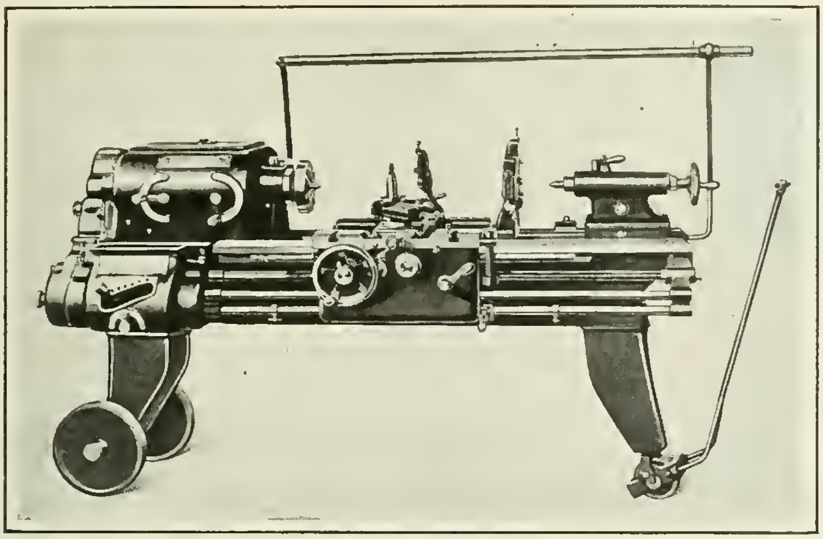


Fig. 1. Cochrane-Bly Cold Saw which has a Capacity for 13-inch Round and 12-inch Square Stock

The machine is driven by a friction-clutch pulley on the hub of which there is an oil reservoir with a capacity for holding sufficient oil to last several months. The clutch is controlled through levers *F* from



Sundstrand Gear-head Lathe equipped with Wheels to permit Ready Transportation about the Shop

either the front or back. Ring-oiling bearings are supplied for the driving shaft. There are three cutting speeds of 30, 40 and 50 feet per minute, any one of which is obtained through lever *G*, by sliding a cone of gears on the driving shaft. All gears in the machine, except the worm-gears, are made of steel and are fully enclosed and run in an oil bath. A set of miter gears on the driving shaft, an arbor gear, and an intermediate gear in the worm-gear box on the carriage are made of nickel steel and casehardened, and the pinions meshing with these gears are made of chrome-nickel steel and hardened. The worm-gears are made of phosphor-bronze. The driving worm is made of steel, and hardened; it is provided with a ball-thrust bearing and runs in oil.

The vise has double clamping screws so as to hold the stock at two points. These screws, as regularly furnished, are hand-operated, but a vise equipped with clamps operated by compressed air can also be furnished. The regular equipment includes a stock-feeding device, which is operated by simply turning a crank to pulling the bar through the vise. The stock-support carriage is moved by means of a chain and sprocket and a crank that is back-geared to the sprocket shaft. It is said that one operator can easily adjust a 12- by 12-inch billet in the vise. The top of the yoke on the carriage is hinged, and may be opened up to facilitate placing a bar in the machine.

Some of the principal specifications of the machine are as follows: Diameter and thickness of saw blade, 37 and 9/32 inch, respectively; diameter of saw arbor, 6 inches; area of work-table, 30 by 27½ inches; speed of driving shaft, 300 revolutions per minute; diameter and face width of driving pulley, 24 and 9 inches, respectively; motor required, 20 horsepower, running at from 860 to 900 revolutions per minute; and weight of machine, approximately 12,600 pounds.

To determine the power required at various speeds and feeds, extensive tests were made in which an 8-inch square billet of 0.40 per cent carbon, open-hearth steel was cut with the following results: With a cutting speed of 30 feet per minute and a feed of ½ inch per minute, an average of 4.8 horsepower was consumed; with the same speed and a feed of 1 inch per minute, 6.85 horsepower; with a feed of 2 inches per minute, 10.97 horsepower; and with a feed of 2½ inches per minute, 14.48 horsepower. With a cutting speed of 40 feet per minute, and a feed of ½ inch per minute, 5.13 horsepower was consumed; with a feed of 1 inch per minute, 7.3 horsepower; with a feed of 2 inches per minute, 12.66 horsepower; and with a feed of 2½ inches per minute, 14.71 horsepower. With a cutting speed of 50 feet per minute and a feed of ½ inch per minute, 5.37 horsepower was consumed; with a feed of 1 inch per minute, 7.86 horsepower; with a feed of 2 inches per minute, 13.71 horsepower; and with a feed of 2½ inches per minute, 15.51 horsepower.

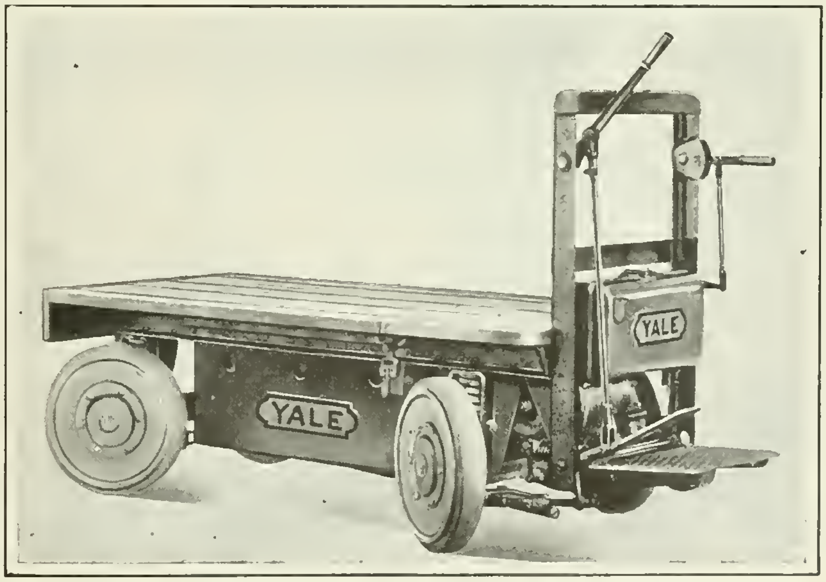
SUNDSTRAND PORTABLE GEARED-HEAD LATHE

A 15-inch geared-head lathe provided with wheels to make it portable has been brought out by the Rockford Tool Co., 2400 Eleventh St., Rockford, Ill. This machine is intended particularly for use in railroad shops and shipyards. It is of the same design and specifications as the Sundstrand 14-inch toolroom lathe described in January, 1922, MACHINERY, with the exception that the oil-pan is omitted, and the wheels and their brackets substituted. Also, when the portable machine is equipped with a motor drive, the motor is mounted directly on the headstock. The distance between centers with a 6-inch bed and the tailstock flush with the end of the bed is 32 inches, and the weight of the lathe with a bed of the length mentioned is approximately 2250 pounds.

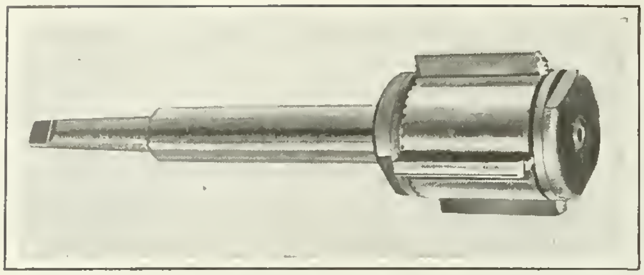
YALE & TOWNE INDUSTRIAL TRUCK

To meet the general requirements of economical intra-plant movement of materials, the Yale & Towne Mfg. Co., Stamford, Conn., has brought out the "Yale Model K-20" industrial truck shown in the accompanying illustration. This truck is intended for handling miscellaneous units of material, which can be placed on the platform by hand, chain block, electric hoist, etc. Auxiliary equipment which has been designed for use with it includes a gravity dump body for handling loose materials, and an electrically operated swinging-boom crane. Large wheels and full spring suspension permit efficient operation over rough floors and roads.

The truck is equipped with a spur-gear unit power axle and ball bearings protected from dirt and properly lubricated. The design and construction of the controller is said to insure durability and efficiency under the most severe service conditions. The majority of single parts and units are standard and interchangeable with those of all other models in this series of Yale industrial trucks.



Yale Industrial Truck for Intra-plant Transportation of Materials



Lambert Universal Expansion Reamer

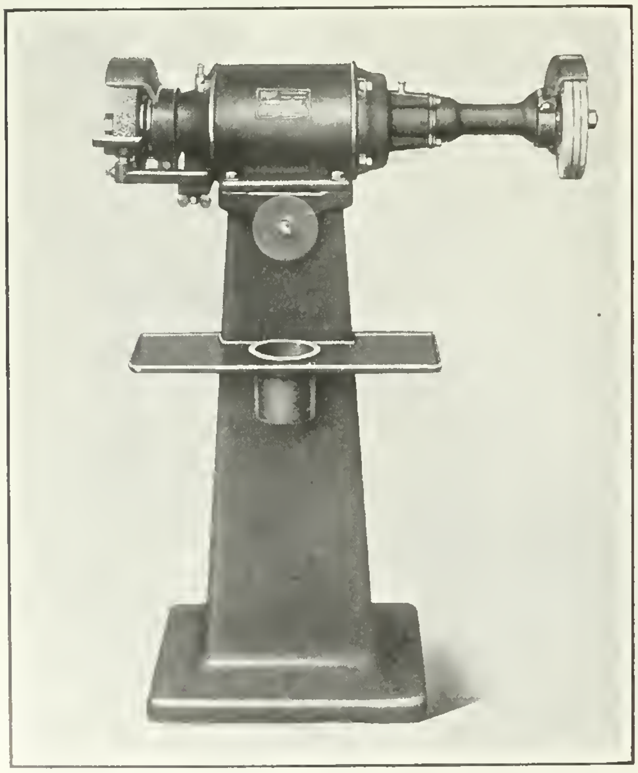
LAMBERT EXPANSION REAMER

An expansion reamer is being manufactured by the Lambert Tool Co., E. 55th St. and Euclid Ave., Cleveland, Ohio, in various nominal sizes from 1 inch up. The 1-inch size may be expanded to 1¼ inches in diameter, the 3-inch size to 4 inches in diameter, and intermediate sizes proportionate amounts. These expansion adjustments are made by releasing the lock-nut and turning the blade cylinder. Scrolls at each end of the blades mesh with teeth cut in the blade ends and cause the blades to expand. The lock-nut is tightened, after an adjustment, to bind the scrolls securely against the ends of the blades and hold the blades positively to the desired diameter. The cylinder simply serves as a housing to support the blades. The diameter of the tool may be readily increased by thousandths of an inch to any dimension within the limits of a particular size.

HISEY-WOLF GRINDING AND BUFFING MACHINE

A new direct motor-driven combination grinding and buffing machine, equipped with a motor of one-horsepower capacity, has been brought out by the Hisey-Wolf Machine Co., Cincinnati, Ohio. The machine may be furnished with a floor stand as illustrated, or with a base for mounting on a bench. It is adapted for a large variety of work requiring the use of grinding, buff, wire-brush, or rotary wire-rasp wheels.

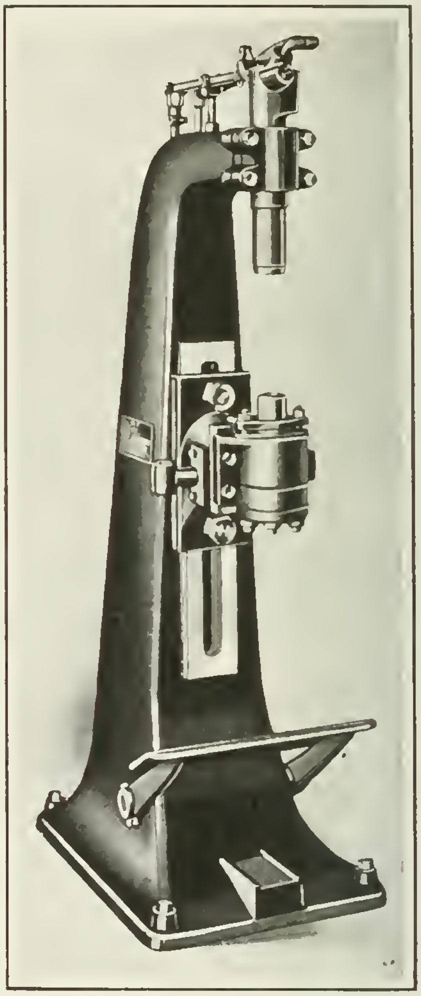
In the general construction details, it is similar to the standard lines of Hisey ball-bearing grinding and buffing machines. The spindle extension is a separate unit and is connected to the motor armature shaft by means of a clutch. Each shaft unit is supported by two ball bearings so as to make the entire spindle and general construction rigid. Alternating-current, single-phase machines are intended for operation by current taken from a lamp socket or lighting circuit, while two- or three-phase machines are intended for operation from power-circuit lines only. Direct-current machines can be furnished for currents of from 80 to 250 volts. Standard grinding and buffing wheels for the machine are 8 inches in diameter by 1½ inches wide, and the distance from the floor to the center of the spindle is 39½ inches. The approximate weight of the machine is 390 pounds.



Hisey-Wolf Direct Motor-driven Grinding and Buffing Machine

FINDLAY PNEUMATIC RIVETING HAMMER

A riveting machine which is operated entirely by air and which may be employed for driving both hot and cold rivets is built by the Findlay Engineering & Mfg. Co., Findlay, Ohio.



Findlay Pneumatic Riveting Hammer

The model A machine drives hot rivets up to ⅝ inch in diameter and cold rivets up to 7/16 inch, while the model B drives hot rivets up to 1 inch in diameter and cold rivets up to ⅝ inch. Rivets up to 10 inches in length can be handled regularly, and rivet hinge pins up to 16 inches long can be handled by means of a special adjustment. It is said that the machine not only produces a head on the rivet, but also upsets the body and fills the hole. The dolly-bar or anvil is air-operated and follows up a rivet with a uniform pressure until the rivet is driven.

The piston, anvil, and all other working parts are made from chrome-vanadium steel and are heat-treated, and the frame, bracket and cylinder are semi-steel castings. As the machine is not driven from shafting or a motor, it can be set up wherever it is most convenient for the work, provided compressed air having a pressure of from 80 to 100 pounds per square inch is available. The force of the blow delivered by the hammer is of wide range, so that the equipment can be used just to make a head, as required in hinge work, or to actually upset the largest sized rivet and fill the hole. The force of the blow is controlled by depressing the foot-pedal. The machine is used by automobile manufacturers to rivet cam and anchor brackets on rear-axle brake disks, and to rivet in place frame brackets, spring hangers, gussets, tank straps, etc. The model A machine weighs about 550 pounds, and the model B, 650 pounds.

O-Z DIRECT-READING TACHOSCOPE

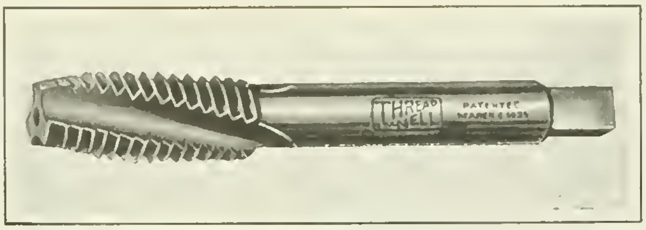
A direct-reading tachoscope which is a combined anti-magnetic chronometer and revolution counter has been placed on the market by O. Zernickow, 15 Park Row, New York City. The instrument shows speeds in revolutions or feet per minute, the speed being determined in six seconds. In using the instrument, the spindle or disk wheel is held against a revolving shaft, and the push-button is depressed and permitted to fly back. Then when the spindle or disk wheel comes to rest, the speed in revolutions or feet per minute can be read on the dial. The disk wheel is used in finding the speed in feet per minute.

The standard time unit of six seconds is controlled by means of a precision watch movement in the indicator, 1½ seconds being allowed for starting and stopping the watch movement and for automatically switching the counting mechanism in and out at the beginning and end of the operation. The push-button lever is also used to wind the watch mechanism, and it automatically returns the counting mechanism to zero from previous readings. The last previous reading remains on the dial until the indicator has been placed in position on the part being tested, and then when the finger is pressed on the button and the button flies back, the counter is reset and the watch wound. One revolution of the large pointer indicates 1000 revolutions of the shaft tested or a distance traversed of 333 1/3 feet when the measuring disk is attached; and one revolution of the small pointer indicates 10,000 revolutions of the shaft or a distance traversed of 3333 1/3 feet. The instrument is designed for use with speeds up to 30,000 revolutions per minute. The dial is 2 inches in diameter, and the instrument weighs about 6 ounces.

O-Z Direct-reading Tachoscope

WELLS "THREADWELL" SPIRAL-FLUTED TAP

A line of "Threadwell" right-hand spiral-fluted taps in which the thread is ground, is manufactured by the Wells Corporation, Greenfield, Mass., in nine screw-gage numbers from 2 to 14, inclusive, and ten fractional sizes from ¼ to 1 inch, inclusive. Each cutting edge has three points of clearance, due to the rake angle of the spiral, the rake angle of the hook in the flutes, and the clearance of the eccentric relief. The tap is said to be designed on the same principle as a properly ground lathe tool, and these clearances are similar in effect to the back rake, side rake, and under-cut clearance of a lathe tool. The right-hand spiral flutes curl the chips and convey them out of the hole.



Wells "Threadwell" Spiral-fluted Tap

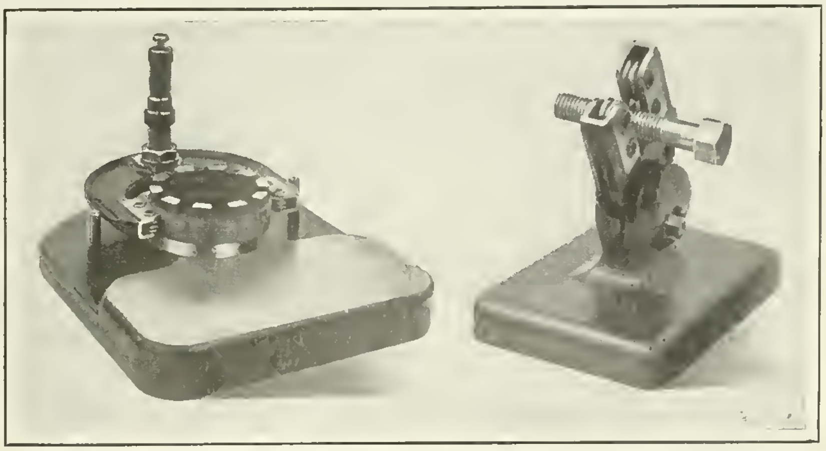
The tap is regularly made with a short "plug" chamfer for tapping all holes except blind holes where a full thread is necessary clear to the bottom. In such cases a very short chamfer is ground on the tapping end. In addition to the eccentric relief, an extra chamfer is given at the point where the taper and straight portions of the tap would otherwise meet. It is said that this double taper results in a more even distribution of the cutting strains and makes the tap less liable to breakage; in addition, less power is required for operating. The edges of the starting or chamfered threads are rounded, and all sharp corners removed to narrow the teeth and enable them to catch a thread without a reaming effect. Accuracy, both in diameter and lead, is guaranteed within 0.0005 inch.

BURKE MOTOR-DRIVEN BENCH DRILLING MACHINE

The No. 2 heavy-duty bench drilling machine built by the Burke Machine Tool Co., 516 Sandusky St., Conneaut, Ohio, which was described in April, 1923, Machinery, may now be obtained with a motor drive. The motor is of ½ horsepower capacity and drives the lower cone pulley through a Morse silent chain, which is adequately guarded. The motor is mounted on an extension of the regular base of the machine. This machine is intended for drilling holes up to 9/16-inch diameter and can drill to the center of a 12-inch circle. The weight of the motor-driven machine is approximately 240 pounds.

JOHN-SONS THREAD-GAGE VISE AND FIXTURE

A vise and fixture have been developed for use in conjunction with the adjustable thread snap gages manufactured by the John-Sons Gage Works, 67 Blue Hills Ave., Hartford, Conn., which were described in September, 1922, Machinery. The vise, which is shown at the right in the illustration, can be used with any style or size of these gages. It is rigid in construction and holds the gage in place by clamping with a collar-head screw. It is shown holding a gage



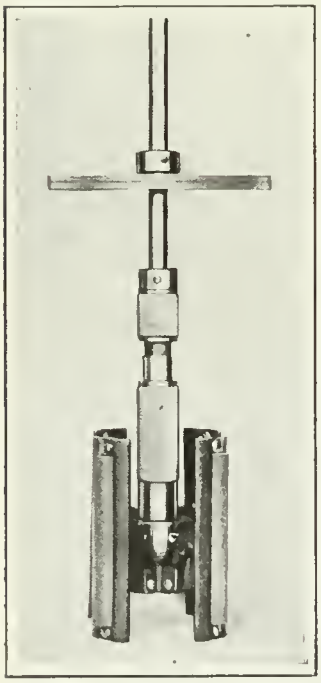
Fixture and Vise designed for Use with John-Sons Adjustable Thread Snap Gages in a tilted position with a cap-screw between the gaging rolls.

The fixture, which is shown at the left of the illustration, may be used with any style of these gages for work larger than two inches in diameter, such as casings, shells, lock and adjusting nuts, or sleeves and bearing retainers. The finished portion of the base on which the work slides is a hardened steel plate, which is ground in position after being fastened on the casting. Through an arrangement of springs in the stem, the gage is made sufficiently free to obtain the necessary alignment between the gaging rolls and the threads on the part being gaged. This eliminates any tendency toward cross-threading.

The position of the gage is regulated by means of the adjusting bolt which projects through the hole in the handle. There is a provision which insures that the gage will always be parallel with the working surface of the base. By giving the work a quarter turn and gaging it a second time, an out-of-round thread is readily detected, and by grasping the handle and elevating and depressing the gage, a taper thread will also be revealed. After the handle is released, the gage will return to its original position.

STIMSON EXPANSION HONE

A patented device for honing the bores of automotive cylinders has been recently placed on the market by the Stimson Engineering Co., 598 Sixty-eighth Ave., Milwaukee, Wis. In operation, a strap which fits loosely on the shaft rests on top of the cylinder, and a collar on the shaft acts as a stop to prevent the honing stones from passing through the bottom of the cylinder. The position of the strap and collar is adjustable along the shaft. Each shoe of the hone is connected through links which center on a central cone, and therefore one shoe cannot be expanded without all four shoes being expanded at the same time. The shoes pivot on the links, and thus insure alignment and overcome any irregularities that may wear in the stones. The central cone is adjusted longitudinally by means of a coil spring within the knurled sleeve. This sleeve is pulled back in placing the hone in a cylinder bore.

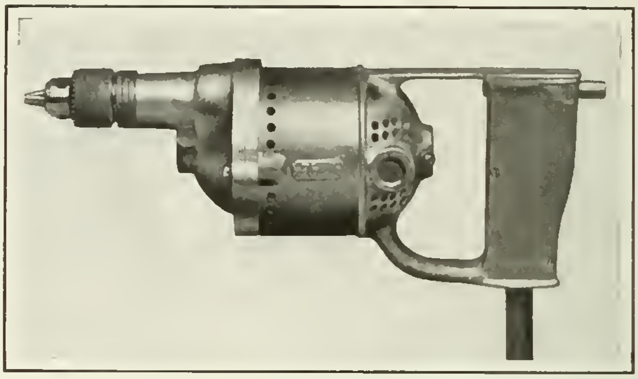


Stimson Expansion Hone

Two sets of shoes are provided, one to suit bores from 2¾ to 3½ inches in diameter, and the other for bores from 3½ to 4¼ inches in diameter. The shoes are easily changed, as each one is held in place by means of one cotter-pin. The stones have a dovetailed mounting on the shoes, which gives them a support on the sides and bottom for their entire length. If the stones become broken, the pieces can be used up because they will remain within the dovetail. This tool may be driven by any ordinary ½-inch electric or air drill or by a drilling machine. It is said that it will true up any cylinder bore, correct errors that may exist due to the piston travel, and eliminate the necessity of regrinding an entire cylinder block to maintain a balanced engine when only one of the cylinders requires regrinding.

U. S. AUTOMATIC PORTABLE ELECTRIC DRILL

A ¼-inch portable electric drill designated as the "U. S. automatic" has been placed on the market by the United States Electrical Tool Co., Cincinnati, Ohio. The handle is cast integral with the aluminum body, and contains a switch lever at the extreme top of the grip. In addition to being located in a convenient position for the operator's forefinger, the lever also forms a grip support when the drill is running.



United States Portable Electric Drill

The motor is of the universal type for operation on direct- or alternating-current circuits. S K F ball bearings are used, and the gears are made from chrome-nickel steel, hardened, and run in grease. A three-jaw screw-back chuck is provided. A bench-base, arbor, and wheel can be supplied to adapt this drill for use as a grinder, and it can be mounted on a drill stand or post bracket to form a bench or bracket drill. The weight of the drill is about 5¾ pounds, and its over-all dimensions, 10 by 4 inches.

VAN KEUREN REFERENCE GAGE SET

A set of reference gages which includes the fractional-inch or common shop sizes has been added to the line of precision measuring tools manufactured by the Van Keuren Co., 362 Cambridge St., Boston 34, Mass. This set contains the following gages: 0.0625, 0.125, 0.1875, 0.250, 0.3125, 0.375, 0.4375, 0.500, 0.5625, 0.625, 0.6875, 0.750, 0.8125, 0.875, 0.9375, and 1.000 inch, and in addition to these sixteenth-inch sizes, 0.09375 (3/32) inch and 0.078125 (5/64) inch, which give combinations in thirty-seconds and sixty-fourths of an inch. The set is particularly suitable as a reference standard for use in measuring steel balls and many other products of which the standard sizes are fractional-inch dimensions. A Bureau of Standards certificate of accuracy is provided with the gages, and they are furnished in a case.

BENCH STAND FOR PORTABLE DRILLS

An improved bench stand intended for use in connection with portable hand drills to convert them into bench equipment has been placed on the market by the Standard Electric Tool Co., Cincinnati, Ohio. The vertical column is made of a 1¾-inch square steel bar. The base is provided with T-slots for fastening work on it. This stand is made for ⅜-, ½-, 9/16-, ⅝-, ¾-, and ⅞-inch drills. The brackets that support the drill can be easily raised or lowered by means of a lever, and there is a quick return tension which is adjustable.

Some of the specifications of this stand are as follows: Height from bottom of base to top of vertical column, 36 inches; vertical adjustment of drill, 9 inches; distance from column to center of drill spindle, 6 inches; horizontal adjustment, a complete circle; vertical travel of drill when operated by lever, 4½ inches; net weight, 85 pounds.

MAKING LEATHER BELTS ENDLESS

By LOUIS W. ARNY

In July MACHINERY, general information was given concerning the tools used for making belts endless and the procedure in making the laps for the joint. This article will deal with certain variations in the practice of making endless belt joints, to meet different conditions.

Belts that are made endless may be divided into three classes: First, those that have been endless and that it is desired to shorten; second, those that have been running either with a laced joint or a metal fastener; third, new belts that have not yet been placed on the pulleys. These belts may again be divided into two classes including (a) those that are small enough to be thrown off the pulley and taken to a nearby bench, and (b) those that, because of their size, must be joined while on the pulleys.

To Shorten Narrow Belts that have been Endless

If a belt has been running endless, but has stretched a little so that the tension is reduced, it becomes desirable to shorten it. First it is necessary to determine how much shorter the belt must be. When this has been decided, find the joint that was made when the belt was last put on, and, with the point of a screwdriver, carefully open it, running the screwdriver under the point of the lap and working it toward the heel, taking care not to tear the leather.

If the belt is double, each ply of leather may have its own lap, or if it is a narrow belt it may have such a lap as is used on a single belt. Remove the belt to the bench; inspect carefully to see from which end it is most desirable to cut the surplus length, as determined by the relation of this end to any other joints in the belt; then bring the end on which it is decided to work nearly to the end of the bench, clamp the belt to the bench with bench clamps, and proceed to cut back the laps the desired distance.

To Make an Endless Joint in a Belt that has been Laced or Hooked

When an endless joint is to be substituted for a laced or hooked joint, the procedure is a little different. If the belt is loose enough on the pulleys so it can be tightened a number of inches equivalent to the number required to make the endless joint, the process consists in removing the belt to the bench as before, and making the necessary lap. If it is a single leather belt, or if it is a narrow double belt—say under 6 inches wide—an ordinary single lap may be used. This lap should be from 4 to 6 inches long, according to the width. The process then may be completed as described in the preceding article. If the belt is an old one, and the surface of the lap appears to be greasy, it should be cleaned with gasoline before attempting to cement it.

When the belt is not long enough to provide from its stretch sufficient material for the lap, it becomes necessary to prepare a piece to set into the belt. If it is a single belt, this may be a very short piece with a lap on each end, and then laps must be cut on the old belt to fit this piece, after which the cementing process is applied. When it is a narrow double belt, the piece inserted may be made in exactly the same way, but for a wider double belt the piece should be arranged so that it provides a separate joint for each of the two plies of the belt, so that these two joints are "broken" and do not come together. The ends of the belt then may be fitted to this insert.

Wider Belts that Cannot Conveniently be Carried to the Bench

With wide belts that cannot be conveniently carried to the bench, but must be joined while in place on the pulleys, the procedure is as follows:

If the belt is an old one that is to be shortened, first find the point on the belt at which the joint has been made, and bring the belt around to a place between the two pulleys where it may be most convenient to work. Then put on the clamps, one of the jaws above and one below the joint.

In putting on belts with clamps, the first requisite is to see that the middle line of the width of the belt corresponds exactly with the line midway between the centers of the rods of the clamps. Most clamps have this point marked on them. The next point, and a most important one, is to see that each pair of jaws of the clamps is exactly square with the edges of the belt. A little care here in drawing up evenly on the two rods will bring the two ends of the belt square and true, and will save effort and possibly a crooked belt.

Apply enough pressure to the clamps to take the tension of the belt off the joint, and then open the joint with the screwdriver, as before, cut down the new lap on one end with the spokeshave and the scraper, scrape off all the old glue from the lap on the other end, and proceed as before. This work can be best done on a clamp board, which fits between the rods and is attached to them.

Points on Making New Belts Endless

In putting on new belts, the laps should be made and the belt drawn over the pulleys, and then the clamps should be adjusted as just described. If the belt is to be bought, the belt-maker should be given the exact length around the pulleys, and he should be told whether it has been measured with a steel tape, a cotton tape, or a string, so that he can make the proper allowances; also "endless-open laps" should be specified.

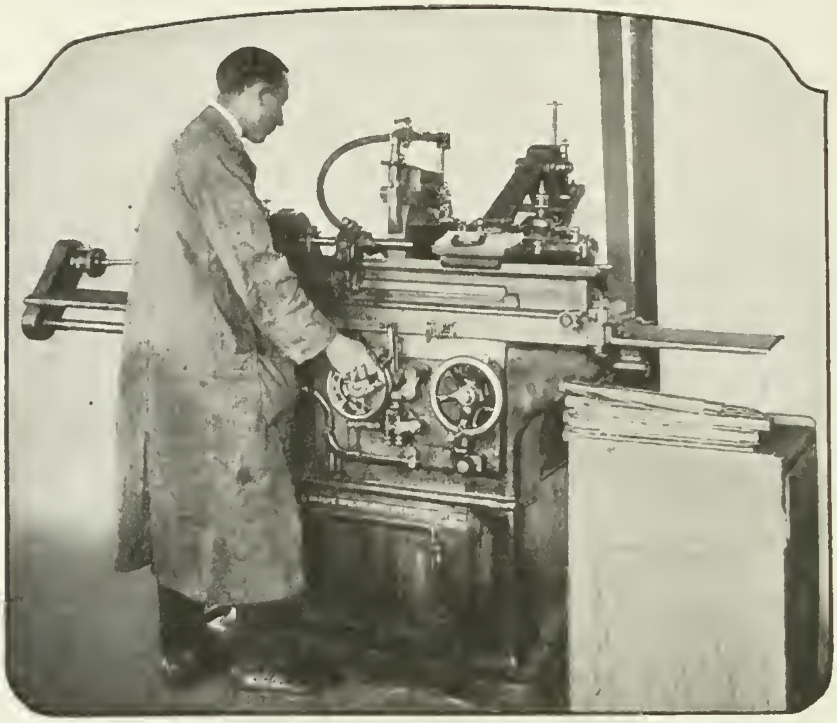
In the case of new belts which it is desired to place on the pulleys endless, the first thing is to get the proper length of the belt. It is usual to estimate that the belt should be 1/8 inch to the foot, or 1 per cent less than the actual steel tape measure around the pulleys, and for small belts that are to be placed on the pulleys without the use of clamps, this will be found to be sufficiently accurate. For those belts that are to be put on with clamps, or where it is necessary that the belt shall be tight to produce tension, this allowance may be increased slightly, but not much. For single belts, this length must be increased by the length of one lap; the belt may then be cut to this total length, and the laps prepared and cemented as described.

For double belts, the plies should be opened for a little distance from the ends of the belts. This distance varies with the width of the belt, and consequently with the length of the lap desired; and it depends also upon whether there are any other joints near the ends. It may be desirable to make it long enough on one side of the belt or the other to include an existing lap, so that two laps shall not come close together on the same side of the belt. This distance must be long enough so that each lap will have a piece of whole leather on the opposite side.

When this distance is determined, one side of one end must be cut back the proper distance, and the opposite side of the other end. New belts can be prepared best at the bench. Clamps for very wide belts usually are made with a heavy screw-eye bolt in one of each pair of blocks, so that a chain hoist or a block and tackle may be used in the case of heavy belts to bring the ends of the belt to a point where the rods may be inserted.

With a new belt it is necessary to pull it up to a point where the laps fit perfectly. Then an observation should be made to see whether the belt is sufficiently tight. There may have been an error in measurement or insufficient allowance for stretch. If it is decided that the belt is not tight enough, it is a simple matter to scrape back the laps far enough to tighten it sufficiently.

There is some sort of agreement among belting men that single belts should be put on so that they have an initial tension, before starting, of 72 pounds per inch of width, and double belts in proportion. Ordinarily no method of measuring this tension is at hand, and it becomes a question of judgment of the workman, who must endeavor to determine the proper tension by watching the performance of his belts after they have been running, and gaging the frequency with which they have to be "taken up."



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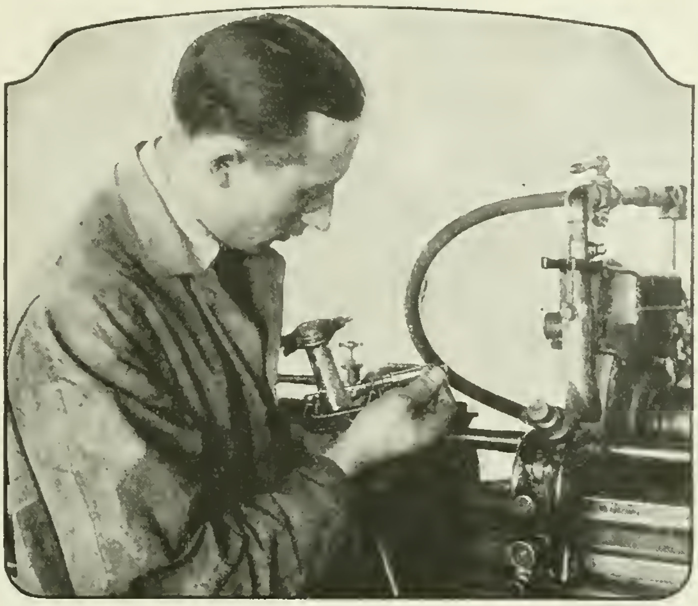

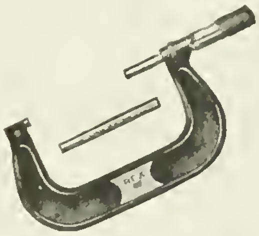

The frames of Rex Micrometers are of I-section to give the greatest rigidity and strength with lightness. The rectangular shape of the frame gives greater measuring capacity than frames of the circular type. Supply your tool cribs with Rex Micrometers.

For uniform results on ground work use Rex Micrometer Sets

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Use **BROWN & SHARPE TOOLS** *for Accurate work*

PERSONALS

Ernest W. Duston, formerly of Cleveland, Ohio, is now chief engineer of the American Bolt Corporation, New York.

Calvin L. Jones, welding engineer of the Westinghouse Electric & Mfg. Co., at Atlanta, Ga., has been elected vice-president of the American Welding Society.

George H. Grundy has been made manager of steel sales for Peter A. Frasse & Co., Inc., with headquarters at the general offices of the company in New York City.

H. M. Crane, consulting engineer, 44 W. 44th St., New York, has been nominated to serve as president of the Society of Automotive Engineers for the next administrative year.

William Breeden, formerly general manager of sales of the Lackawanna Steel Co., has been made manager of steel sales in the Buffalo district for Peter A. Frasse & Co., Inc., with offices at 52 Exchange St., Buffalo.

James C. Bennett, comptroller of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., was elected a director of the company at a recent meeting of the stockholders in place of John R. McCune, who died on May 14.

Walter Rogers, until recently connected with the Taft-Peirce Mfg. Co., Woonsocket, R. I., returned July 1 to the Vonnegut Machinery Co. of Indianapolis, Ind., to take charge of the accessory department of that company.

J. R. Viets, for many years in charge of the shipping department of the General Electric Co.'s Lynn works, and more recently traffic representative for the New England district, has been appointed assistant traffic manager with headquarters at River Works, West Lynn, Mass.

L. R. Louis has resigned his position as vice-president and sales manager of the Cleveland Cap Screw Co., formerly known as the F. P. Screw Co., of Cleveland, Ohio. Previous to his connection with this company he was assistant sales manager for the Foster Bolt & Nut Mfg. Co., also of Cleveland.

Professor Harold A. Thomas, for the last thirteen years a member of the staff of the Rose Polytechnic Institute, Terre Haute, Ind., has joined the faculty of the Carnegie Institute of Technology for the coming year. He will begin his new work in the fall as professor of theoretical hydraulics and of hydraulic and sanitary engineering.

A. S. Moody, assistant northwest manager of the General Electric Co., Schenectady, N. Y., has been appointed local manager of the Los Angeles office of the company, to succeed R. L. Cash, who has been transferred to Schenectady. Mr. Moody has been identified with the General Electric Co. on the Pacific Coast for the last sixteen years.

R. B. Hubbell, formerly connected with the Norton Co. and the Heald Machine Co., Worcester, Mass., is now in charge of machine tool sales with the Greenfield Tap & Die Corporation, Greenfield, Mass. Mr. Hubbell has had many years of experience in the manufacture and selling of machine tools, particularly in the grinding field.

George G. Everitt, for eleven years associated with the Whitman & Barnes Mfg. Co.'s eastern sales organization in New York, has been made manager of the New York office and warehouse, at Church and Chamber Sts., New York City. Mr. Everitt's previous experience has given him a wide knowledge of the twist drill and reamer requirements in this territory.

Thomas H. Endicott has been appointed vice-president and general manager of the Green Equipment Corporation, Monadnock Block, Chicago, Ill., manufacturer of commutator under-cutting tools, and commutator stones and cements. Mr. Endicott was formerly sales engineer with the Crocker-Wheeler Co., and later sales manager for the metal-cutting department of E. C. Atkins & Co.

W. J. Leighner has been appointed works manager of the George Cutter Co., a subsidiary of the Westinghouse Electric & Mfg. Co., located at South Bend, Ind. Mr. Leighner has been in the employ of the Westinghouse company since 1903, having advanced step by step through the positions of errand boy, drawing-room attendant, follow-up clerk, order clerk, chief clerk of the railway department, and assistant supervisor of production, until he has reached the position of works manager.

William C. Frye, for seven years president of the Chain Belt Co., Milwaukee, Wis., and for twenty-eight years associated with the company, has retired from active participation in its affairs, and has been succeeded by C. R. Messinger who held the positions of vice-president and general manager since 1917. Mr. Messinger is also president of the Interstate Drop Forge Co., vice-president of the Sivyer Steel Casting Co., and vice-president of the Federal Malleable Co., all of Milwaukee, as well as a director in the Nugent Steel Castings Co., of Chicago.

OBITUARIES

J. Harry Kitt, for many years traffic manager for the Carborundum Co., Niagara Falls, N. Y., died Thursday, July 19, at his home in that city, aged fifty-seven years.

Walter M. Aikman, an outstanding figure in the stamping, enameling, and galvanizing business, died July 6 at his home in Greenwich, Conn., in his ninety-sixth year. At the time of his death he was chairman of the board of directors of the Central Stamping Co. of New York and Newark, N. J., with whom he had been connected for nearly seventy-seven years. Mr. Aikman was born in New York on April 6, 1828, and at the age of nineteen began his career in the sheet metalware industry with the firm of N. A. James & Co., which was established in 1834. At the end of the second year, he became a partner of the firm, and upon the death of N. S. James, the concern became James, Aikman & Co. The company later consolidated with E. Ketcham & Co., and in 1886, when the name Central Stamping Co. was assumed, Mr. Aikman became president, which office he held until 1922, when he became chairman of the board of directors. He is survived by two daughters and a son.

IMPROVEMENT IN BRITISH BUSINESS CONDITIONS

A general but slow improvement in European business conditions is predicted by Brudenell P. Boyle, assistant to the European manufacturer of the Westinghouse Electric International Co., London, England, who is in this country on a brief business trip. Mr. Boyle has been in the export business for many years, and is quite familiar with world affairs. He states that the general tone in England is toward stability; that people are making up their minds to take things as they are and make the most of them; and that the increase in stability and confidence is reflected in the present building boom in England. The building industry is the only one that is showing real signs of activity, but it is bringing the steel and electric industries along. The situation in England is, therefore, much like that in this country, where building activity led to the return of better industrial conditions, and where the electric power companies have for some time been increasing their capacity, to take care of the increase in business resulting from increased building activity.

* * *

THE RAILROAD SITUATION

The railway earnings for the last few months are the best on record for many years. The freight loadings are the highest in the history of the railroads, and owing to the large number of freight cars added to the equipment, there is a surplus of cars in good repair. In October, 1920, when 1,018,500 freight cars were loaded in one week—the highest previous loading record—there was a car shortage of nearly 70,000 cars. During the last week in June, 1,021,800 cars were loaded, and there was a surplus of 63,600 cars in good repair. This is due to the fact that 248,000 freight cars have been ordered since January 1, 1922, of which about 140,000 have been delivered. In the same period 4250 locomotives have been ordered, of which about 2000 are still to be delivered. The railroads are making great strides in providing sufficient equipment to handle the increased traffic that is being offered by the expanding industries.

* * *

INDUSTRIAL LABOR CONDITIONS

Employment in the manufacturing industries has remained fairly constant during the last six months. In most of the machine-building centers there has been a shortage of skilled labor. Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association points out, however, that there is really enough labor available for a steady production, and that the apparent labor shortage is mainly due to the fact that some manufacturers assume that if they can get sufficient labor, they can turn out the orders that they are able to obtain in what amounts to a boom period, even though most other manufacturers cannot do so. This practice merely brings about an increase in wages without increasing the total supply of goods or orders for goods, and causes increases in costs and prices, thereby doing a great deal of harm to both the industry and the community.

The Adaptable—

CINCINNATI VERTICAL MILLER

"A Good Way to Mill a Spiral"

Note that the only special part of the equipment is a small bracket fastened to the end of the plain table for supporting the intermediate change gears. It is a simple task to connect the standard rotary table drive with the plain table screw by means of change gears. For every revolution of the rotary table the plain table is advanced a distance of 1.25" which was the lead of the spiral.

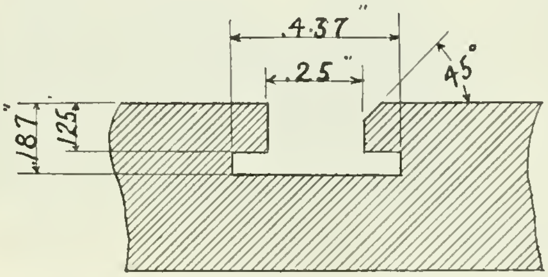
A standard high speed milling attachment added to the regular head gave the necessary speed to the small cutters required for the job.

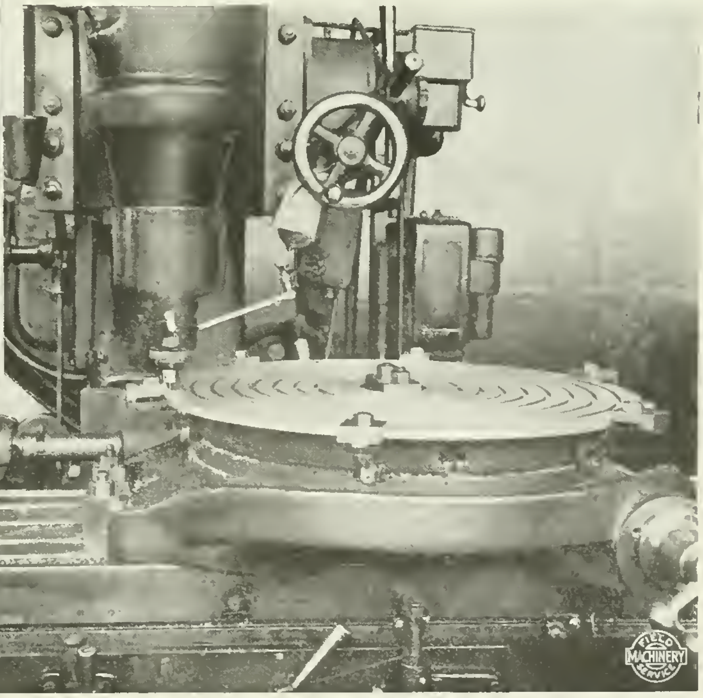
The piece is an aluminum disc 28" outside diameter, 7/16" thick, with a spiral T-slot that makes 8 revolutions at a lead of 1.25".

This handling of an unusual job is a good example of the adaptability of the Cincinnati Vertical Milling Machine. We'll be glad to show you other examples.

THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI, OHIO, U. S. A.





TRADE NOTES

Manning, Maxwell & Moore, Inc., has moved its offices to the Pershing Square Building, 100 E. 42nd St., New York City.

Latrobe Tool Co., Latrobe, Pa., manufacturer of high-speed drills and reamers, has moved its Chicago warehouse to 1440 W. Lake St.

V & O Press Co., manufacturer of presses, dies, and special machinery, is now located in its new plant at Hudson, N. Y., to which all mail should be addressed.

Vanadium Alloys Steel Co. announces that its Pittsburg sales office will be removed September 1 from its present location at First and Ross Sts. to the Oliver Bldg., Pittsburg, Pa.

Colonial Supply Co., Pittsburg, Pa., has been appointed exclusive distributor in the western Pennsylvania territory for the Latrobe Tool Co., Latrobe, Pa., manufacturer of high-speed drills and reamers.

American Nickel Corporation, Clearfield, Pa., has discontinued the Pittsburg sales office formerly maintained, and has moved its entire sales organization to the main office and plant at Clearfield, Pa.

Rockford Tool Co., 2400 Eleventh St., Rockford, Ill., has appointed the Foss Machinery Co., 305 St. James St., Montreal, Canada, exclusive representative for the Sundstrand tool-room, manufacturing, and engine lathes in the Montreal territory.

Williams, White & Co., Moline, Ill., announce that J. B. Hill has taken charge of the sale of the company's machinery in the Detroit district, succeeding C. G. d'Ugglas who recently died. Mr. Hill's office will be located at 623 Majestic Bldg., Detroit, Mich.

Manhattan Machine & Tool Works, 40 Market Ave., N. W., Grand Rapids, Mich., has been purchased by Frank J. Jarecki, and the business will be continued at the same location under the name of Jarecki Machine & Tool Co., manufacturing tools, dies, special machinery, screw presses, and grinders.

Kendell Motor Products Co., Fort Wayne, Ind., has been formed to take over the patent rights and business of the Kendell Engineering Corporation. The new company will continue the manufacture of the Kendell piston-rings, for which the old company had approximately 250 domestic and foreign distributors and dealers.

Prybil-Genzlinger Machine Co., manufacturer of spinning lathes, all-ball-bearing wood turning lathes, as well as accessories, such as oval spinning chucks, trimming and beading attachments, and compound leather spinning attachments, formerly situated in the Herald Bldg., New York City, is now located at 22-26 Frost St., Brooklyn, N. Y.

Roller-Smith Co., 233 Broadway, New York City, has appointed H. D. Baker, 525 Woodward Ave., Detroit, Mich., representative of the state of Michigan for its line of instruments, circuit breakers, and radio apparatus. Mr. Baker has been associated with the Roller-Smith Co. in various capacities for several years.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., announces that it is now represented in the Memphis and Vicksburg territories by the J. E. Dilworth Co., Inc., 493 S. Main St., Memphis, Tenn., who will have the exclusive distribution of Chicago leather belting in this district. The J. E. Dilworth Co., Inc., will carry a complete stock of "Reliance" and "Sea Lion" leather belts, in addition to the Chicago line of belting accessories and special belts.

Goddard & Goddard Co., Inc., Detroit, Mich., manufacturer of milling cutters, recently held its yearly gathering of representatives and salesmen at the home office, under the supervision of C. S. Goddard, sales manager. L. K. Berry, sales manager of the Detroit Twist Drill Co., and A. N. Goddard, president of Goddard & Goddard Co., gave the principal addresses. One of the features of the meeting was a tour through the plant of the Hudson Motor Car Co.

Elk Mfg. Co., New York City, has been taken over by the Elk Machine Tool Corporation, 243 W. 17th St., New York City. The new company will continue to manufacture and sell all the precision tools formerly made by the Elk Mfg. Co. under the Elkin patents, including machines for shaving, burnishing, and squaring bearings used in internal combustion motors, valve-lifters, air compressors, etc. J. G. Elkin is president of the company and will have entire charge of manufacturing.

Connecticut Blower Corporation, Hartford, Conn., has been incorporated under the laws of Delaware, with a capitalization of $250,000, to manufacture blowers and exhaust fans, blower systems of all kinds, dust collecting systems, etc. The new company will take over the business of the International Blower Co. and the Hartford Sheet Metal Works. The plant of the former company will be utilized until the fall, at which time a larger plant will be occupied. The officers of the company are as follows: President, M. E. Keeney; treasurer, C. H. Keeney; and secretary, C. E. Keeney.

Blakely Mfg. Co., Detroit, Mich., has purchased the stamping machinery and equipment of the Liberty Stamping & Mfg. Co., and is removing this equipment to its new factory at Fullerton Ave. and Monnier Road. The company manufactures shipping fastenings, particularly hold-downs of various kinds for automobiles. A new line of fastenings is being brought out, which is adapted to the general manufacturing trade for holding parts in position in crates, boxes, or freight cars. The Liberty Stamping & Mfg. Co. will concentrate its efforts in the future on the manufacture and sale of its line of enameled metal tables.

Brightman Bros. Co., Columbus, Ohio, is a new organization incorporated for $250,000 to engage in the manufacture of hexagon steel bar nuts, shafting machinery, and straightening machinery. It is intended later to install equipment for manufacturing turned and drawn shafting, screw stock, and cold-drawn products. Land has been purchased between Markinson and Woodrow Aves., in South Columbus, on which a plant will be erected which is expected to be in operation in about two months. The officers of the company are as follows: President, C. W. Brightman; vice-president and treasurer, G. F. Brightman; vice-president, H. M. Brightman; secretary, H. L. Brightman, and assistant secretary, T. L. Brightman. All of the officers were formerly connected with the Brightman Mfg. Co., of Columbus, and were among the originators of the Brightman process for turning shafting.

COMING EVENTS

August 20-30—Meeting of the American Institute of Mining and Metallurgical Engineers at Quebec, Canada. Secretary, F. F. Sharpless, 29 W. 39th St., New York City.

September 17-22—Ninth national exposition of chemical industries, in the Grand Central Palace, New York City. For further information address National Exposition of Chemical Industries, Grand Central Palace, New York.

September 18-21—Third annual machine tool exhibit given by the New Haven branch of the American Society of Mechanical Engineers in the Mason Laboratory, New Haven, Conn. Chairman, A. C. Jewett.

September 24-28—Meeting of the Association of Iron and Steel Electrical Engineers at Buffalo, N. Y., in conjunction with the Iron and Steel Exposition held in the Buffalo Auditorium. Further information may be obtained from the Association of Iron and Steel Electrical Engineers, Empire Building, Pittsburg, Pa.

October 8-12—Annual convention of the American Society for Steel Treating to be held in Pittsburg, Pa., in connection with an international steel exposition. W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio, national secretary.

October 25-26—Production meeting of the Society of Automotive Engineers at Cleveland, Ohio. Further information may be obtained from the society's headquarters, 29 W. 39th St., New York City.

October 29-31—Convention of the American Management Association in New York City; headquarters, Hotel Astor. Further information can be obtained from the secretary of the association at 20 Vesey St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

University of Delaware, Newark, Del. Catalogue for 1922-1923 containing calendar, description of courses, and general information concerning registration, fees, etc.

Polytechnic Institute of Brooklyn, Livingston and Court Sts., Brooklyn, N. Y. Catalogue of the College of Engineering for 1923-1924, containing calendar, requirements for admission, outline of courses, and other information relative to the institute.

Pennsylvania State College, State College, Pa. Circular containing announcement of the eighth summer session in industrial organization and administration, which is held from August 27 to September 8. The circular gives information regarding the course, and shows views in the various departments.

NEW BOOKS AND PAMPHLETS

Methods of Measurement of Properties of Electrical Insulating Materials. By J. H. Dellinger and J. L. Preston. 72 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 471 of the Bureau of Standards. Price, 15 cents.

Patent Worth and Worthless Patents. By Thomas A. Hill. 48 pages, 5 by 7 inches. Published by the Davie Press, Inc., 267 W. 17th St., New York City.

The reason for the preparation of this book, states the author in the preface, is that comprehensive text-books on patent law are necessarily voluminous and cannot be fully appreciated without some preliminary study of law; therefore, there seems to be a need for a book that tells, plainly, something about both what is of value and what is worthless in connection with patents.

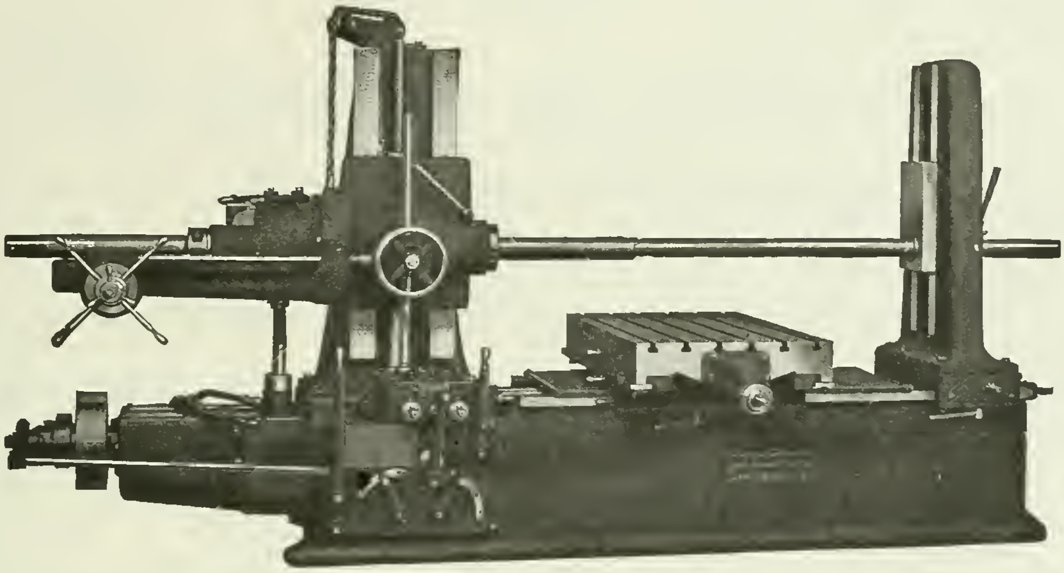
Construction and Use of Automatic Screw Machines. 352 pages, 6 by 9 inches. Published by the Brown & Sharpe Mfg. Co., Providence, R. I. Price, $1.

This book has been prepared by the Brown & Sharpe Mfg. Co., as a book for the operator of the automatic screw machines built by the company, and also deals with automatic turret forming machines and automatic cutting-off machines. It is divided into nine chapters, dealing, respectively, with a general explanation of how the

We could say many good things about the LUCAS

"PRECISION"

BORING, DRILLING AND MILLING MACHINE



But it is what the users say that counts; and here is what one of them DID say:

"When any one asks to see our Lucas, we take him over to the machine, take off our hats, and say, 'there it is.'"

And we have a large collection of "customer's ads" almost as good.

WE ALSO MAKE THE
LUCAS POWER
Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo. Aux Forges de Vulcain, Paris. Benson Bros., Sydney, Melbourne.

Brown & Sharpe automatic screw machines operate, the erection and care of the machine, how to set up a machine for a job, the construction and adjustment of the machine, the standard tools used, the automatic turret forming and cutting-off machines, how to design cams, how to machine cams, and attachments. A number of tables and a complete index are also included. The book contains numerous illustrations pertaining to the different subjects dealt with. All parts are clearly shown, and the text is simple and to the point.

Design of Steam Boilers and Pressure Vessels. By George B. Haven and George W. Swett. 435 pages, 6 by 9 inches; 206 illustrations. Published by John Wiley & Sons, Inc., New York City. Price, $4.

This is the second edition of the author's well-known book on steam boilers and pressure vessels. The book is intended primarily to teach rational methods of boiler design, but at the same time it serves as an introduction to a broader study of machine design. The application of the principles set forth at the beginning of the book is ably illustrated in the last six chapters by working out from beginning to end complete designs for boilers and tanks of six different types. The book comprises ten chapters as follows: General Principles; Stresses in Pressure Vessels; Fastenings by Riveted Joints; General Proportions; Design of a Horizontal Return Tubular Boiler; Design of a Dry Back Scotch Boiler with Combustion Chamber in Shell Extension; Design of a Vertical Straight Shell Multi-tubular Boiler; Design of a Locomotive Type Boiler for Contractors' Use; Tank Design; and Water-tube Boiler Design.

Locomotive Catechism. By Robert Grimshaw. 958 pages, 5 by 7½ inches; 500 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $4.

This is the thirtieth revised and enlarged edition of a unique book on the design, construction, running and repairing of all kinds of locomotives, including information on air brakes, superheaters, the Walschaert valve gear, etc. The present edition contains over 4000 questions and answers. The catechism form in which the book is published makes it especially valuable in preparing for examinations. Some of the questions included are those used by prominent American railways in examining firemen and engineers for employment and promotion. In the present edition special attention is paid to certain branches more recently brought to the engine-runners and fireman's notice—for instance, the unaflow engine, the improved superheater, the latest design of power brake, and the electric locomotive. The chapter on accidents has been enlarged, and material has been added on valve diagrams, traction curves, and motion studies.

NEW CATALOGUES AND CIRCULARS

Findlay Engineering & Mfg. Co., Findlay, Ohio. Circular containing illustrations and specifications for the models A and B riveters produced by this firm.

Goulds Mfg. Co., Seneca Falls, N. Y. Bulletin illustrating the construction of the Goulds new line of single-stage, double-suction centrifugal pumps.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheet No. 154 FE describing the application of New Departure ball bearings in a variable-speed hydraulic transmission.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Booklet known as Special Publication No. 1667, containing a list of over 300 installations of Westinghouse industrial heating apparatus.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., is supplying belt users, upon request, with belt record cards, 5 by 8 inches in size, for keeping a record of the performance of belts of different kinds and sizes.

Pryibil-Genzlinger Machine Co., 26 Frost St., Brooklyn, N. Y. Circular illustrating and describing ball-bearing metal-spinning lathes for round and oval work. The circular gives full specifications and dimensions.

L. Best Co., 28-30 West Broadway, New York City. Supplementary catalogue (1923) of Sterling grinding wheels of different types, including vitrified, silicate, and elastic wheels of all the commercial grades and grains.

Crescent Tool Co., Jamestown, N. Y., is issuing a monthly publication called "The Crescent," published by and for the employes, which contains personal items and other news of the social activities of the organization.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Circular showing applications of the "Liftabout" electric hoist, a small, easily installed hoist adapted for moving both large and small loads in all lines of work.

Latrobe Tool Co., Latrobe, Pa. Catalogue for 1923, covering the line of high-speed twist drills and reamers made by this concern. Tables of dimensions and list prices are given for each of the tools, and illustrations are included.

Affa Specialty Co., 34 Southbridge St., Worcester, Mass. Circular containing facts about the Affa pressed-steel C-clamp for machinists and toolmakers, which is claimed to give a pressure of 175 pounds when screwed up with the fingers only.

Mabr Mfg. Co., Minneapolis, Minn. Circular descriptive of the Mahrvel oil-fired compressed-air tool furnace, for hardening, drawing, and annealing high-speed or carbon steels and similar work. Specifications are given for four different sizes of furnaces.

Consolidated Tool Works, Inc., 296 Broadway, New York City. Circular illustrating the No. 26 heavy-handle adjustment hacksaw frame manufactured by this concern. The frame is made of heavy steel construction, and is adjustable for 8- to 12-inch blades.

Ingersoll-Rand Co., 11 Broadway, New York City. Bulletin 3044, descriptive of Imperial type XPV duplex steam-driven air and gas compressors, equipped with Ingersoll-Rand plate air valves. These air compressors are made in a number of different types and sizes.

Wisconsin Electric Co., 2562 Sixteenth St., Racine, Wis. Circular showing "Dumore" high-speed grinders in use on a variety of work. These grinders are portable, electrically driven, and are made in six distinct styles with different speed ranges for various classes of work.

Crescent Washing Machine Co., New Rochelle, N. Y. Circular entitled "Washing Metals by Machinery," containing illustrations and specifications of the line of metal cleaning machines made by this concern, which utilizes both chemical and mechanical action in cleaning metal parts.

Westcott Chuck Co., Oneida, N. Y. Catalogue 510, covering the Westcott line of lathe chucks and Little Giant drill chucks. Dimensions and prices are given for the four different styles of drill chucks and the six styles of lathe chucks produced by this firm. The various styles of chucks are illustrated

Brown Instrument Co., Philadelphia, Pa. Booklet entitled "The Automatic Control of Temperature in the Heat-treating of Steel," containing illustrations and descriptions of Brown automatic control pyrometers, illustrations of installations, and statements from users in regard to their experience with this equipment.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has issued the first number of a publication devoted to industrial heating, which is entitled "Electric Heat." This number contains articles concerning the use of electric heat in the manufacture of storage batteries and electric motors, as well as many other applications.

Johns-Pratt Co., 41 E. 42nd St., New York City, has issued a locomotive chart for the use of engineering and mechanical departments of steam railroads. The chart shows a typical modern locomotive in outline, with each part numbered, and gives a complete list of the parts numbered, with a definite reference to defects as covered by the Interstate Commerce Commission rulings.

Motorbloc Corporation, Summerdale, Philadelphia, Pa. Bulletin L25, illustrating and describing the Motorbloc motor-driven chain hoist intended for a wide range of material-handling operations. Bulletin L50, containing instructions for maintaining the Motorbloc motor-driven chain hoist. This bulletin contains a general description of the hoist, oiling directions, and a list of parts.

W. S. Rockwell Co., 50 Church St., New York City. Circular describing the relation of furnace temperature control to the quality and cost of the finished product. The circular will aid in giving a better understanding of the underlying principles affecting the manner, rate, and time of heating, which must be considered, in addition to temperature regulation, in determining the uniformity with which a product is heated or cooled.

Yale & Towne Mfg. Co., Stamford, Conn. Folder on the new Yale trolleys, containing, in addition to detailed descriptions of the plain and geared types of Yale steel plate roller bearing trolleys, a description of the new Yale cast-iron trolley. Details are given of some tests to which the steel plate trolley has been subjected, as well as a complete list of the material-handling equipment manufactured by this company.

Edwin E. Bartlett, Nashna, N. H. Circular entitled "Questions Answered Regarding Greenerd Arbor Presses," containing information concerning the construction of these arbor presses. Circular illustrating Greenerd arbor presses, which are made in thirty different styles and sizes. This circular also gives a table of pressure factors for different shaft diameters, used in determining the size of arbor press to be used. The Greenerd arbor presses are sold by Henry Prentiss & Co., 149 Broadway, New York City.

Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Circular illustrating some of the special single-purpose types of riveters made by this concern to suit a wide variety of conditions. A brief description is given in connection with the different styles of the particular work for which each is applicable. The regular line of Hanna riveters is made in 500 styles and sizes, ranging from 4 inches to 21 feet reach, with capacities of from 10 to 150 tons.

Rollway Bearing Co., Inc., Syracuse, N. Y. Catalogue 3, containing a general description and tables of dimensions, load ratings, speeds, etc., of the Rollway "Maximum" type bearings, which are designed for use under the most severe type of service. The original range of sizes has been increased so as to afford a proper selection for practically any condition. Data are included on the Rollway thrust bearings which are also designed for severe work.

Mitchell Engineering Co., Springfield, Ohio. Catalogue illustrating and describing the line of ball-bearing polishing and buffing machines made by this concern. Two styles of machines are shown, single- and double-spindle machines, and specifications are given for the different sizes in both styles. One of the special features claimed for this line of machines is the rapidity with which the spindles can be removed and replaced, thus eliminating lengthy shutdowns and delay in production.

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Pamphlet descriptive of the course in vocational training offered by this company, the purpose of which is to train students to become skilled mechanics. Class-room instruction and practical shop work are carried on at the same time, and the boys are earning a wage doing actual production work, while acquiring their training. A complete account of the course is given, and the illustrations show the attractive environment with which the boys are surrounded.

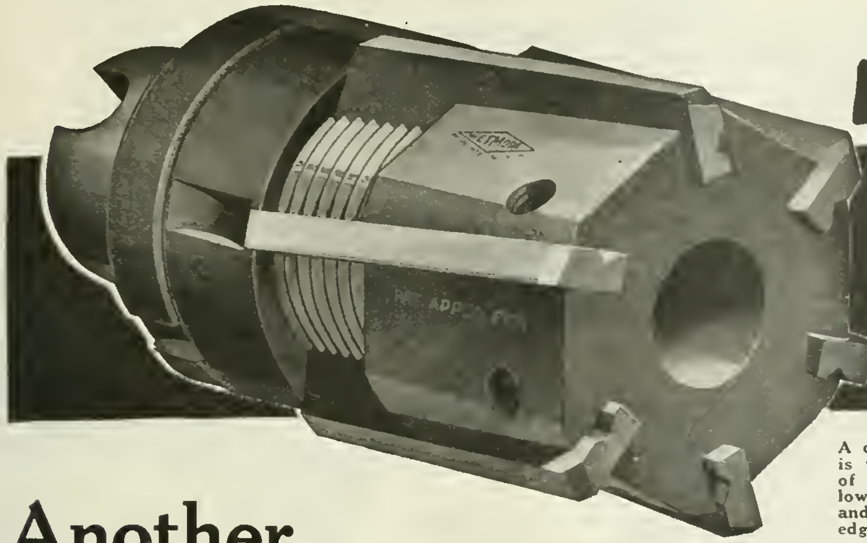
Niagara Machine & Tool Works, Buffalo, N. Y. Bulletin 63, illustrating and describing Niagara straight-sided single-crank power presses, series No. 50, and trimming presses, series No. 50-T. Bulletin 64, descriptive of Niagara double-crank power presses, series No. 60. Bulletin 65, illustrating and describing Niagara double-crank power presses, series No. 70. These bulletins contain detailed descriptions, and clear and distinct illustrations of the various types of presses manufactured by the company, as well as information relative to modifications of design and special features.

Brown & Sharpe Mfg. Co., Providence, R. I. Booklet on Brown & Sharpe ground-form cutters, which have been developed with a view to obtaining work of a high degree of accuracy, increasing production, and securing cutter economy. The booklet describes in detail the important features of these cutters. The principle of the ground-form cutter is confined to cutters of comparatively simple outlines, such as those for cutting gears, sprockets, and spline shafts, and the advantages of this form of cutter for each of these classes of work are pointed out.

Hanchott Swage Works, Big Rapids, Mich. Folder illustrating and describing the Hanchett portable combination woodworker, which consists of a universal saw, a planer, and a drum sander. This combination makes it possible to perform all the most common woodworking operations on one machine. The pedestal is mounted on rollers, and fitted with a roller jack which locks the machine in a stationary position or lifts it and allows it to be rolled to the place where the work is to be performed. The machine is approximately 35 inches high, and weighs about 500 pounds; the size of the combined work-table top is 24 by 33 inches.

Norton Co., Worcester, Mass. Handbook on tool and cutter grinding, and catalogue of Norton universal tool and cutter grinding machines. The book contains considerable general information on the subject of tool and cutter grinding, including the selection of wheels and grinding procedure. An interesting feature of the book is the section containing problems in tool and cutter grinding, which gives data on equipment to be used, preliminary preparation, methods of setting up and grinding a wide variety of work. While these problems are especially applicable to Norton machines, they may also be adapted to other makes. Pamphlet giving information on grinding wheels, covering selection of grain and grade, wheel faces, how to order, testing for safety, methods of mounting, and wheel speeds.

Wells Corporation, Greenfield, Mass. Catalogue 1, of standardized small tools, superseding all other small tool catalogues formerly issued by the constituent companies of this corporation, namely, the Frank O. Wells Co., American Tap & Die Co., and the Williamsburg Mfg. Co. The catalogue gives dimensions and list prices of screw plates, taps, dies, die-stocks, tap wrenches, die-holders, reamers, counterbores, keyway sets, broaches, broaching presses, back-saw frames, tool sets, screwdrivers, levels, nail sets, center-punches, etc. Attention is called to the fact that this catalogue includes only sizes and sets of tools that are in constant demand, and only such screw threads are shown as are recommended by the National Screw Thread Commission and the committee appointed by the American Society of Mechanical Engineers. The aim in thus standardizing the tools shown in this catalogue is to reduce the number of unnecessary sets, styles, and sizes, thus reducing waste and incidentally prices.



Note this Advantage

A distinctive feature of this Wetmore Shell Reamer is the 1/8" projection of the blades over the end of the reamer body for chip clearance. This allows the chips to fall off ahead of the reamer body and prevents chips from clogging up along cutting edge of blades.

Another WETMORE REAMER that Cuts Production Costs

Here is the famous *Wetmore Expanding Shell Reamer*, the reamer that helped so many production men turn out more work at less cost—and in less time—during the rush periods of 1922.

Now, again—this is one of the most popular of the Wetmore line. It is turning out job after job that other reamers have fallen down on. More than one user has told us that this Wetmore Shell Reamer has done work which they thought would stump any reamer.

That's why we say: The *Wetmore Expanding Shell Reamer* is guaranteed, absolutely, to lower your production costs. It does quicker work—the reamer stands up longer—blade replacement costs are cut.

This Wetmore Shell Reamer is adaptable for either line or pilot reaming. Fits all standard bars and shell reamer arbors. Body, lock nut and cone nut are finest heat-treated alloy steel. Has .087" expansion. Made in these sizes: 1¼" to 3", 6 blades; 3 1/16" to 5", 8 blades; 5 1/16" to 6", 10 blades. Made also with straight hole, if desired. Left-hand blades are staggered to eliminate chattering.

Send for FREE Catalog.

Write for Wetmore Catalog, showing full line of standard, heavy duty, shell, small machine and cylinder reamers. Also arbors and replacement blades. Sent *free, postpaid*—no obligation to you.

WETMORE REAMER COMPANY
MILWAUKEE, WISCONSIN

WETMORE Replacement Blades

The method of holding the blades on the Wetmore Shell Reamer eliminates unnecessary extra parts. This saves time and simplifies the replacement and adjustment of blades.

All Wetmore blades are scientifically ground for working various metals—steel, cast iron, bronze, etc. Best high-speed steel, ground to thickness, length and on seat. Tested for hardness and toughness. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron or bronze.

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

INSEPARABLE

IF YOU SAY "ARMSTRONG" TO A MACHINIST HE WILL THINK, TOOL HOLDER

Thirty years of honorable association have made the words almost inseparable in his mind to which they also suggest Convenience, Economy and Efficiency. This also explains why Dealers find that among their customers 90% of the demand is for ARMSTRONG TOOL HOLDERS.

ARMSTRONG TOOL HOLDERS

SAVE High-Speed Steel
Time
Grinding Wheels

INCREASE PRODUCTION

SPECIFY ARMSTRONG when ordering AND GET THE BEST

Write for free catalog.

ARMSTRONG BROS. TOOL CO.
"THE TOOL HOLDER PEOPLE"
313 N. FRANCISCO AVE. CHICAGO, U.S.A.

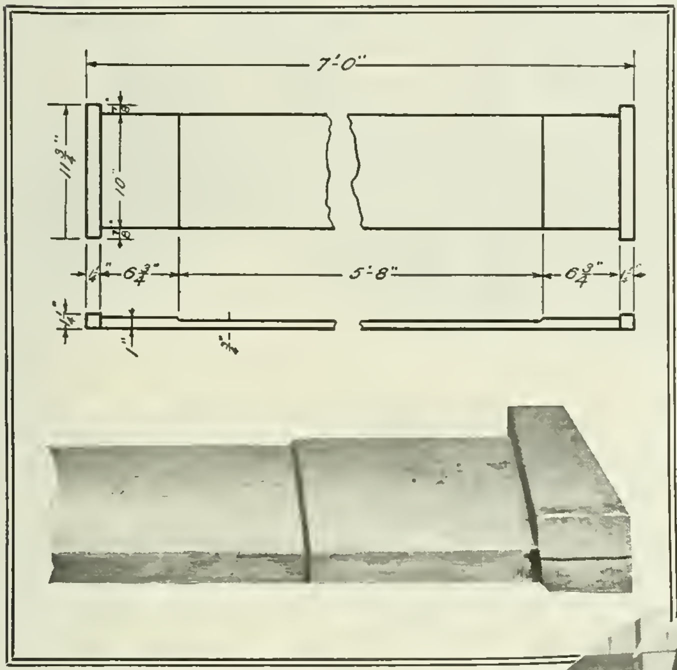
AJAX INSTALLATIONS Lower Costs

THIS NEW MODEL 5″ Ajax Upsetter at the Joliet Railway Supply Company, Chicago, Ill., has materially lowered the cost of these steel straps for Huntoon Blosters.

The piece was formerly bought from a contract shop at a price which allowed for the laborious operation of drawing it down from 1¼″ x 12″ stock under the hammer. Now it is produced "at home" on the 5″ Ajax by upsetting the ends of ¾″ x 10″ stock.

The size of the ends necessitates a preliminary stock gathering and a finishing operation. *The great vertical die space* of the 5″ Ajax accommodates both these operations in a two high die so that an end can be completed at one heat and one handling, eliminating the second die and tool set-up, and the additional heating and handling which the ordinary forging machine would require.

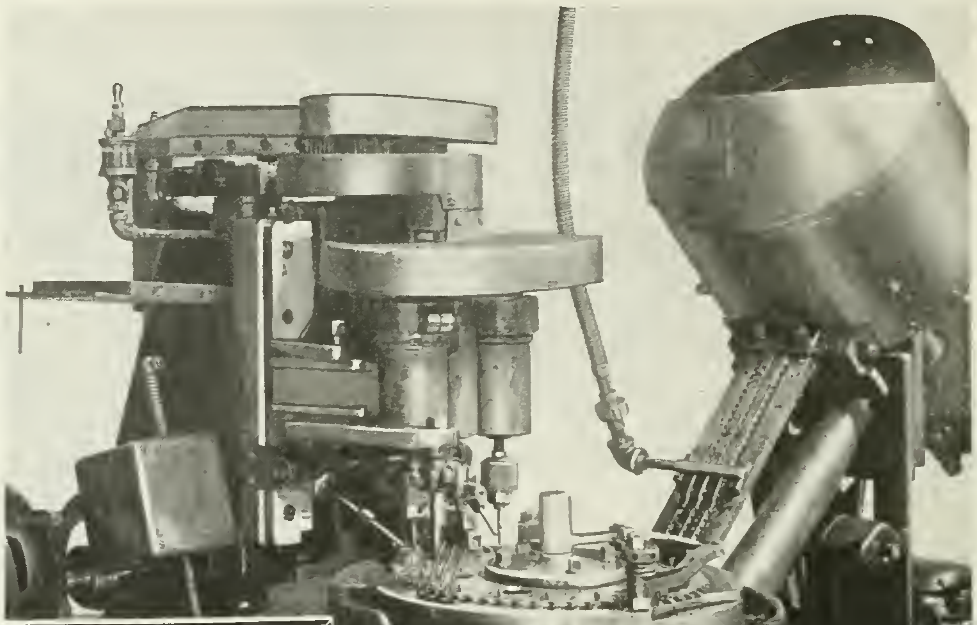
Let us show you how the installation of an Ajax would lower your costs.

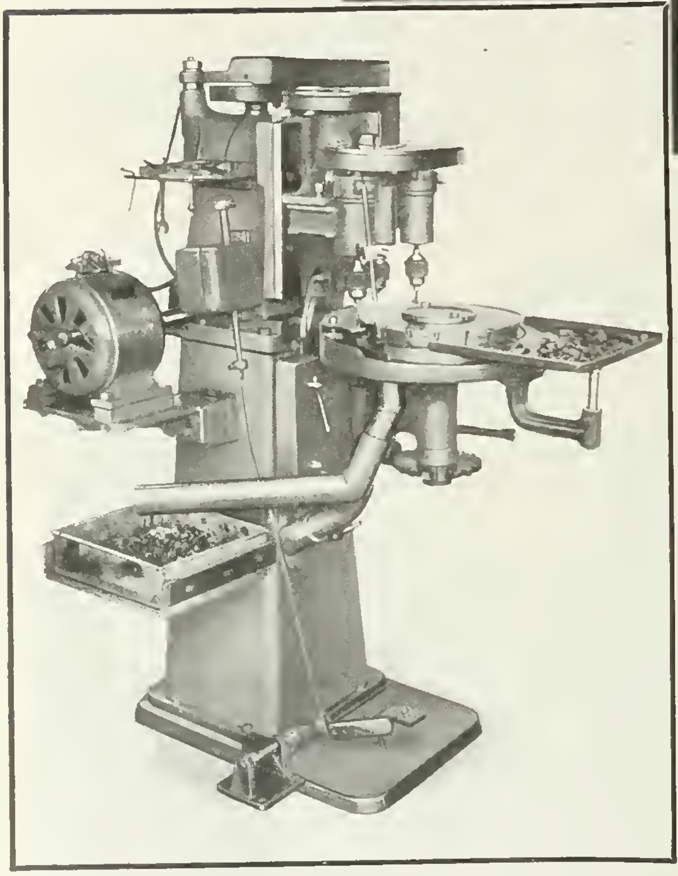


The Ajax Manufacturing Company
621 Marquette Bldg.
CHICAGO, ILL.
1369 Hudson Terminal
NEW YORK CITY
CLEVELAND, OHIO

AJAX

(Trade Mark Registered)





The standard Anderson Dial Feed Tapping Machine is semi-automatic, that is, an operator is required to load and unload the work. It is a remarkably efficient machine, run at a predetermined speed, which will maintain its output hour after hour. It handles a considerable range of work, with one, two or three holes, and all three taps can be of different lead if required.

Let us tell you all about Anderson machines; send samples for estimates.

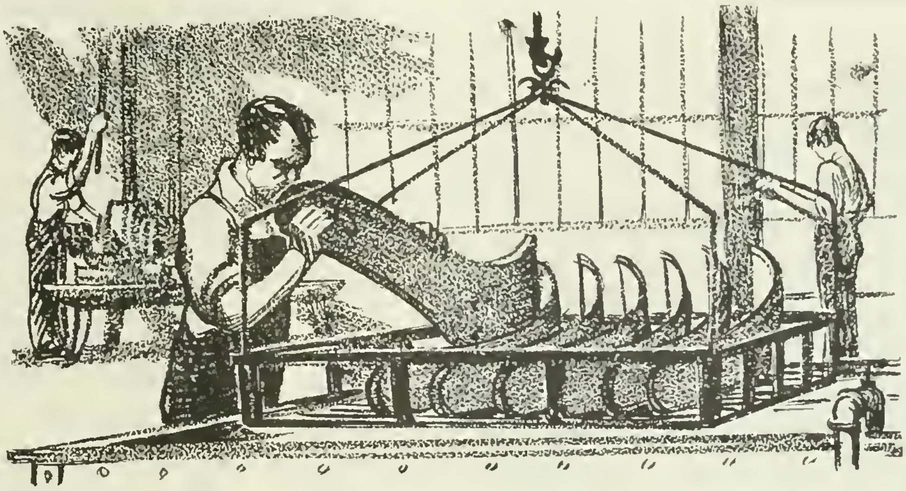
An Attachment that Makes the Anderson Tapper Fully Automatic

A full automatic can be made of the Anderson Dial Feed Tapping Machine by combining with it a hopper feeding attachment as shown. This particular machine was developed for tapping battery thumb nuts; but the automatic feed can be arranged for other similar classes of work.

The hopper has a chute with three raceways; the machine has three tapping spindles; the feeding dial, with 54 openings, is indexed by an 18 tooth ratchet; one movement of the dial, therefore, puts three nuts under the three spindles; a positive ejector removes the completed work.

The machine is timed to run 40 strokes per minute giving a theoretical production of 120 pieces per minute, 7200 per hour. On actual production three of these machines, running on a 20 hour schedule, tap 375,000 to 421,000 pieces per day.

THE ANDERSON DIE MACHINE COMPANY
BRIDGEPORT, CONN.



How much work will a pound of cleaning material do?

10 lbs. of Oakite materials cleans 480 auto fenders and other large sheet steel parts in one of the best known auto factories.

The job calls for the removal of oil and grease before japanning. It must be done right, to pass inspection and avoid rejects. A 10-minute immersion of these pieces in a thousand gallon tank does the work so well that not a single piece has been turned down on account of poor cleaning since they started using Oakite.

Oakite materials cost them slightly less than 1 cent for every 3 parts **perfectly** cleaned. That's economy!

Your own cleaning work may be quite different. It probably is. But no matter what kind of a metal product you may be making, you are doubtless just as interested as the foreman and superintendent of this plant were to get the most work you can out of each pound of cleaner you use.

It is likely that out of our experience in serving more than 14,000 plants in 52 different industrial classifications, we can offer you some valuable suggestions about cleaning methods, equipment or materials that will considerably reduce your cleaning costs.

When two practical men get together, each backed by his own special experience and knowledge, ways and means for improving methods are bound to be uncovered. One of our cleaning specialists will be glad to cooperate with you. Write us when you would like to have him call.

There are 70 Oakite Service Men, cleaning specialists, located at: Allentown, Pa.; Baltimore, Boston, Bridgeport, *Brooklyn, Camden, Cedar Rapids, *Chicago, *Cincinnati, *Cleveland, *Dallas, Dayton, *Denver, *Des Moines, *Detroit, Erie, Evansville, Ind.; Grand Rapids, Greenville, N. C.; Harrisburg, Hartford, *Indianapolis, *Kansas City, Lansing, *Los Angeles, Louisville, *Milwaukee, *Minneapolis, *Montreal, Newark, New Haven, *New York, *Oakland, Philadelphia, Pittsburgh, Portland, Me.; Poughkeepsie, *Providence, Reading, Rochester, Rockford, *Rock Island, *San Francisco, Schenectady, *Seattle, *St. Louis, Toledo, *Toronto, Utica, Waterloo, Williamsport, Pa.; Worcester.

***Stocks of Oakite materials are carried in these cities.**

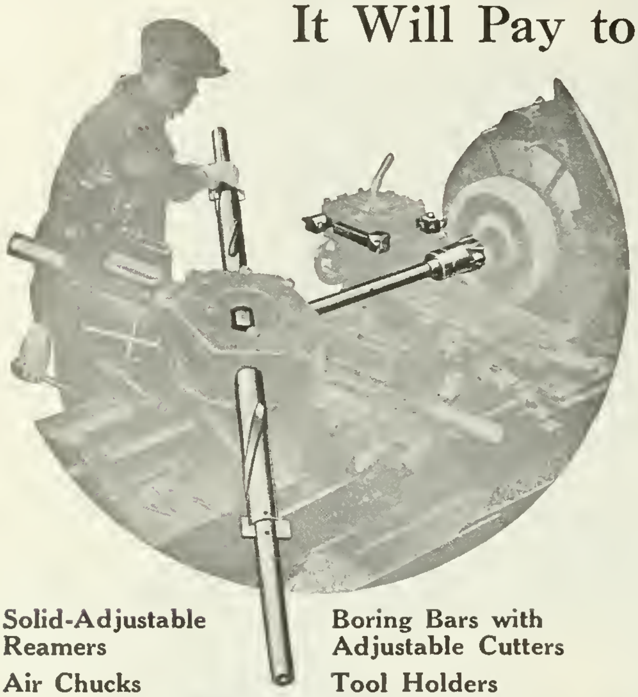
Write for our booklet "Modern Metal Cleaning"

Oakley Chemical Co. *General Offices:* **26 Thames St., New York, N. Y.**

OAKITE

Industrial Cleaning Materials

It Will Pay to Fit your Turret Lathes with GISHOLT BORING BARS



Gisholt Boring Bars can be depended on to keep up their end of the work. Ample chip clearance eliminates all danger of cutters breaking from clogging chips; unusual rigidity is secured by locating the slot and pin so the cutter leads the largest diameter of the bar itself. Bars are machined in jigs and cutters are interchangeable, so no time is lost fitting new cutters when occasion requires.

Cutters are made solid or adjustable. Oil tubes deliver coolant to the cutters. Bars for holes from 1 inch to 9½ inches.

Send for descriptive circular

Solid-Adjustable Reamers
Air Chucks

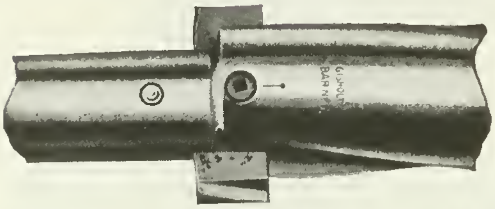
Boring Bars with Adjustable Cutters
Tool Holders

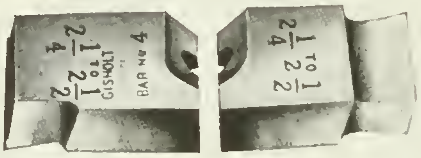
GISHOLT MACHINE COMPANY

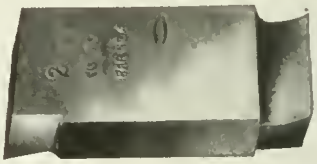
9 South Baldwin Street MADISON, WISCONSIN

Eastern Office:
Room 1725, 30 Church St.
New York City

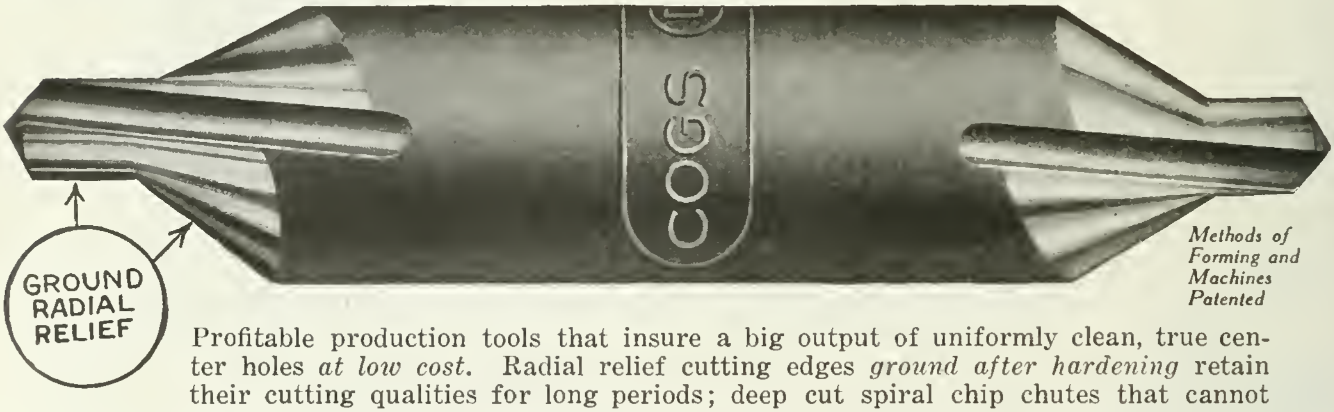
Cleveland Office:
1888 Page Avenue
Cleveland, Ohio







COGS DRILL Centre-Drills



Methods of Forming and Machines Patented

Profitable production tools that insure a big output of uniformly clean, true center holes *at low cost.* Radial relief cutting edges *ground after hardening* retain their cutting qualities for long periods; deep cut spiral chip chutes that cannot clog eliminate tool breakage from this cause.

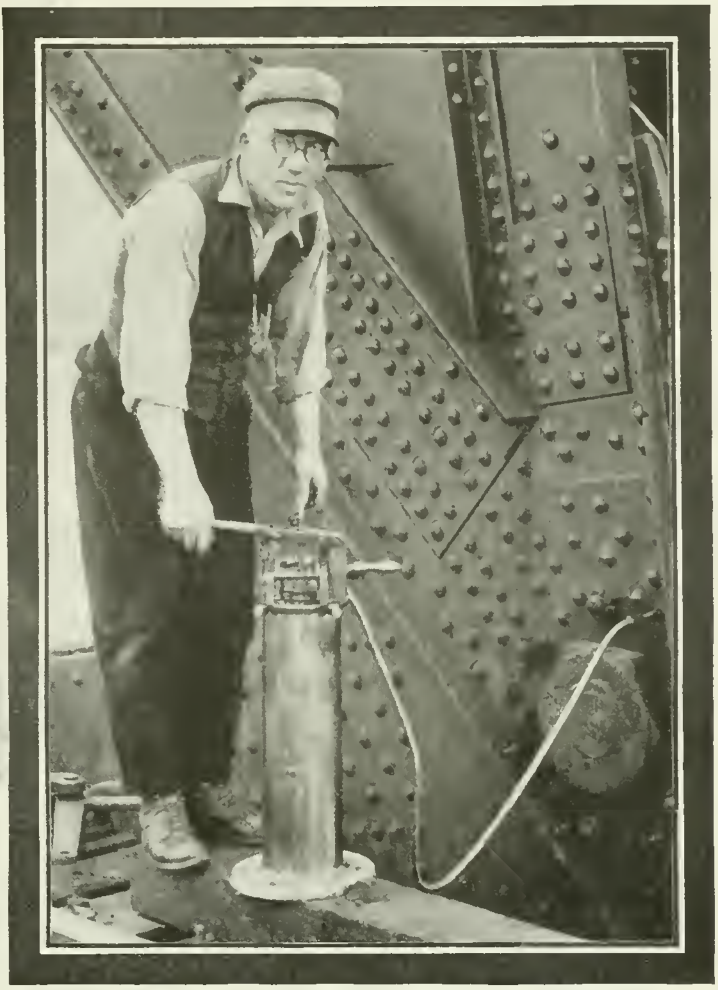
Accurate center holes insure accurate diameters, reduce wear on the machines, save time in machining and eliminate burned centers—to insure satisfaction use Cogsdrill Centre-Drills.

Catalog 2 Gives Further Details

COGSDILL MFG. CO., Detroit, Michigan

Originators of the Ground Radial Relief Centre-Drill

It made this bridge work right



The American Bridge Company built this railroad bridge across the River Rouge at Detroit. Upon completion the lift operation was jerky and irregular. It knocked badly because the erecting engineers were unable to force lubricant over the entire surface of the lift bearings.

So they decided to try Alemite.

Alemite fittings were installed. And the Alemite high pressure system forced lubricant to all the vital bearing surfaces at once. There was a marked improvement immediately—and E. E. Smith, Foreman of Erection, writes:

> "A continued application of your (Alemite) lubricant resulted in a continued improvement until the operation was all that could be desired.
>
> "You may rest assured we will recommend your lubricating system when the opportunity presents itself."

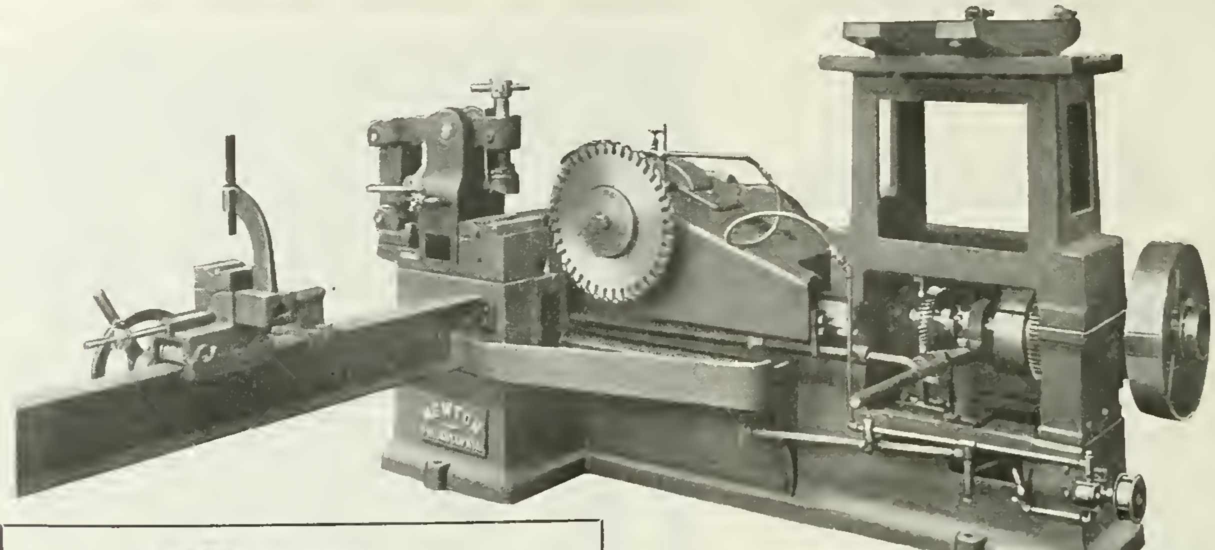
For every type of machine from railroad lift bridges to high speed machine tools Alemite lubrication is daily demonstrating its superiority. Our engineers will be pleased to show you how it can be applied to any industrial lubricating problem.

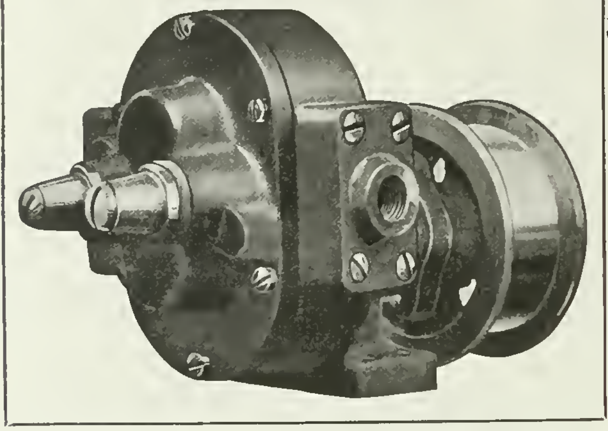
Alemite Lubricant is made specially for high pressure lubrication. It is pure solidified oil. Ordinary greases or oil can be used with the Alemite System, but we know of none that quite equals this special formula. Sold in 100, 200, and 400 pound drums. Also in 5, 1, and ½ pound containers for the hand gun.

ALEMITE

High pressure lubricating system

A Bassick-Alemite Product
THE BASSICK MANUFACTURING CO.
2664 North Crawford Avenue, Chicago, Illinois





Ask the Consolidated Machine Tool Corporation of America—

Once oracles would have been consulted. Now you ask the man who owns one—the Newton Machine Tool Division of the Consolidated, for example.

This company builds and guarantees to the limit Cold Saw Cutting-off Machines that drive saws up to 84 inches in diameter through solid metal 24 inches thick. This guarantee includes the Trahern Pump equipment, for what would happen to both saw and work without abundant and dependable coolant!

Trahern Coolant Pumps are designed for use on metal working machinery of all kinds; will supply cutting tools with water, oil or compound—in a slow drip or propelled with force to reach the deepest cuts and bores—but always free from pulsation.

Two types, one-way or reversible. Will operate against 100 pounds pressure; run at low speed; deliver 16½ gallons per minute; do not lose their prime.

Ask for bulletin 44.

Every NEWTON COLD SAW is Furnished with a

REG. TRADE MARK
TRAHERN
REG. U. S. PAT. OFF.

PUMP

LEADER-TRAHERN COMPANY

Plants: DECATUR and ROCKFORD, ILL.

NEW YORK CITY
21 East 40th Street

SEATTLE, WASH.
311 L. C. Smith Building

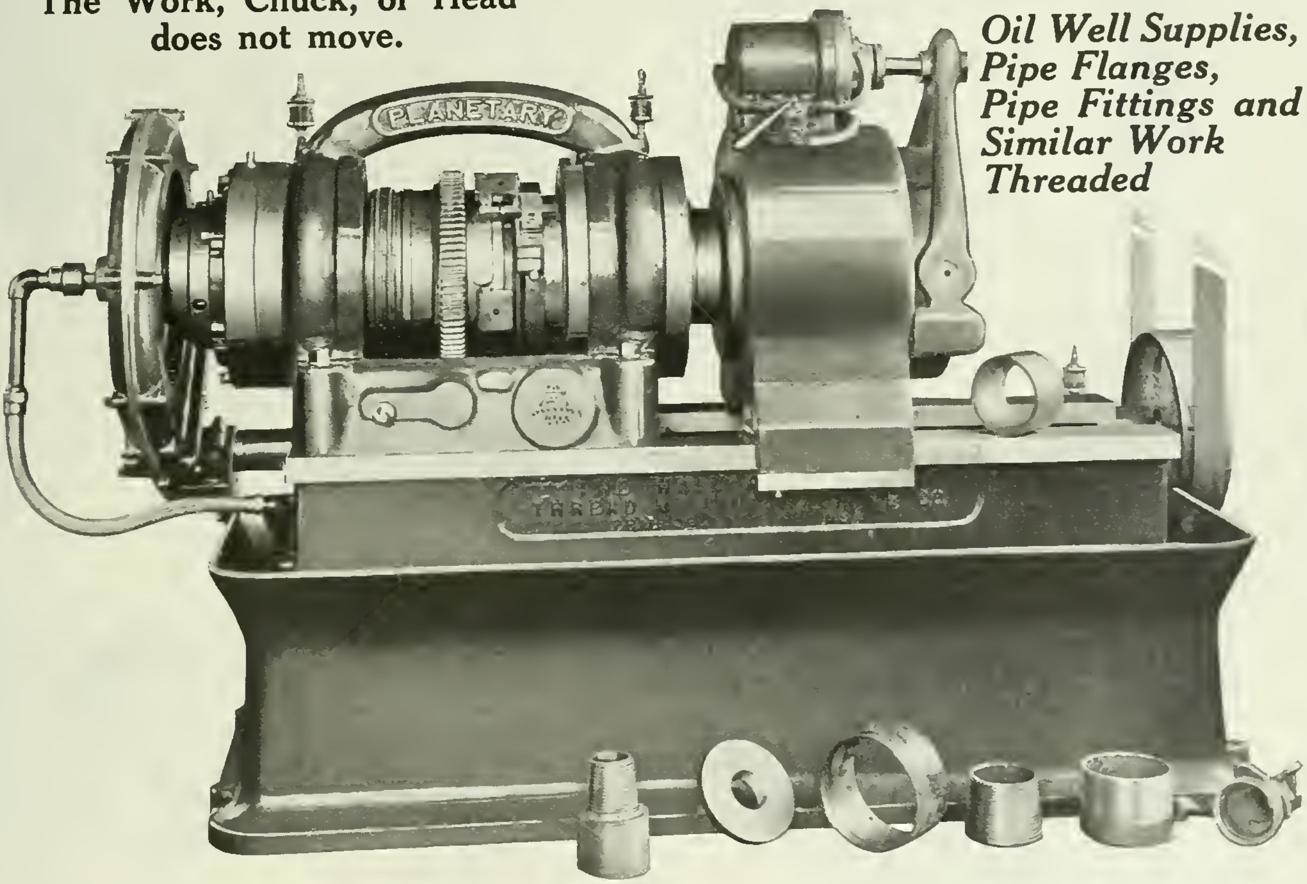
CHICAGO
327 S. LaSalle Street

The Largest and Most Awkward Pieces to Thread are Easy for the

PLANETARY

The Work, Chuck, or Head does not move.

Oil Well Supplies, Pipe Flanges, Pipe Fittings and Similar Work Threaded



6"—3 minutes, floor to floor
8"—4 minutes, floor to floor
10"—5 minutes, floor to floor
12"—6 minutes, floor to floor

A thread milling machine with the basic principles of the perfect machine tool. No sliding ways or gibs of any kind. Smooth, clean cut threads.

Strong, Heavy and Rigid Enough to Continually Hold to the Closest Tolerances. What Kind of Threading Interests You?

THE HALL PLANETARY
THREAD MILLER

THE HALL PLANETARY THREAD MILLING MACHINE COMPANY, Incorporated

Bridesburg, Philadelphia, Penna., U. S. A.

AGENTS:—San Francisco, Eccles & Smith Co. Detroit, J. C. Austerberry. Cleveland, The Cleveland Duplex Mchy. Co., Inc.

THE WELLS CORPORATION

Greenfield, Mass., U. S. A.

A NEW ERA IN PRODUCTION TAPPING

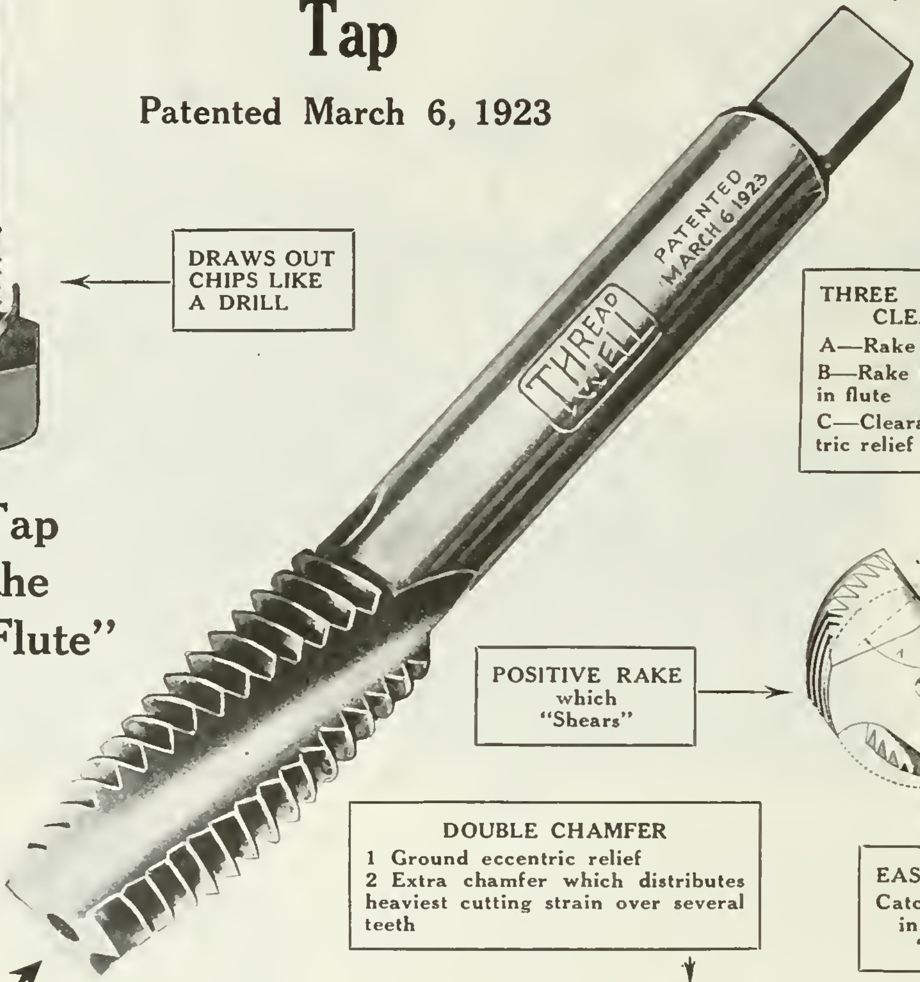
with the

Spiral THREAD WELL Flute Tap

Patented March 6, 1923

DRAWS OUT CHIPS LIKE A DRILL

“The Tap with the Drill Flute”



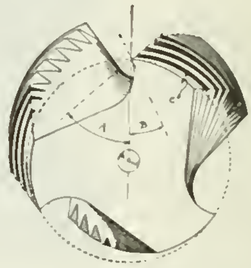
THREE POINTS OF CLEARANCE

A—Rake angle of spiral

B—Rake angle of hook in flute

C—Clearance of eccentric relief

POSITIVE RAKE which “Shears”

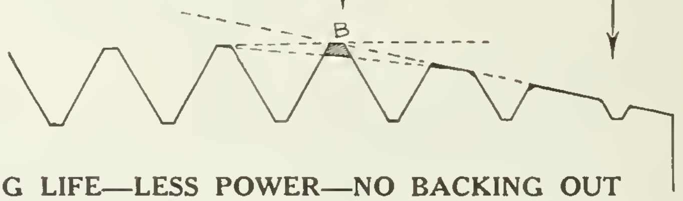


DOUBLE CHAMFER

1 Ground eccentric relief

2 Extra chamfer which distributes heaviest cutting strain over several teeth

EASY STARTING Catches thread instantly—no “reaming”



EASY STARTING—LONG LIFE—LESS POWER—NO BACKING OUT
IDEAL FOR “BLIND” HOLES

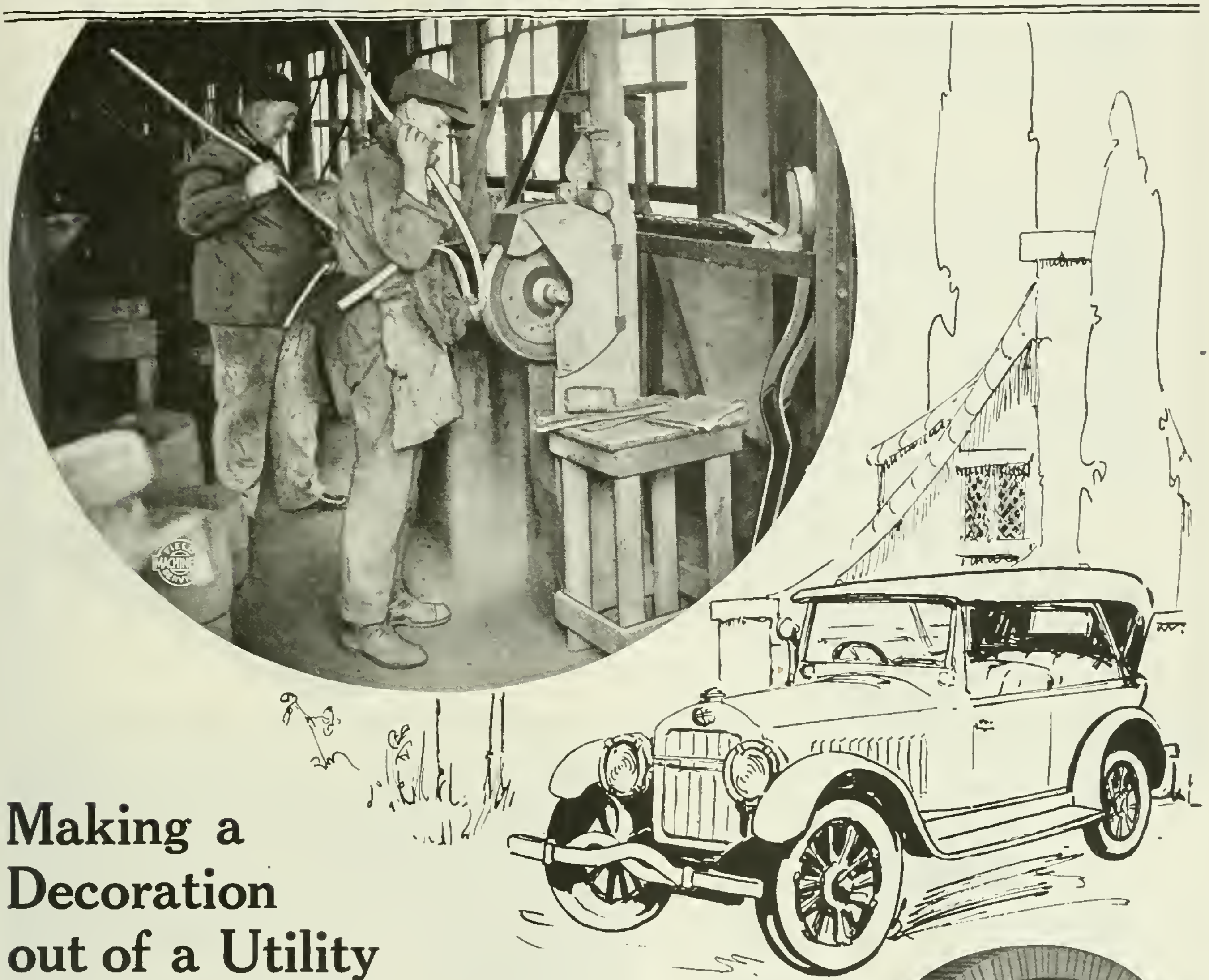
Send for our Catalog No. 1—See Pages 21-24—Also Other New Tools

THE WELLS CORPORATION

Greenfield, Mass., U. S. A.

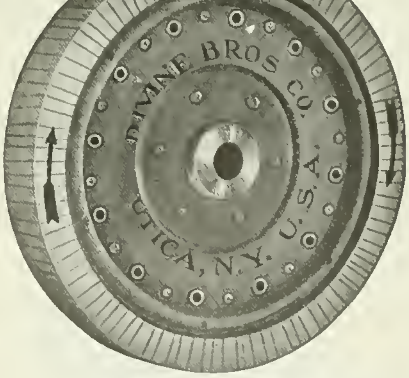
M-8-23

DIVINE POLISHING SERVICE



Making a Decoration out of a Utility

Nickel finish gives style to automobile bumpers, gives them greater sales value. It costs a little extra to polish the bars and nickel them—but it is worth it. Lyons Bumpers are finished this way. Divine Polishing Service assisted in planning the methods used; Divine Polishing Wheels do the actual work. The operations are grind, polish, plate and buff. On the polishing operation an operator will finish 200 to 225 bumpers per day.



A correctly planned and equipped polishing room will help you gain in production, economy, efficiency and profit. Let us show you.

ENGINEERING DEPARTMENT

DIVINE BROTHERS COMPANY

Utica, New York, U. S. A.

Just What Automobile and Tool Builders Have Always Needed

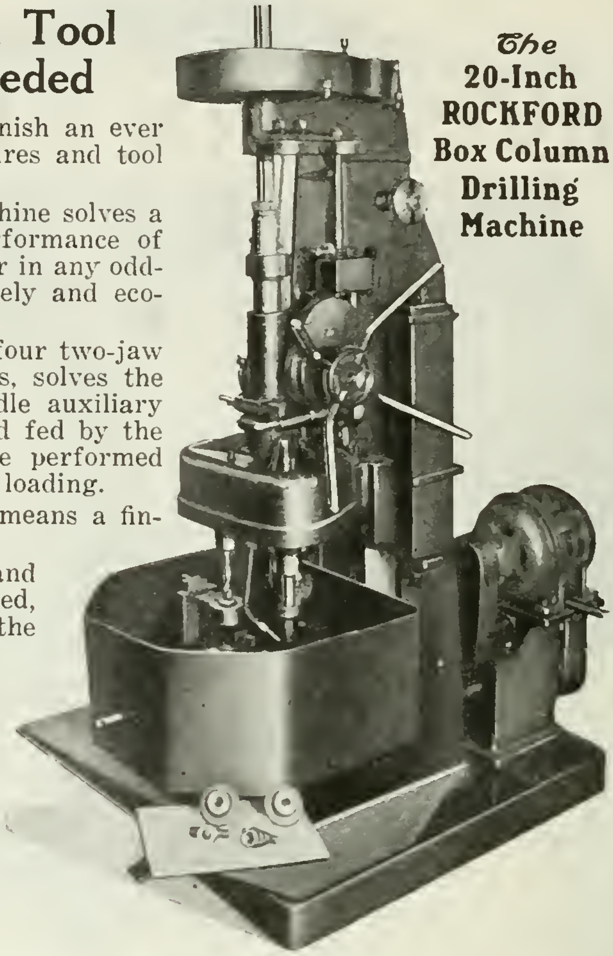
Second operation jobs on odd-shaped parts furnish an ever present problem, often entailing expensive fixtures and tool changes.

This recent adaptation of a well established machine solves a host of these difficulties; provides for the performance of three successive operations with a common center in any odd-shaped parts within its capacity—fast, accurately and economically.

A rotary station indexing table, equipped with four two-jaw chucks provided with special work-holding jaws, solves the feeding and fixture problem; and a three-spindle auxiliary head, carried on the table ways, but driven and fed by the spindle, permits three tooling operations to be performed simultaneously and leaves one position open for loading.

Indexing is the only idle time and every index means a finished part.

Output? Excellent! The accompanying yoke and flange members, for example, are rough drilled, taper reamed, faced and finish taper reamed at the rate of 250 pieces per 10-hour day.

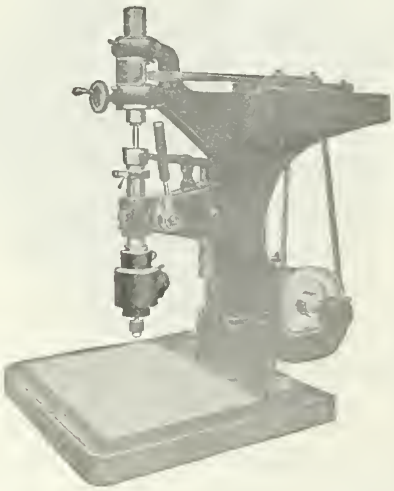


The 20-Inch ROCKFORD Box Column Drilling Machine

THE
ROCKFORD
DRILLING MACHINE Co
·ROCKFORD·
ILL., U.S.A.

Let us tell you more about it.

Like all our other products
Avey
TAPPING ATTACHMENTS give the best of satisfaction



Six sizes to give maximum results from 0 to 13/16" in cast iron.

Our Bulletin C.B. 2 tells all about the High Speed and the General Purpose Attachments.

Let us help you solve your tapping problems

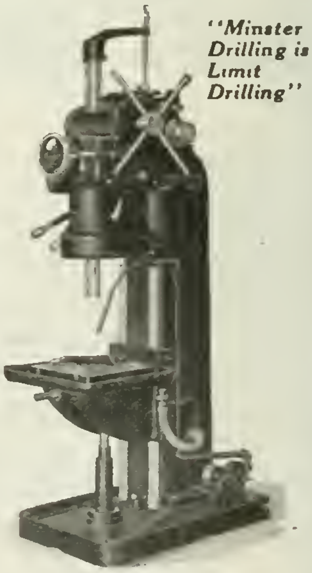
The Avey Drilling Machine Company
CINCINNATI, OHIO

Minster Hi-Duty Drills

Profitable equipment for shops specializing in big work. Have wide range, plenty of power and every operating convenience for big production on wide variety of work.

Five sizes from 1½" to 3¼" in solid steel.

Ask for the catalog which describes them fully.



"Minster Drilling is Limit Drilling"

The Minster Machine Co.
MINSTER OHIO, U. S. A.

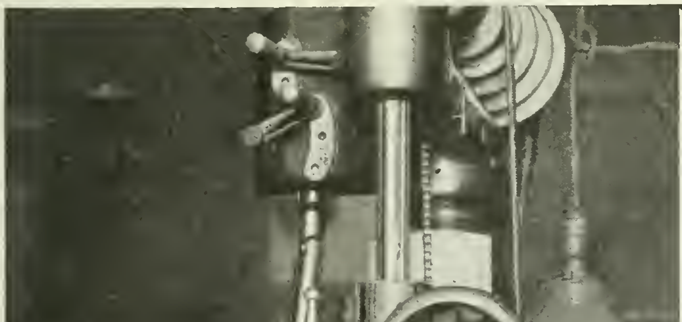
HOLES

drilled with speed and utmost
accuracy when you have—

HARRINGTON
Multiple Spindle Drills

made by

Edwin Harrington, Son & Co., Inc.
Philadelphia, Pa.



An Unusual Machine for Unusual Work

In an experimental shop, the Knight Milling and Drilling Machine is more than ordinarily useful—its tilting table makes it the equivalent of several machines.

In the manufacturing department the Knight more than holds its own. You could not find a better machine for rapid and accurate production of duplicate parts—for milling and drilling at angles.

The illustration shows one of the four "Knights" at the Davis-Bournonville Company plant, Jersey City, N. J. This one is finishing slots 3/16" wide, in a cast-iron gear guard while micrometers on slide and table locate the cutter and determine the length of slot. All four machines in this plant handle a great variety of unusual work and are greatly appreciated.

Write for Knight details

W. B. Knight Machinery Co.
3920 W. Pine St. St. Louis, Mo., U. S. A.

FOREIGN AGENTS—The Coats Machine Tool Co., Ltd., London, Eng.; Yamatake Company, Tokyo, Japan; Allied Machinery Co. of America, France, Spain, Portugal, Italy, Switzerland, Begium.

Could You Equal These Drilling Records?

Piece Number	Remarks	Size of Hole	Depth of Hole	Material	Pieces Per Hour
1	One hole	⅛	⅝	C. R. Steel	900
2	Six holes to center of head	⅛	⅞	C. R. Steel	150
3	One hole at a time	⅛	⅞	C. R. Steel	450
4	One hole at a time	3/16	1	Seamless Tubing	450

1

2

3

4

RESULTS LIKE THESE

would only be possible on a machine that operates continuously with no non-productive time to be charged against the job.

We also build the Detroit Continuous Production Centerless Grinder.

On the Detroit 5-Spindle Semi-Automatic Drilling Machine, all five drills are fed to the work and returned in an uninterrupted sequence of movements.

The operator is merely required to load and unload the fixtures; and their quick acting mechanism enables him to set up work for all five spindles.

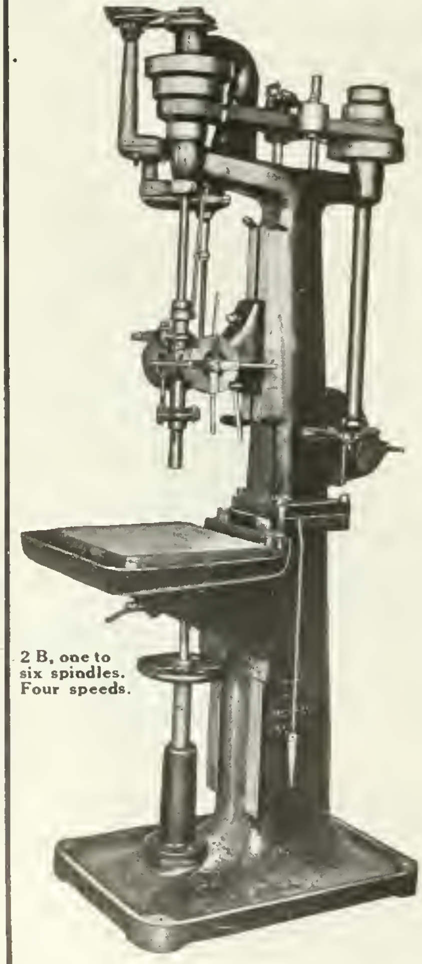
It's eliminating the non-productive time that counts.

May we quote on your blueprints or samples?

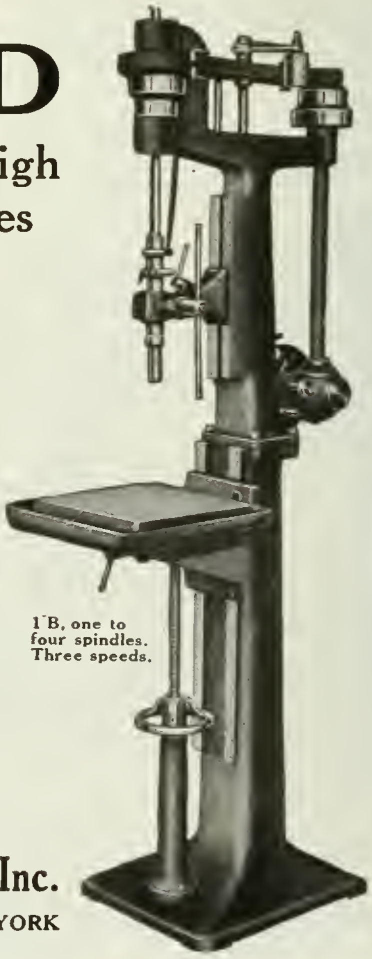
DETROIT MACHINE TOOL COMPANY
DETROIT 6525 St. Antoine St. MICH.

EDLUND

Ball Bearing, Sensitive, High Speed, Drilling Machines


2 B, one to six spindles. Four speeds.

Ten ball bearings per spindle; speed changes made from natural working position, without stopping machine; straight, endless belt drive; belt shifted by rack and pinion and from either side; spindle carefully balanced and counterbalanced; adjustable depth screw; splash system of lubrication; provision for taking up all slack and wear; pump, tank and fittings if desired.


1 B, one to four spindles. Three speeds.

Builders of Portable Bench Hack Saws and Semi-Automatic Drilling Machines for all purposes.

Edlund Machinery Company, Inc.
CORTLAND NEW YORK

In Morris Radials You Get Power and Convenience

In the Morris Radial the head is heavily constructed, correctly balanced and travels freely on the arm's broad ways by means of a rack and pinion—controlled through reduction gears by a handwheel within easy reach at its highest position—and is locked by two screws, clamped simultaneously by one handle.

Spindle gears are helical—providing more than one tooth in mesh at the same time—and all the back gears and back gear clutches are of chrome nickel steel, important features in securing the smooth, quiet, powerful force for which these machines are famous.

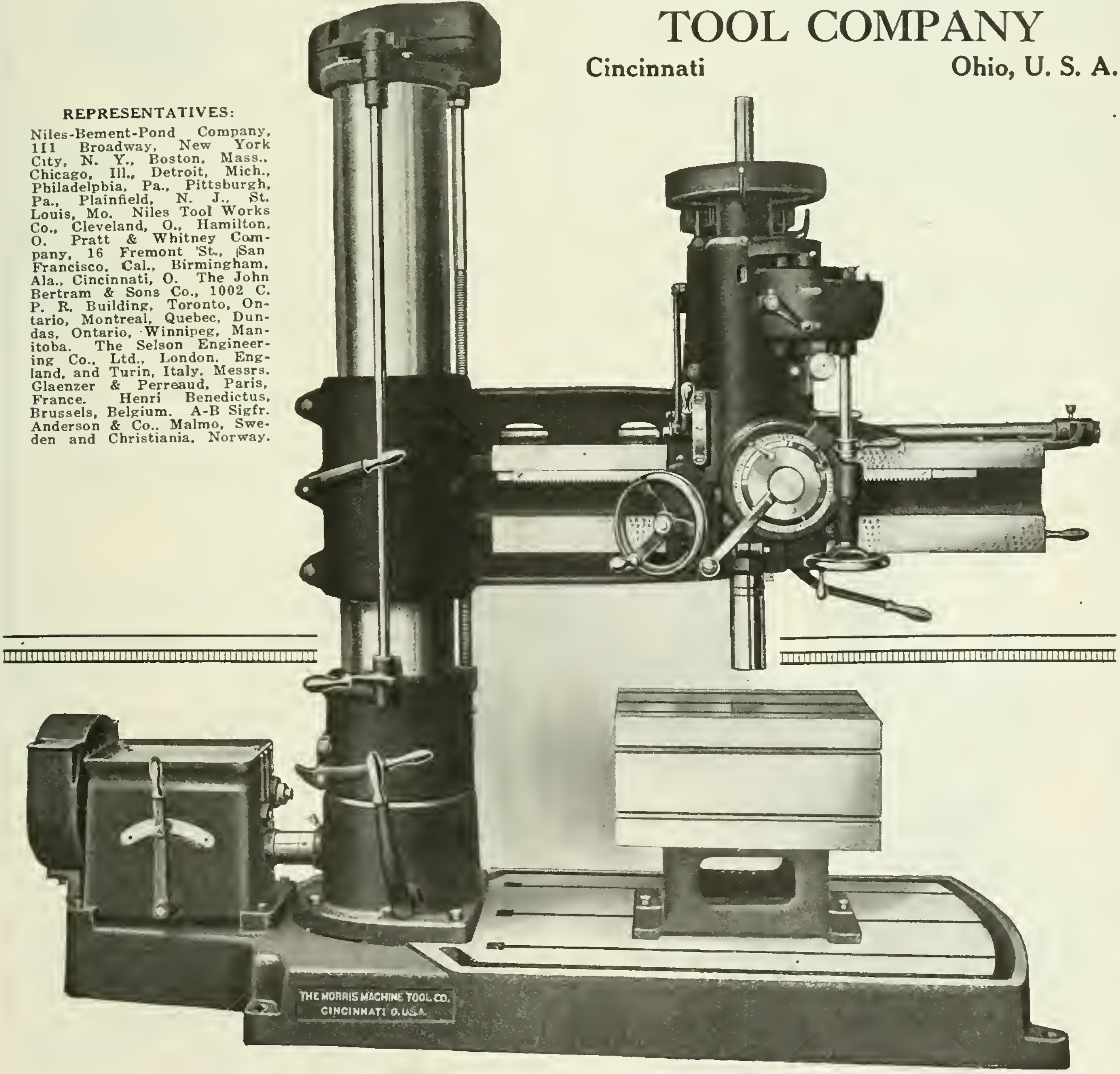
The "Morris" head has other advantages and the column, arm, base and speed box have still more—equally interesting, equally important and fully described in the circulars which show the whole line of 2, 2½, 3, 3½, 4 and 4½ foot machines.

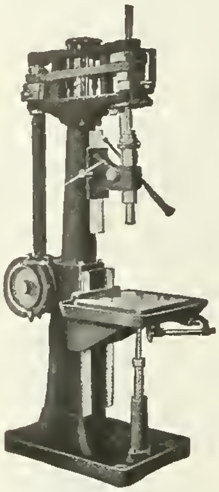
THE MORRIS MACHINE TOOL COMPANY

Cincinnati Ohio, U. S. A.

REPRESENTATIVES:

Niles-Bement-Pond Company, 111 Broadway, New York City, N. Y., Boston, Mass., Chicago, Ill., Detroit, Mich., Philadelphia, Pa., Pittsburgh, Pa., Plainfield, N. J., St. Louis, Mo. Niles Tool Works Co., Cleveland, O., Hamilton, O. Pratt & Whitney Company, 16 Fremont St., San Francisco, Cal., Birmingham, Ala., Cincinnati, O. The John Bertram & Sons Co., 1002 C. P. R. Building, Toronto, Ontario, Montreal, Quebec, Dundas, Ontario, Winnipeg, Manitoba. The Selson Engineering Co., Ltd., London, England, and Turin, Italy. Messrs. Glaenzer & Perreaud, Paris, France. Henri Benedictus, Brussels, Belgium. A-B Sigfr. Anderson & Co., Malmo, Sweden and Christiania, Norway.





How the Fosdick Family Grew

A concern using Fosdick Radial Drilling Machines needed an Upright Drill—but they were so solidly "sold" on Fosdick quality that it *had* to be a Fosdick machine.

So we brought out the Fosdick Upright.

Later, other manufacturers called for further variations of the Fosdick models—and we designed the Fosdick Ball Bearing Sensitive Drill.

The several sizes in which each style drill is built make the Fosdick family large—but each unit in the line embodies the Fosdick standard of excellence and represents developments far in advance of general practice.

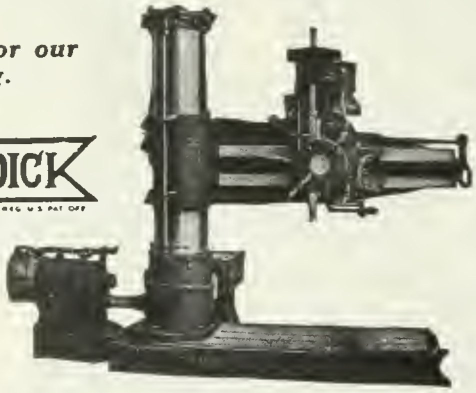
Radial Sizes—2′ to 6′; High Speed Sensitive, 3′ 3½′, 4′; Balanced arm, 4′, 5′, 6′.

Upright Drills—21″ to 30″ swing.

Ball Bearing—Superspeed Sensitive, 1 to 8 spindles, 13″ to 24″ swing.

Send for our catalog.

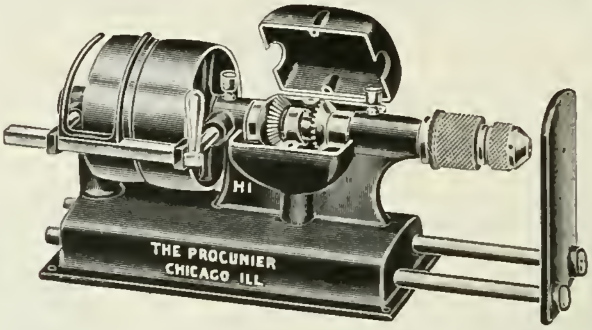
FOSDICK



THE FOSDICK MACHINE TOOL COMPANY

CINCINNATI, OHIO, U. S. A.

The "Procunier"



A New Bench Tapping Machine Designed by Tapping Experts

The "Procunier" reputation for efficient tap holding devices and tapping attachments makes this new machine worth noticing. It is built for service. All bearings are of bronze. Simple in construction and having the new and improved driving and reversing mechanism. The "DOUBLE-JAW" chuck, plus the Safety Friction, which slips the instant the tap hits bottom, eliminates tap breakage.

If you do any tapping, get the details of this new machine.

WILLIAM L. PROCUNIER

18 So. Clinton Street CHICAGO, ILL.

The Mueller Radial

Reduces Drilling Costs

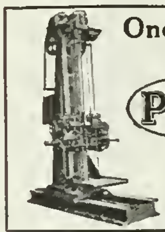
Because its unique one-piece column construction and extra long arm-bearing provide more than ordinary power and rigidity; and the convenient centralization of *all* controls within reach of working position saves time and effort.

"It's a Leader"

The Mueller Machine Tool Co.

RADIAL DRILLS AND LATHES

CINCINNATI Established 1902 **OHIO, U.S.A.**



One Set-Up, Then Uninterrupted Operation

P&H Boring, Drilling & Milling Machines

Give Maximum Production—Accuracy

PAWLING & HARNISCHFEGER CO.

MILWAUKEE, WIS.

HOEFER

"Minute-Savers"

Speed the coming of better business to you

HOEFER DRILLERS *and* **AUXILIARY HEADS** by their time saving features make possible an economy in drilling operations that increases your margin of profit considerably.

Adopt Hoefer better drilling methods without delay. Catalog?

Branches in Principal Cities

THE HOEFER MFG. CO., Freeport, Ill.

Sipp Sensitive Drill Presses

Stop Waste—Bring Prices Down

Each unit of time, power or material lost adds to the cost of the finished job.

In Sipp Drill Presses waste motion, time and power are eliminated.

Speed changes are made in two seconds, belt changes in ten; direct drive, smooth, even and without power waste; sufficient weight, careful balance and ample power insure accuracy—eliminate loss of material—even at highest speeds.

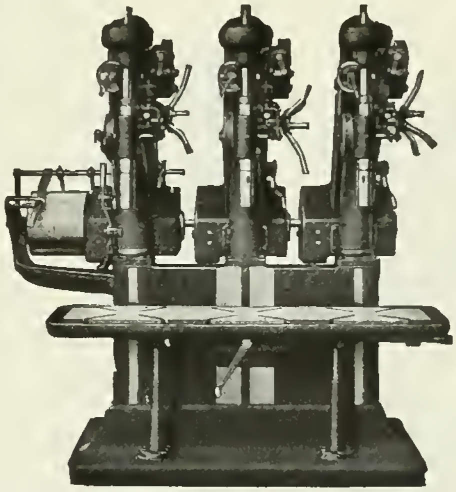
Get the details

If ITS TRADE A MARK SIPP It's Right

THE SIPP MACHINE CO.
PATERSON, N. J.

For Fast Production, Use Our

SELF-OILING ALL GEARED BOX COLUMN GANG



Mechanically perfect. Wonderful productive capacity. All gears and their bearings fully enclosed, and automatically and continuously oiled. Each spindle has eight geared speeds and eight geared feeds, all independent and all under instant control of operator from front of machine. No slipping, troublesome, time-wasting, expensive cone belts. Every movement positive and result producing. The 20" machine here shown drives ¼" to 1¼" high-speed drills to their working capacity. In actual use has multiplied output over 1400 per cent! It pays to use the **ALL GEARED SELF-OILER.**

Write for Catalog "M"

BARNES DRILL CO., Inc., 1907
814 Chestnut St., Rockford, Ill., U. S. A.

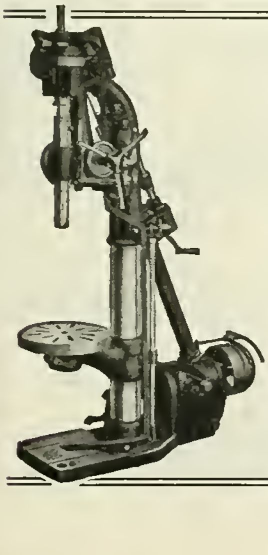
Agents for Great Britain: Burton, Griffiths & Co., Ltd., London, E. C. **Belgium:** G. & F. Limbourg Freres, Brussels. **France:** R. S. Stokvis & Fils, Paris. **Japan:** Roku-Roku Shoten, Tokyo. **Italy:** Alfred Herbert, Ltd., Milan **Spain and Portugal:** American Machinery Corporation, S. A. C., Madrid. Sindicato de Maquinaria Americana, Bilbao. **New South Wales:** R., L. Scrutton & Co., Sydney.

Francis Reed Co.

Sensitive Drilling Machines

Send for catalogue

43 Hammond St., Worcester, Mass.



The Lindgren 20" High Speed All Geared Drill

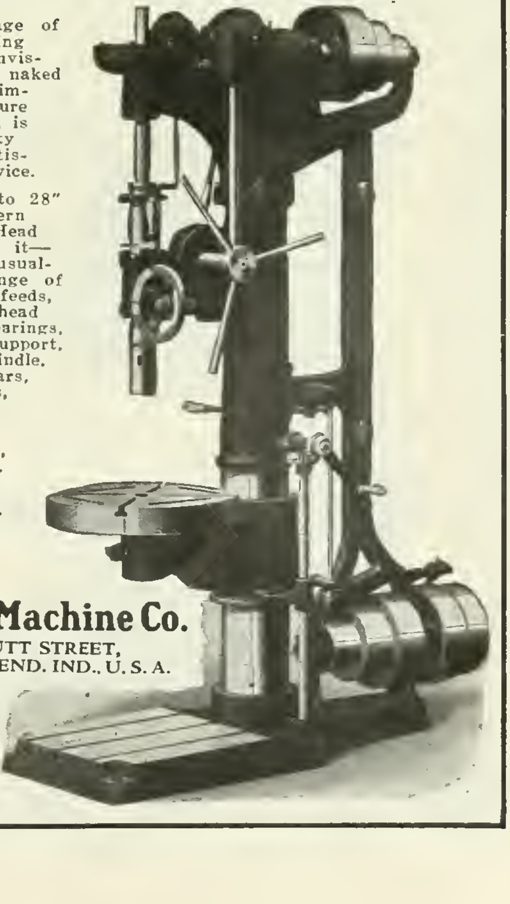
A powerful machine with back gear, also tapping attachment which can be operated either by hand or foot. Self-oiled with new lubrication features, no leakage of oil. Positive gear feed. Ten speeds with back gear, five without.

Write for descriptive Circular

Mechanics Tool Company
ROCKFORD ILLINOIS, U.S.A.

Sibley Drilling Machines

Built for Long Service



An advantage of Sibley Drilling Machines, invisible to the naked eye but an important feature nevertheless, is their capacity for long, satisfactory service.

These 24" to 28" Heavy Pattern Stationary Head Drills have it—likewise unusually wide range of speeds and feeds, extra long head and arm bearings, firm table support, balanced spindle, enclosed gears, wide pulleys, etc.

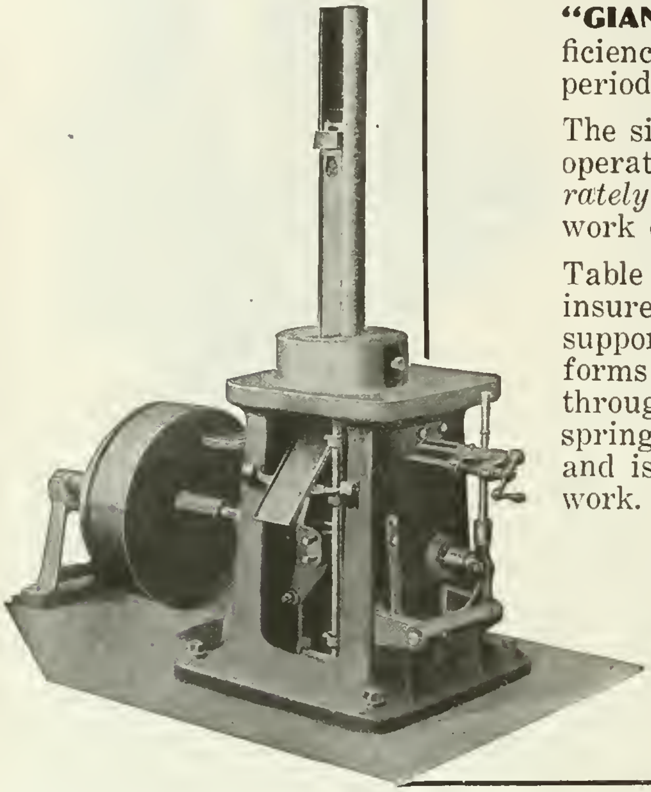
Other types, 16" to 30".

Write for Details

Sibley Machine Co.
8 TUTT STREET,
SOUTH BEND, IND., U. S. A.

Satisfactory Keyseating!

What Does It Mean to You?



"GIANT" Keyseaters maintain high efficiency in constant operation over long periods, *without repairs.*

The simplicity of these machines and their operating principle enables them to *accurately* cut straight or taper keyways on work of all sizes.

Table and column are cast in one piece to insure rigidity; the work set up on the post supports itself by its hub; the same post forms a guide for the tool bar supporting it through its entire length and preventing spring. The stroke can be set to any length and is easily changed for single operation work.

A serviceable, *profitable* machine made in 8 sizes. Let us tell you more about it.

MITTS & MERRILL

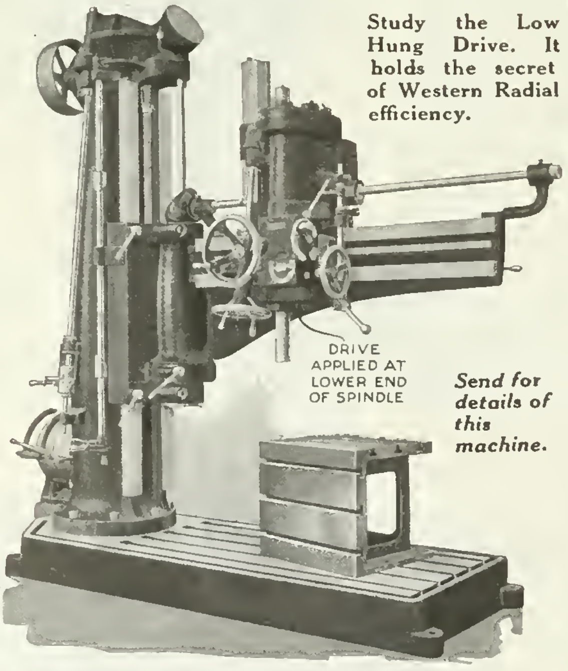
843 Water Street Saginaw, Mich.

FOREIGN AGENTS: Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. V. Lowener, Christiania, Norway and Stockholm, Sweden.

For Heavy Drilling

Ample power and sturdy construction make Western Radial Drills particularly efficient in heavy drilling operations.

Study the Low Hung Drive. It holds the secret of Western Radial efficiency.



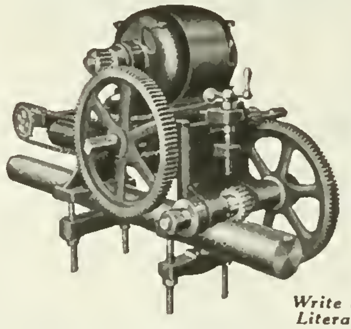
DRIVE APPLIED AT LOWER END OF SPINDLE

Send for details of this machine.

WESTERN MACHINE TOOL WORKS

HOLLAND, MICH., U. S. A.

Portable Power Keyway Cutter



BEST portable machine made for cutting keyways in shafts. Clamps to shaft and attaches to nearest light socket. Cuts accurate keyways quickly of any standard size and length—at very low cost. We also furnish hand-operated machines.

Write today for Literature and Prices.

THE BUCHER-SMITH CO., East Liverpool, Ohio

SPECIAL MACHINERY BUILT TO BLUEPRINTS

CUT KEYSEATS ANYWHERE

Quickly—Accurately—Economically

Burr Portable Shaft Keyseater saves the time and trouble of setting up or moving machines; works accurately in any position; mills keyseats 12" long with one setting in shafts to 5" diameter. Hand or motor drive. Write for particulars.

JOHN T. BURR & SON, 432 KENT AVENUE BROOKLYN, N. Y.

"When you buy the Burr you buy the best"

LAPOINTE KNOWS!

Broaching efficiency means profitable production. Put your broaching problems up to men who know.

Send for a catalog of Lapointe Broaching Machines and Broaches.

The Lapointe Machine Tool Company

HUDSON, MASS., U. S. A.

GRANT

Tight rivets that will not work loose; loose rivets that do not bind. For "Rivets that hold" get details of Grant Riveting Machines.

1200 Rivets per Hour!

There are three rivets in each bar, nine bars in each adding machine made by this company. So the operator completes the bars for an average of 44½ machines in an hour—every hour.

The result is accurate, the finish excellent. Good production, low operating costs, practically no repairs, make Grant Riveters extremely profitable. Made in sizes to handle all classes of work and for spinning tight or loose rivets.

GRANT MANUFACTURING & MACHINE CO.

N. W. Station, Bridgeport, Conn.

Automatic Buffing Machines

Better Production, More Pay, Greater Profits

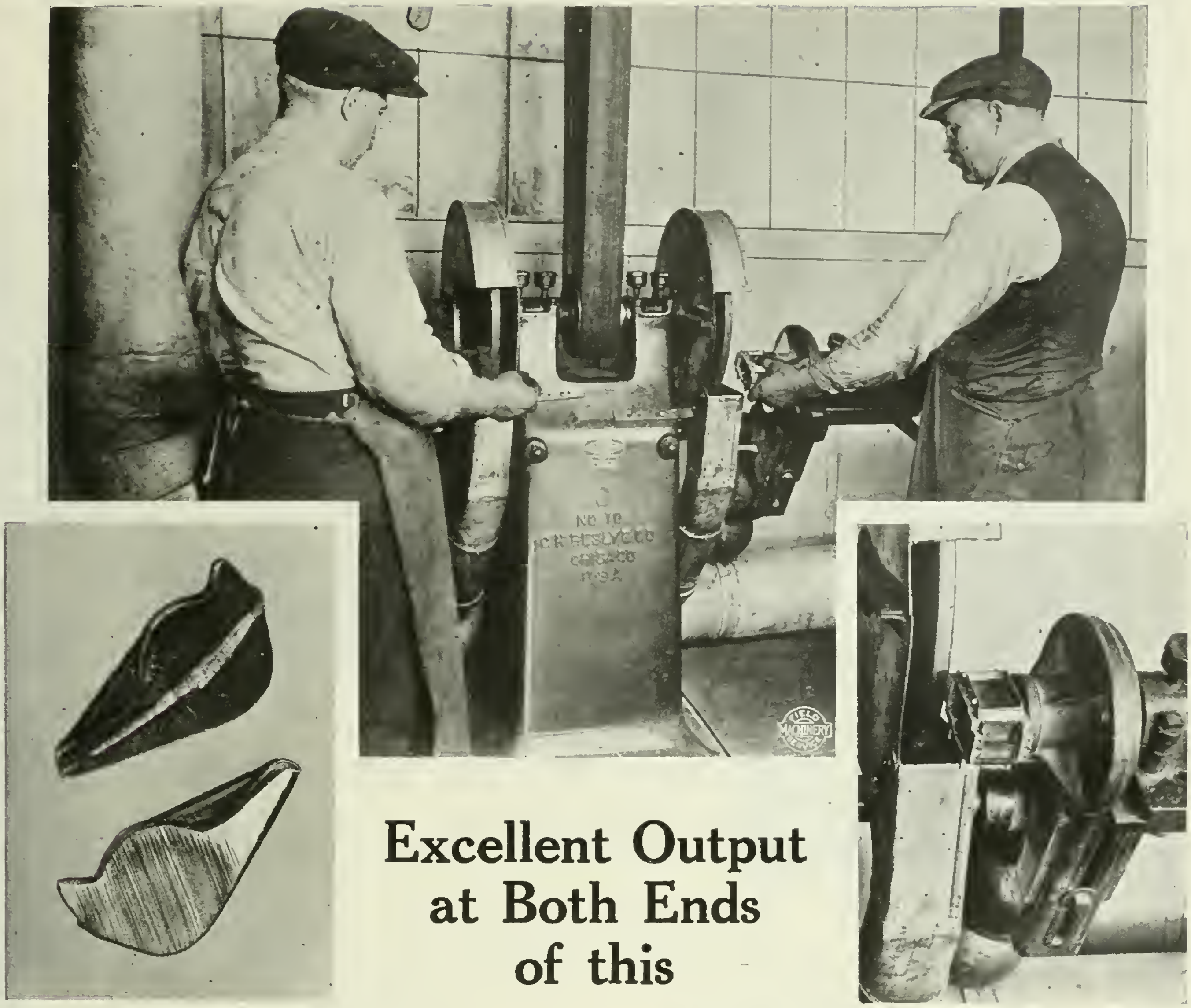
There's a double story to the installation of Automatic Buffing Machines by the Illinois Pure Aluminum Company, Lemont, Ill.—an interesting story of modern methods and profitable results.

Three years ago a new factory manager dug out and set up a pair of old style Automatic Buffing Machines (unused because of prejudice) and immediately jumped the production of their 15" kettle from 275 to 1000 in 10 hours, one operator. The installation of a dozen "Automatics" which followed not only jumped production on all work but put it on a stable basis.

About a year ago when added equipment was needed some new Type H Machines were tried out. Production was increased again, from 10% by the single spindle machine to 25% by the double spindle type. The operators of the old style machines (on piece work) kicked strenuously—*they all wanted new machines.*

The result—with a progressive manager—was obvious. All the old type Automatic Buffing Machines were sold and Type H Machines were installed throughout. There are now 36 in operation with space reserved for more to come. The last order was for a car load; 22 machines in one shipment. If you polish any work that may be chucked—investigate these machines. They are simple, practical and easily operated—and the investment is not so high as the increased profits would seem to indicate.

THE AUTOMATIC BUFFING MACHINE COMPANY
BUFFALO, N. Y., U. S. A.



Excellent Output at Both Ends of this

BESLY DISC GRINDER

The Webster Electric Company, of Racine, Wisconsin, has placed several re-orders for Besly No. 10 Double End Grinders during the past six years.

At the left, cast iron push fingers are being ground on both sides to ½″ thick. They are held in one of the simple fixtures characteristic of Besly production. Production averages 290 pieces per hour.

The operator at the right is grinding die oscillator frames on both sides. These pieces have a 2″ hole through them and are located on a stub arbor against a stop. About .004″ to .005″ of stock is removed from both sides at the rate of 200 pieces per hour.

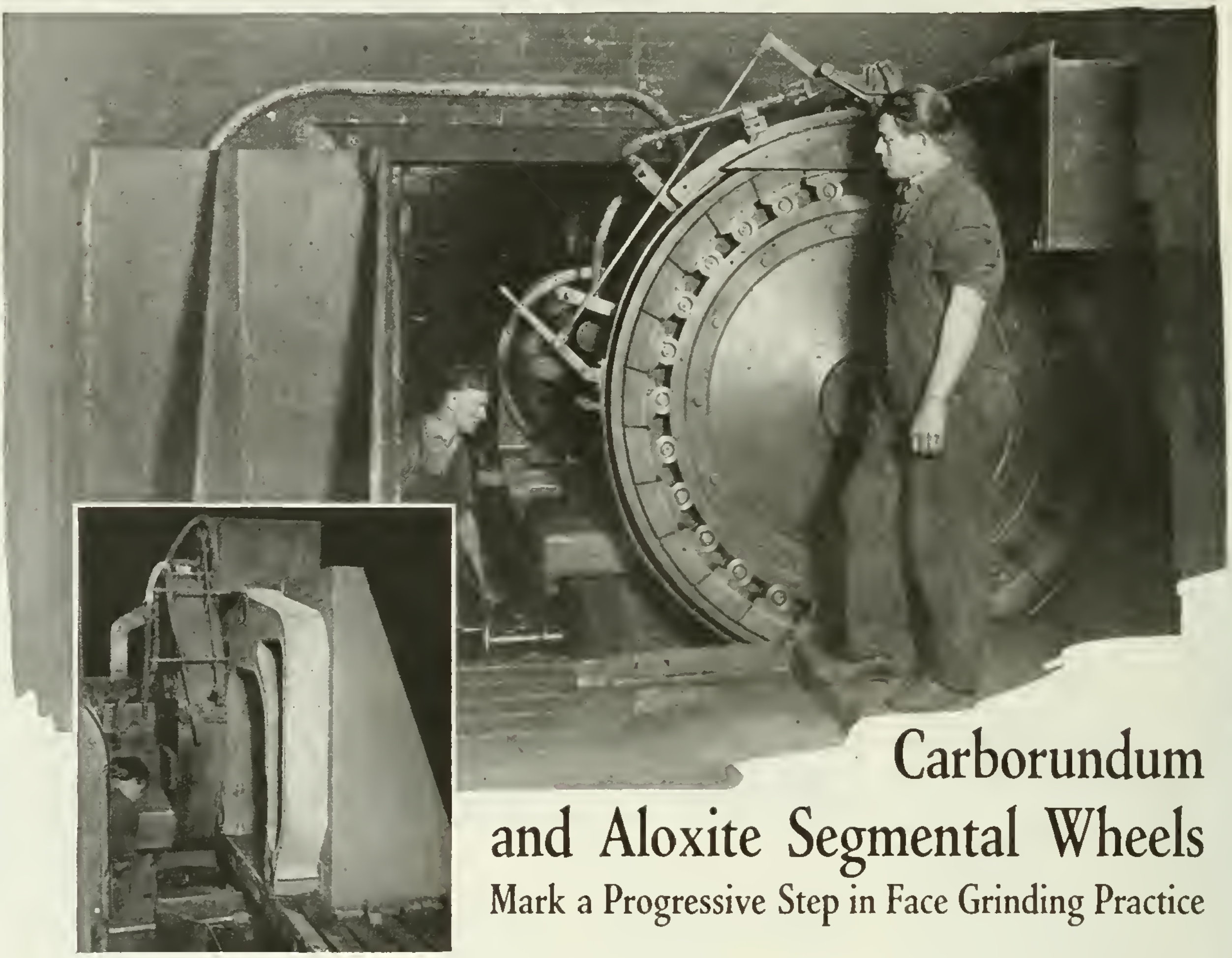
Besly Grinders are economical and durable, fast and accurate.

BESLY
CHICAGO

Let us mail to you our catalog describing the whole line.

CHARLES H. BESLY & COMPANY

120-B. No. Clinton St., Chicago, Illinois



Carborundum and Aloxite Segmental Wheels

Mark a Progressive Step in Face Grinding Practice

Many of the jobs of surface grinding on machines such as the Diamond Heavy-Duty Face Grinder are now being done with Carborundum or Aloxite Segmental Wheels, made up of abrasive segments or blocks.

These segmental wheels are particularly effective on big work where comparatively large amounts of stock are to be removed and where production is an all-important factor. The blocks have a shear-cutting action and a more definite clearance than is provided by the solid wheel, therefore they cut fast, clean and cool.

Then, too, there is the economy of their long life to consider. Segmental wheels can be made in 30-, 36-, 54- and 66-inch diameters—the blocks in all standard grits and grades to meet many classes of work.

The illustration shows a 66-inch segmental wheel on a Diamond machine. It is the biggest wheel of its kind ever made and it is used at the U. S. Radiator Corporation Detroit plant for grinding heating boiler sections.

The sections are approximately 5½ feet wide and 4½ feet high. The operation consists of grinding the bearing surfaces of the sections so as to insure a tight joint. From 1/16 to 3/8 inch of stock is removed depending upon the condition of the casting. Four passes across the wheel and the casting is ground clean and true and it takes two minutes to grind one side.

The Carborundum Sales Engineering Department would be glad to give you every possible help in increasing your grinding production and promoting grinding economy by the segmental wheel method

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y., U. S. A.

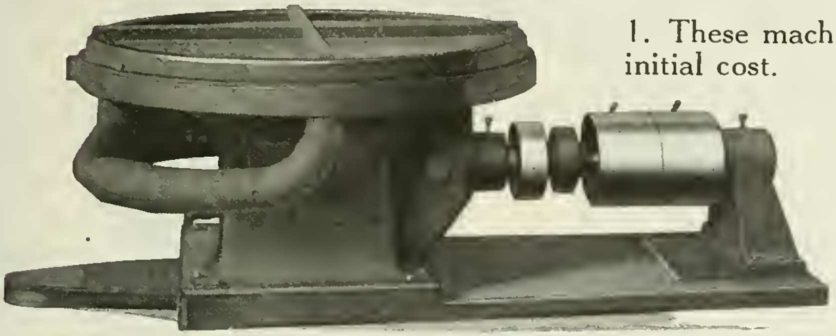
New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Grand Rapids, Milwaukee
The Carborundum Company, Limited, Niagara Falls, Ont.

Real Production Tools—

that's one reason why

GARDNER DISC GRINDERS

upon adaptable flat surfaces, will effect great economies over other methods of finishing.



2 More Reasons Are:

1. These machines are relatively inexpensive in initial cost.

2. They're extremely economical to operate, because of our heavy-type G. I. A. Disc, which cuts disc expense to the minimum.

Find Out What GARDNER-GRINDING Can Do On YOUR Flat Surfaces!

Write for Our Operation Folder giving bona-fide production data!

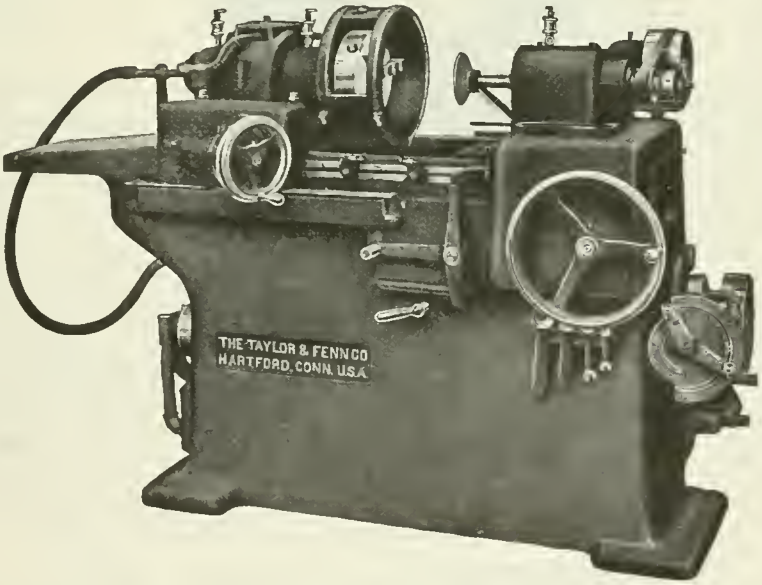
Gardner Machine Company
414 East Gardner St., Beloit, Wisc., U. S. A.

For Accurate Bore Grinding

The efficiency of the unique design of the Taylor & Fenn Bore Grinder is shown in the excellent results it gets.

The wheel spindle head and intermediate pulley supports are integral, firmly screwed to the base and without movable parts. The substantially built work-head and table move on a large V and lubricated flat ways protected from water and grit. Design and construction insure rigidity and permit high speeds on heavy grinding.

Massive, compact and self-contained the Taylor & Fenn Bore Grinder grinds round, straight holes to 8″ diameter, 8″ deep at minimum cost.



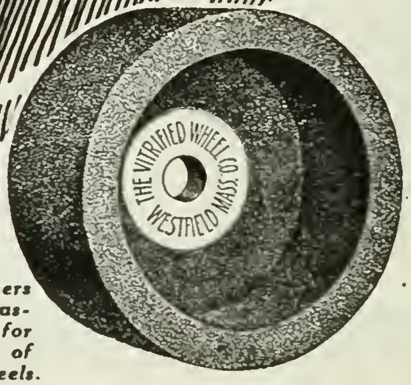
Let us send you details

THE TAYLOR & FENN COMPANY, Hartford, Conn., U.S.A.

VITRIFIED WHEELS

VITRIFIED

There's a grade, grain and style for every machine, each class of work. Grinding Wheel experts are ready to help you in the selection, and advise you in the use of the wheel you buy. Our carefully developed recording system guarantees perfect duplication whenever you reorder.

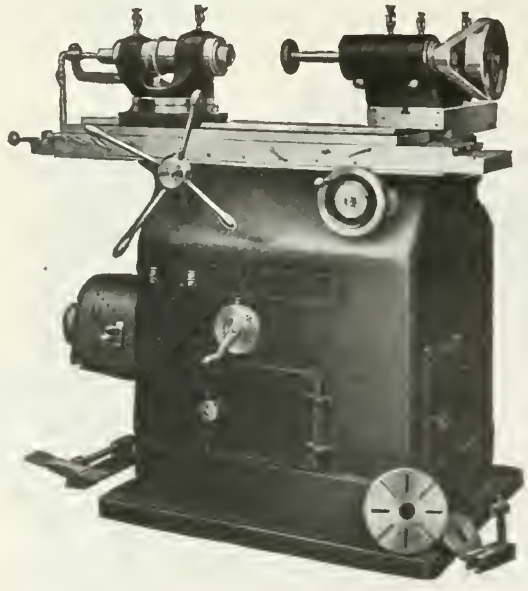


Vitrified users are regular customers. Send for a catalog of Vitrified Wheels.

VITRIFIED WHEEL COMPANY, Westfield, Mass., U.S.A.

"RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY"

"RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY"



Specify The Rivett No. 106 Internal for tool-room

TOOL-ROOM INTERNAL GRINDER

Time can be saved in the TOOL-ROOM as well as in the production departments. Selection of the proper machine is important.

An Internal Grinder for TOOL-ROOM use must be:

Quickly set up for the difficult job. Big enough for the larger work. Refined enough for the smaller work. Adaptable to the unusual. Rugged enough to last.

The Rivett No. 106 is all this.

Dealers in all the principal cities. Write to them or direct to us.

Rivett Lathe and Grinder Corporation
Brighton District of Boston, Mass., U. S. A.

"RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY"

"RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY"

Borolon

TRADE MARK

and

Electrolon

TRADE MARK

GRINDING WHEELS

Worn Down 50% but Still on the Job

This grinding wheel was 24″ in diameter when it was put to work. The diameter is 12″ now and it will probably be kept on the job until it's down near the flanges, when a new one just like it will take its place.

Grain 20, Grade R Borolon gives excellent service in grinding mining tools of the kind shown in photo. This wheel stands up well under difficult conditions without frequent dressings to keep it in condition.

They have used "Abrasive" Grinding Wheels of various grains and grades for some years in this mine tool shop—always with satisfaction; they tell us what they wish to grind—our engineers see that they get the "right wheel for the job." This insures the invariable efficiency of "Abrasive" Grinding Wheels.

The new "Abrasive" booklet is just off the press. Write for it.

TRADE
ABRASIVE
MARK
REGISTERED

ABRASIVE COMPANY

Bridesburg, Philadelphia, U.S.A.

566 W. Washington Blvd., Chicago

For Fine Finishing

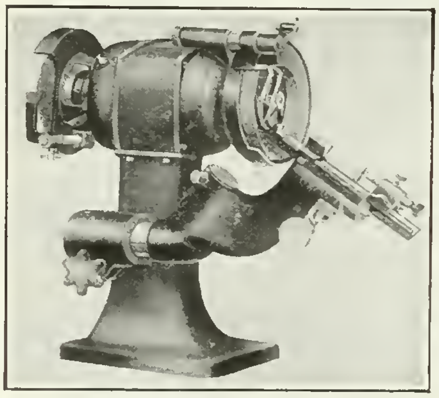
This Abrasive Surface Grinder, shown finishing a lamination die for a Ritter Dental Lathe (Ritter Dental Manufacturing Co., Rochester, New York) is used for all the finish grinding operations in the manufacture of these delicate machines. So much for accuracy! Operating conveniences make it an equally efficient production grinder—a machine that is profitable wherever it is used.

Let us tell you more about Abrasive Grinding Machines.

Abrasive Machine Tool Company

East Providence Rhode Island

Drills Ground on this Machine Cut Faster — Stay Sharp Longer Than Hand Ground Drills



In addition to this you can reduce drill breakage to a minimum by the installation of this machine. There is a Grand Rapids Drill Grinder particularly adapted to your requirements.

Get your Grinder Book today; it's free.

Gallmeyer & Livingston Co.

Successors to

G. R. Grinding Machine Co., Valley City Machine Co.
344 Straight Ave., S. W., Grand Rapids, Michigan

BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD, VERMONT

BRYANT

Reg. U. S. Pat. Off.

Builders of

- Hole Grinders
- Hole and Face Grinders
- Deep Hole Grinders

THOMPSON

UNIVERSAL GRINDING MACHINES

SEND FOR BULLETIN No. U-13

THE THOMPSON GRINDER CO.
SPRINGFIELD - - - - . OHIO

Grinding and Polishing Machinery

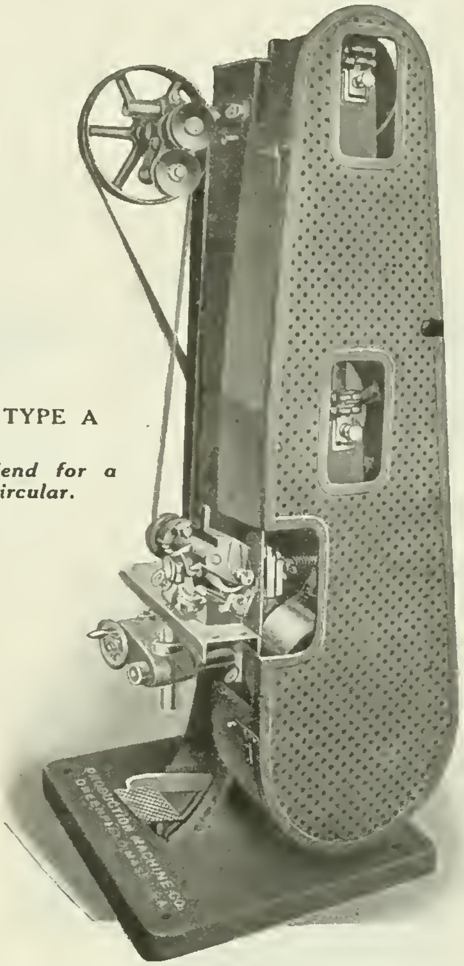
Diamond Machine Co.

Providence, R.I., U.S.A.

"PRODUCTION"
POLISHING AND FINISHING MACHINES

For Quickly and Efficiently Finishing Cylindrical Parts in Metal, Rubber, Fibre and other Hard Composition Materials.

The centerless feed mechanism insures high speed production with a minimum expenditure of labor. The unique design and accurate construction insure mechanically uniform results. Send us a sample of work—any size to 4″ diameter; time studies and production estimates will interest you.



TYPE A

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PRODUCTION MACHINE CO.
GREENFIELD MASSACHUSETTS, U. S. A.

Motch & Merryweather Machinery Co., Cleveland, Pittsburgh, Cincinnati. Roland Anderson, 40 Lawrence Ave., Detroit, Mich. Marshall & Huschart Machinery Co., Chicago, Milwaukee. Allied Machinery Co. of America, New York City, N. Y. (Export.)

William Sellers & Co., Incorporated
Established 1848
PHILADELPHIA, PA.

LABOR SAVING MACHINE TOOLS

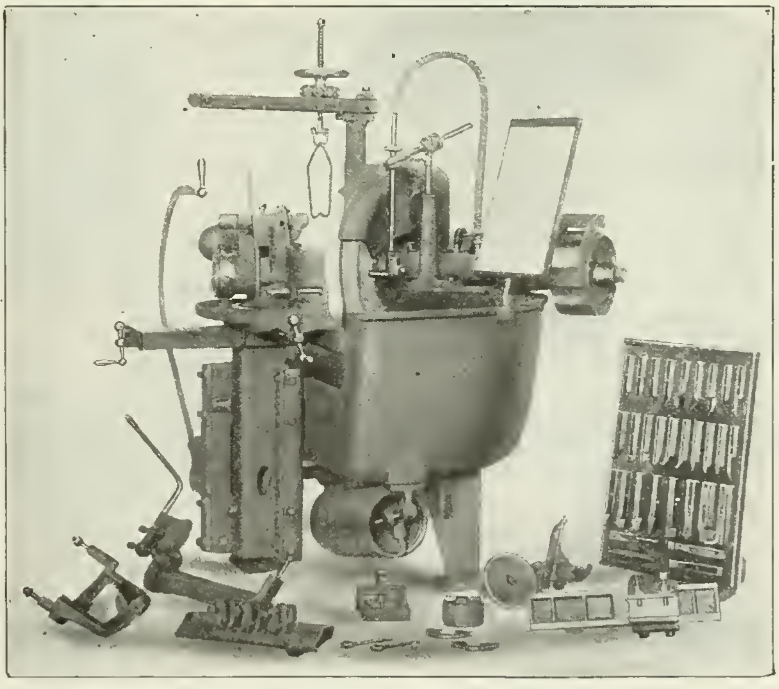
The Sellers Tool Grinder

for quickly, correctly and economically forming and sharpening (with one chucking) cutting tools for Lathes, Planers, Slotters, etc., is without an equal. It produces and duplicates shapes and angles at a surprising saving over any other method.

Large Output
Accurate Work
Low Cost of Maintenance

are three of the reasons why users of this machine find it so profitable that it is regarded as indispensable wherever installed. Tools ground and shaped by it do much more work before regrinding than when sharpened in any other way.

It Saves Time
It Saves Money



SHAFTING—INJECTORS—DRILL GRINDING MACHINES

Proof of the Pudding

"I am in need of some Emery Wheels. I have been a user of your wheels for a long time (over forty years) and wish to use some more—I will want wheels for saw gumming, also special wheels. I will take up with you a little later the matter of these special wheels."

F. W. Shuls, Galion, Ohio.

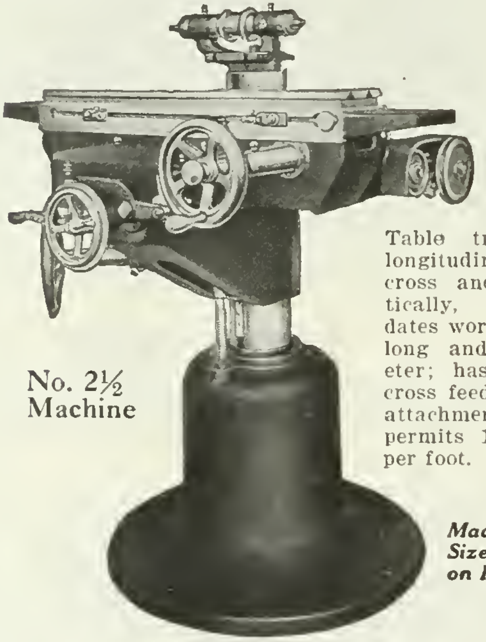
Here's proof that Staralon Wheels "make good," and make friends and keep them. Tell us what you grind and let us select a Staralon Wheel for you, or order from the catalog.

"STARALON"

DETROIT-STAR GRINDING WHEEL CO.
DETROIT Established 1872 MICHIGAN, U. S. A.

Woods Tool and Cutter Grinder

Universal machine of the swivel head type, designed for tool-room grinding; equipped with automatic longitudinal feed, which provides 12 table speeds varying from 24" to 143" per minute.



No. 2½ Machine

Table travels 22" longitudinally, 7½" cross and 10" vertically, accommodates work up to 22" long and 9" diameter; has automatic cross feed and taper attachment which permits 1/16" taper per foot.

Made in Three Sizes—Circular on Request.

WOODS ENGINEERING CO.
ALLIANCE, OHIO

BLOUNT

Ball-Bearing Motor Buffs

Floor or Bench Type

5 Sizes—¼ to 3 H.P. inclusive

J. G. BLOUNT CO., Everett, Mass.

MARSCHKE Grinders, Buffers and Combination Machines

Spindles of these machines are equipped with four sets of S.K.F. Ball Bearings—motor bearings being entirely independent of outboard bearings. Five sizes ranging from 1½ to 10 h.p. Easy start and stop devices and other features described in circular—send for a copy.

MARSCHKE MANUFACTURING CO.
INDIANAPOLIS, IND.

BATH

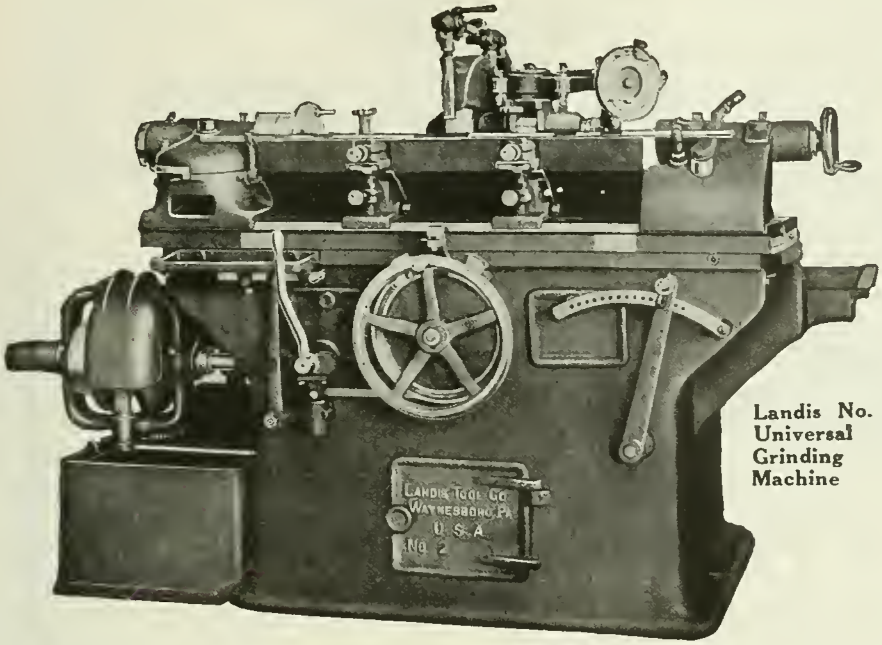
Universal Grinding Machines
for Cylindrical, Surface, Internal, Disc, Tool and Cutter Grinding. Built by
UNIVERSAL GRINDING MACHINE CO.
FITCHBURG, MASS., U. S. A.

FITCHBURG

Cylindrical Grinding Machine

Various sizes, both Power Feed and Hand Operated, for work up to 54 inches in length.

FITCHBURG GRINDING MACHINE CO.
FITCHBURG, MASS., U. S. A.



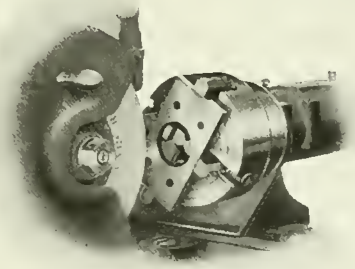
Landis No. 2
Universal
Grinding
Machine

Grinding in Railway Repair Shops

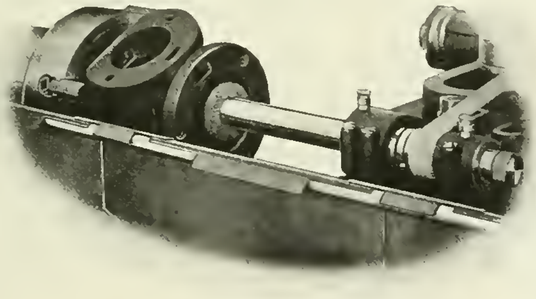
Ultimate economy in finishing internal or external surfaces — straight or taper work—indicates the use of LANDIS GRINDING MACHINES.

The Landis Universal Grinding Machine is the most versatile and satisfactory grinding machine made—grinds straight and taper, external and internal, making it equally valuable for either the tool-room or the repair shop.

It grinds accurately, rapidly and economically such parts as reamers, gages, boring tools, dies, arbors, flue cutting and expanding tools, knuckle pins, crosshead pins, link blocks, link bolts, triple valves, engineer brake valves, etc. In fact, any work that can be held by either a faceplate or chuck can be ground to advantage on this machine.



Link Block Plate



Triple Valve

Simple construction, easy operation and convenience, rigidity, accuracy and great power, insure high production and low operating costs. High grade tools and other work adaptable to these machines are turned out day after day with complete satisfaction.

Ask for catalog

LANDIS TOOL COMPANY

WAYNESBORO PA.

New York Office: 51 CHAMBERS STREET

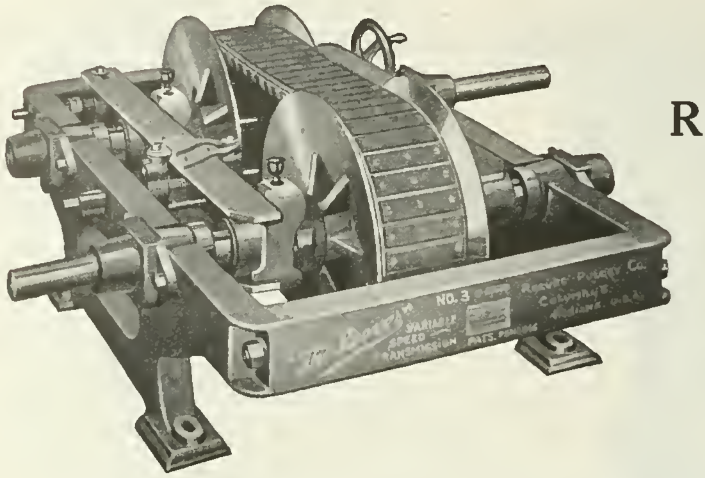
DOMESTIC AGENTS—Hallidie Machinery Co., Seattle; Smith, Booth, Usher Co., San Francisco and Los Angeles; Peden Iron & Steel Co., Houston Fulton Supply Co., Atlanta; F. C. Richmond Machinery Co., Salt Lake City.

CANADIAN AGENTS—F. F. Barber Machinery Co., Toronto; Williams & Wilson, Ltd., Montreal; A. R. Williams Machinery Co., Nova Scotia, New Brunswick, Manitoba and British Columbia.

FOREIGN AGENTS—Allied Machinery Co., Paris, Turin, Barcelona, Brussels, Zurich and Lisbon; Andersen, Meyer & Co., Ltd., Shanghai; Andrews & George Co., Ltd., Tokyo; Benson Brothers, Sydney and Melbourne; Burton, Griffiths & Co., Ltd., London; Wilh. Sonesson & Co., Malmo and Copenhagen.

Infinite Variation of Speed Quickly Obtained

"The Reeves"
VARIABLE
SPEED
TRANSMISSION


"The Reeves" Variable Speed Transmission
No. 3
Reeves Pulley Co.
Columbus, Indiana, U.S.A.
Pats. Pending

REGULATES—

the speed of any machine or conveyor and enables the operator to get

FAST SPEED
MEDIUM SPEED
SLOW SPEED or
ANY IN-BETWEEN SPEED

desired even to a fraction of a revolution.

"THE REEVES" Transmission is installed between the source of power—motor, line shaft or engine, and the machine to be regulated.

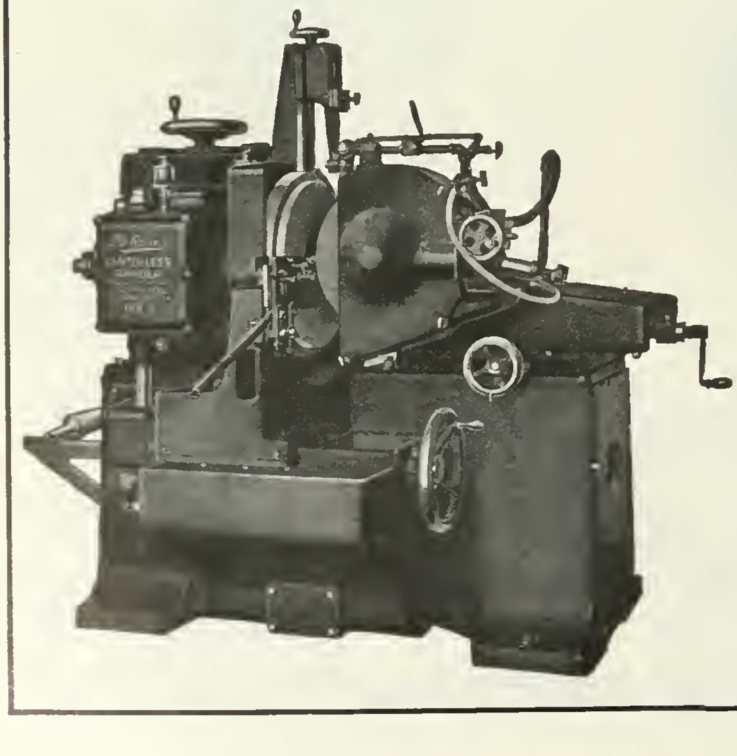
Any one speed may be maintained indefinitely or the speeds may be changed as often as necessary. The power transmitted is steady and positive at all times. It is possible to get a variation as low as 2 to 1 or as high as 16 to 1.

Put your variable speed problems up to us. Write for new 52-page catalog M-44.

REEVES PULLEY COMPANY, Columbus, Ind.

"The Reeves" CENTERLESS GRINDER

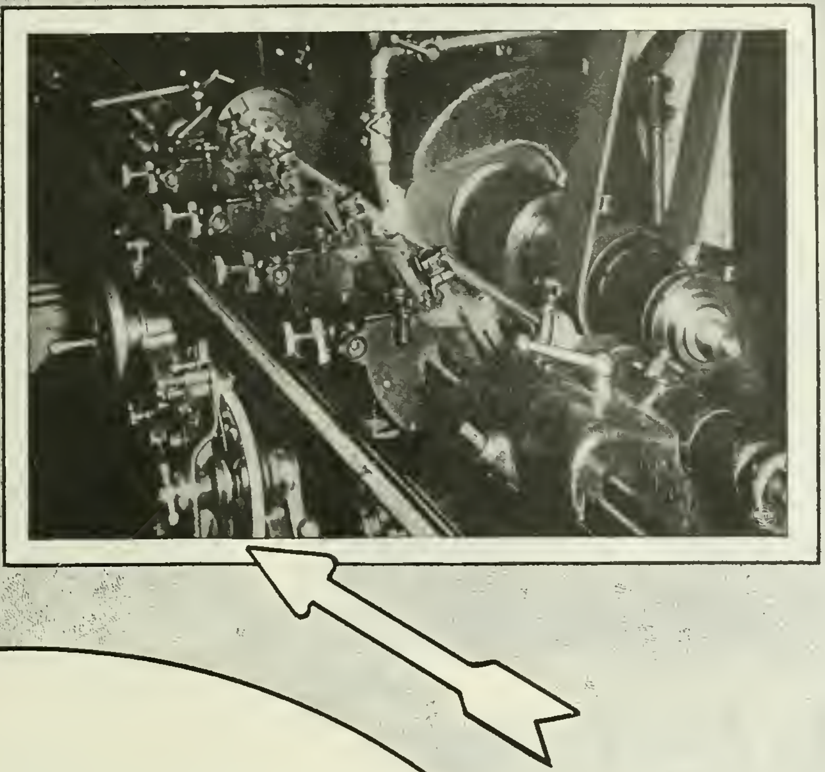
The design of "The Reeves" Centerless Grinder is radically different. The distinctive DROP-IN work rest, which is thoroughly covered and protected by patents, makes grinding of shoulder, taper and straight pieces a very simple affair.



Engineers and factory superintendents are now beginning to realize that in a great many cases where work is ground on centers it is costing too much. They have learned that "The Reeves" way not only increases production considerably, but also turns out more accurate and uniform finish.

Do not be satisfied that you are getting precision grinding on your work until you have tried "THE REEVES" Centerless Grinder. We will gladly demonstrate its wonderful possibilities on any samples you may submit.

REEVES PULLEY CO.
COLUMBUS INDIANA

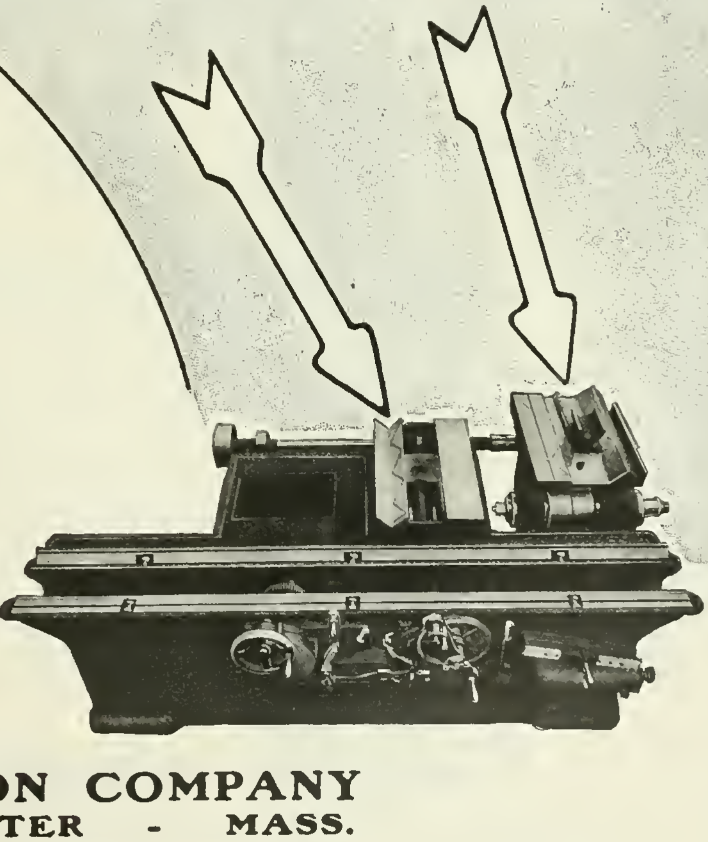


TRADE
NORTON
MARK

The wheel feed mechanism of the NORTON CYLINDRICAL GRINDING MACHINE indicated by the arrow in the upper illustration is the controlling and adjusting part of a large micrometer. It can quickly and easily be adjusted for measurements of 0.00025" and such limits maintained in regular production. THE INDEX ALWAYS REMAINS IN THE SAME CONVENIENT PLACE under the right hand of the operator, who can readily change it as required without even looking at it.

The lower view shows the massive construction of the base and large proportions of table and wheel slide ways. These ways support the tables and wheel slides which are designed to remain in position from their own weight, NO GIBS BEING REQUIRED.

The half nut on the under side of the inverted wheel slide and the wheel feed screw in the base of the machine convey the accuracy of the wheel feed mechanism to the grinding wheel.



NORTON COMPANY
WORCESTER - MASS.

NEW YORK
53 Park Place

CLEVELAND
442 Engineers' Bldg.

SYRACUSE
206 Keith Theatre Bldg.

CHICAGO
11 North Jefferson St.

PHILADELPHIA
3208 Market St.

HARTFORD
49 Pearl St.

DETROIT
233 W. Congress St.

PITTSBURGH
421 Wood St., Room 404

Have You Met An S.G.E.?

An S. G. E.—Sterling Grinding Engineer—is a shop man. A graduate of the only school of grinding there is—the school of practical experience.

He brings to industry this practical knowledge; he brings to industry a sincere desire to help make better grinding and better grinding results, and he is supported wholeheartedly by this old and powerful organization; by a broad general policy of service, and by a background of grinding experience as old as grinding itself.

All this is giving impetus to the rapid development of grinding—more grinding and **better grinding.** These are the things that a Sterling Grinding Engineer likes to talk to you about. He wants to talk shop with you to the end that you do better grinding.

And he can tell you of some really important achievements with Sterling Wheels and Sterling Service. Invite a Sterling Grinding Engineer in. Get acquainted with him. Let him tell you about Sterling Wheels and Sterling Service and the results that have been accomplished.

THE STERLING
STERLING
GRINDING WHEEL CO.

A Complete Source of Supply

Clevelond Grindstones

Power or Hand Operated
Mounted and Unmounted
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Sterling Abrasives

Sterlith Wheels
Sterbon Wheels
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Silicate Wheels
Elastic Wheels
of every size and shape
Sterbon Round Knife Sharpeners
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Sterling Grinding Machinery

Bench, Floor, Swing Frame and Wet Tool Grinding Machinery

THE STERLING
GRINDING WHEEL CO.
Division of
The Cleveland Stone Co.

The Cleveland Stone Co.

CLEVELAND, New York and Boston
THE STERLING GRINDING WHEEL CO., Tiffin, Ohio, and 30 No. Clinton St., Chicago.
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STERLING ABRASIVES

AND STERLING GRINDING MACHINES

When You Buy a Dillon Electric Buffer or Grinder

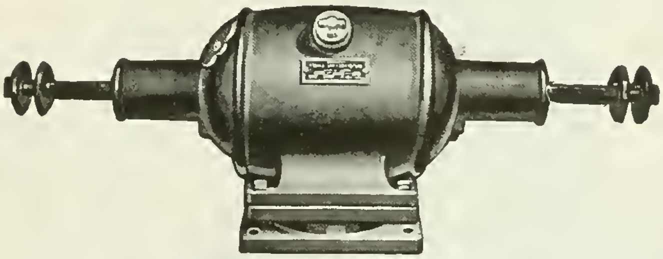
You get an efficient, easy running trouble proof machine. The motor is especially constructed to meet the heavy demands made on this type of buffer and grinder. It is dustproof and trouble proof. It has ample power to drive the machine to full capacity without strain and can be operated 24 hours a day without running hot. Spindles running in S.K.F. Ball Bearings insure easy operation.

Strong, well-balanced construction and convenient design make these machines both efficient and serviceable — a surely profitable investment.

The Dillon Heavy Duty Buffer Pedestal Type

Dillon Medium Duty Grinders and Buffers are made in ½, 1 and 2 H.P. sizes, Bench and Pedestal Types.

Dillon Heavy Duty Grinders and Buffers are made in 3, 5 and 7½ H.P. sizes, pedestal type only.



The Dillon Medium Duty Grinder Bench Type

The Dillon Electric Company

CANTON, OHIO, U. S. A.

LA SALLE SURFACE GRINDER

Here's a Good Grinder for Truing and Surfacing—Die and Toolwork or Production

Besides more than ordinary rigidity, durability of alignment and operating convenience than is usually found in machines of this class, the No. 2 "La Salle" is provided with an attachment which automatically supplies water to the wheel while it is in operation, and a wheel truing device cast integral with the wheel which permits trueing the wheel without disturbing the work.

This machine will grind work up to 20″ long, 6″ wide and 10″ high with a 7″ wheel; work table is 49″ long and 8″ wide and travels automatically in both directions. Vertical spindle movement is controlled by a handwheel graduated in .0005″; machine is arranged for belt or motor drive and occupies 3 by 6 feet of floor space.

Details and quotations on request.

La Salle Tool Company
LA SALLE, ILLINOIS, U. S. A.

RANSOM

Heavy Duty—Ball Bearing Grinders

16-inch Wheels or Larger

Write for Catalog.

RANSOM MANUFACTURING CO.
Oshkosh, Wis., U. S. A.

A Diamo-Carbo for Each Grinder

There's no excuse for grinding with wheels out of true. The cost of this dresser is so low, its efficiency so great, that a Diamo-Carbo Emery Wheel Dresser is regular equipment at each machine in many plants. Try it at our expense.

Send for a catalog of our grinding tools. Huntington, Sherman, magazine, etc. Diamonds in stock for selection.

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BADGER TOOL COMPANY

**Grinding Machinery
Supplies and Accessories**

E. B. GARDNER, President R. D. GARDNER, Treasurer
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Emery Wheel Dressers

Two Sizes Nos. 1-2

CUTTERS

We make the regular Huntington (Pattern) for all sizes. Roughing for Nos. 1 and 2. Paragon for No. 1 only.

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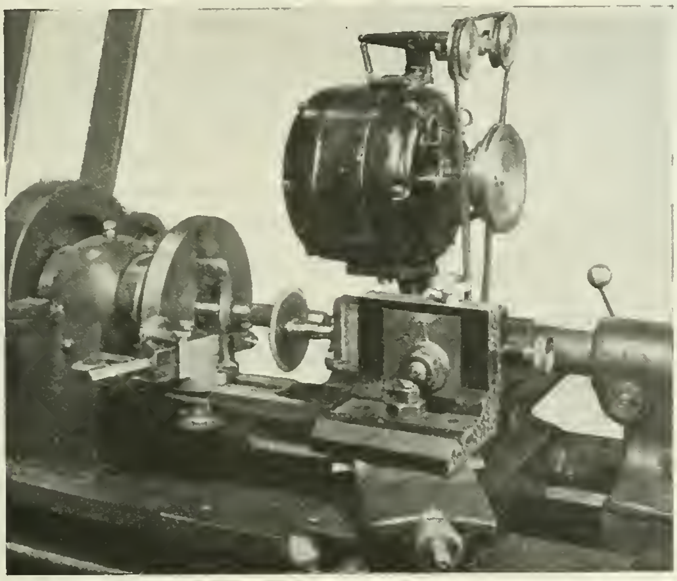
THREAD GRINDING

1923 Model Multi-Graduated Precision Grinder and Precision Thread Lead Variator

For Grinding Thread Gages, Taps, Hobs, Chasers, Roll Thread Dies—also for Cylindrical and Internal Grinding



PRICE REDUCED 20%

The 1923 Model has many improvements; is more accurate; free from vibration; has greater power and capacity.

At present price is now within reach of smaller shops. Soon pays for itself.

Used by hundreds of nationally-known machine, tool, automobile and metal working plants.

Send for New Hand Book on "THREAD GRINDING"—Just Issued

"Cold-Set" Diamonds do not require resetting. Send for Circular.

PRECISION & THREAD GRINDER MFG. COMPANY

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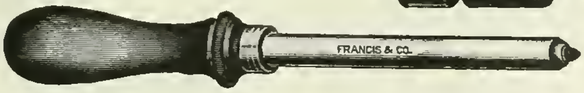
Francis Diamond Hand and Grinder Tools

High quality diamonds correctly set in well-balanced tools. Send for an assortment for selection.

Diamonds carefully reset by experts. Write us.

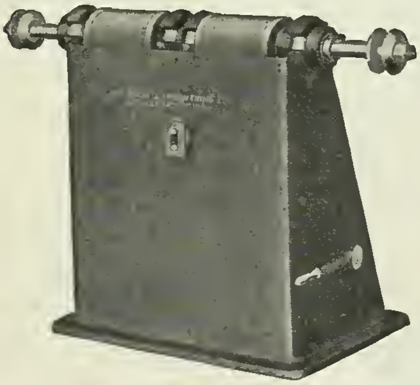


FRANCIS & COMPANY

Established 1799

50 State St. First National Bank Bldg. Hartford, Conn., U. S. A.

MOTOR DRIVEN POLISHING LATHES



A self-contained Motor Driven Unit with which it is possible to obtain any desired spindle or wheel speed regardless of motor speed.

Catalog ?

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SPRINGFIELD, O.

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The Wheel Trueing Tool Company, through its overseas connections, can furnish industrial diamonds in any grade, size or quantity. These diamonds are sorted into packages that will meet the individual requirements of your plant.

Next in importance to buying diamonds that exactly fill your needs is the proper mounting of the stones. Our laboratory, the largest of its kind, is devoted exclusively to the making of our perfected mountings and to working out our unique factory cost keeping service to diamond users.

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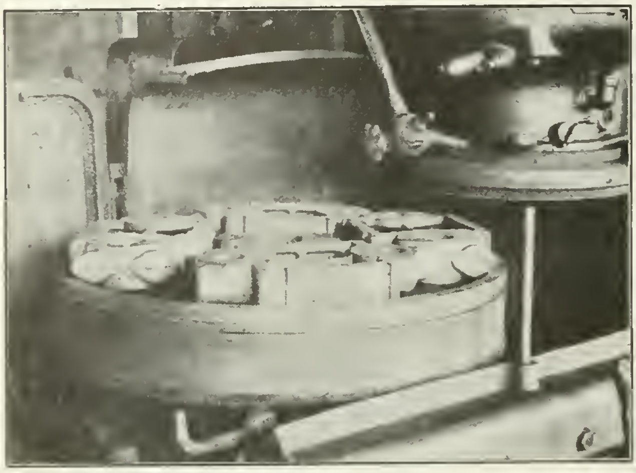


BLANCHARD GRINDERS
in the
STEAM PUMP SHOP

Duplex Pump Steam Chests
14 in. x 8½ in. x 2¾ in.

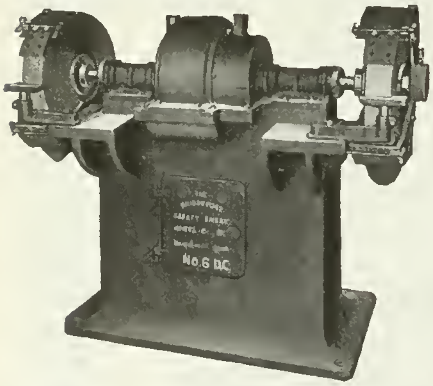
No. 16 Blanchard Grinder
30 in. Magnetic Chuck
Material, Cast Iron
Stock per side, ⅛ in.

Limits, ± .003 in.
No. of Sides, 2
Production, 15 pieces (30 surfaces)

"A Better Product for Less Money"

THE BLANCHARD MACHINE CO.
64 State Street, Cambridge, Mass.

Bridgeport Motor Driven Grinders



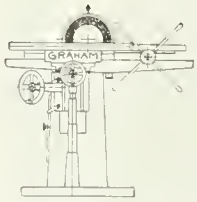
Built for Work

Carefully built, well-balanced machines with every provision to insure rigidity, reduce vibration and give accuracy — particularly good on heavy operations.

Direct motor drive practically eliminates power waste. Extra large spindles have four ball bearings per spindle. Send for catalog.

Strong and Powerful A. C. or D. C. Motor

The Bridgeport Safety Emery Wheel Co., Inc.,
83 Knowlton Street, Bridgeport Conn



GRINDER
Knee Type Ring Wheel

For Flat Surfaces

THE GRAHAM MFG. CO.
Providence, R. I.

KELLER AUTOMATIC MACHINES
CUT DIES TIME COST

KELLER MECHANICAL ENGINEERING CORP.
74 WASHINGTON ST. BROOKLYN, N.Y.

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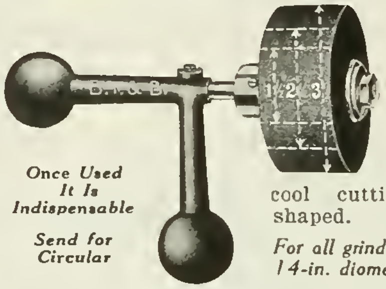
EMERY WHEEL DRESSERS



Once Used It Is Indispensable

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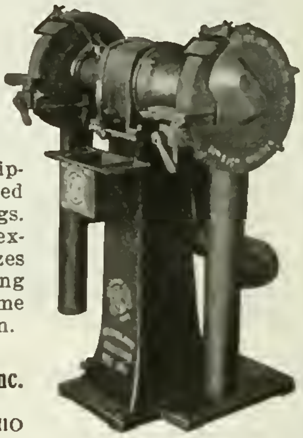
Dressers which will shape a grinding wheel like holding an icicle on a hot stove. The Metcalf Dresser is a marvel for keeping wheels clean, cool cutting and properly shaped.

For all grinding wheels up to 12- or 14-in. diameter, 1-in. or less thick.

Machinery Company of America
BIG RAPIDS MICH., U. S. A.

Announcing the
C. A. W.
Grinders, Buffers

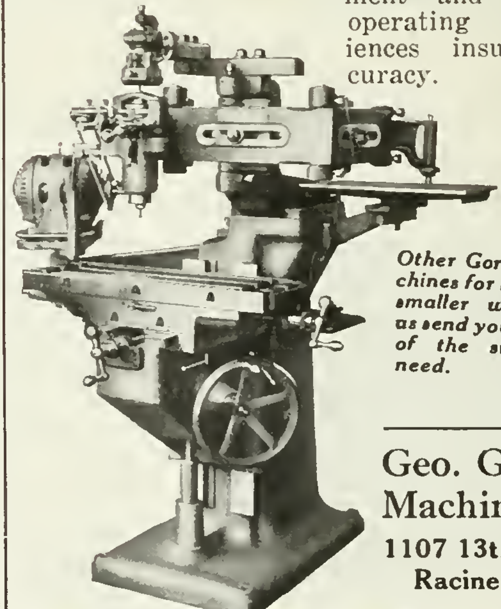


Polishers, Tire Buffers, equipped with Timken Tapped Adjustable Roller Bearings. The products of 28 years' experience. Made in all sizes and types. Liberal long term payment plan. Some dealers territory still open.

Cleveland Armature Works, Inc.
4732 St. Clair Ave.
CLEVELAND OHIO

Make Heavy Die-sinking and Engraving Profitable

The Gorton No. 1S has ample power to do the work quickly and *accurately*. For example, it cut a 2" letter in 9/64" relief in *cold rolled steel* in 15 minutes; a letter the same size 5/16" relief in *bronze* in two minutes. Ample provision for precise adjustment and special operating conveniences insure accuracy.



Other Gorton Machines for larger or smaller work—let us send you details of the size you need.

Geo. Gorton Machine Co.
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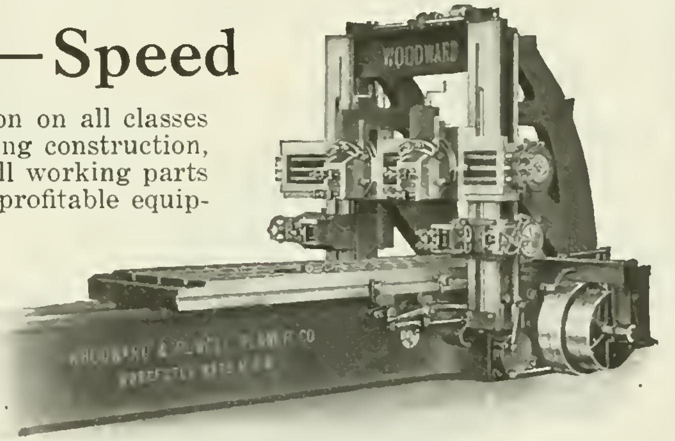
Power—Accuracy—Speed

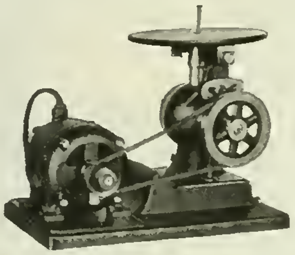
Woodward & Powell Planers promote production on all classes of planer work. Wide range, ample power, strong construction, convenient operation and easy accessibility of all working parts make these machines efficient and economical—profitable equipment wherever work is heavy and varied.

Standard, Medium and Heavy Duty Types. Belt or Motor Drive. Send for details of the special features.



Woodward & Powell Planer Co.
Worcester, Mass., U. S. A.

Illinois Die Filing Machine



The "Illinois" Die Filer is very compact, and the work done by it is extremely accurate without sacrifice of efficiency or production.

An illustrated booklet of interest to every Diemaker will be sent Free on request.

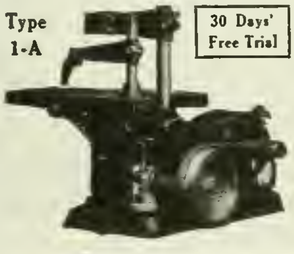
ILLINOIS TOOL WORKS
160 E. Erie Street CHICAGO, ILL.

J & B Filing and Sawing Machines

Are Real Productive Machines!

They saw or file 30% faster than any other like machine. Use any standard tapered or crooked file up to 12". Patented device holds any length saw blade and positively prevents buckling. Will file to shoulder or in blind corners.

Type 1-A



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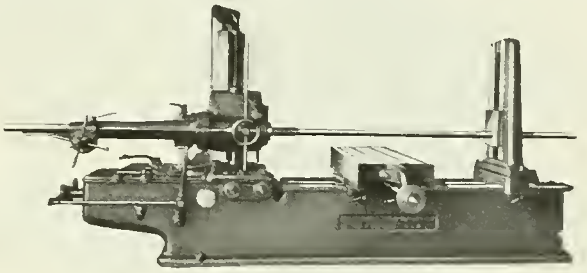
Variable speed and adjustable stroke.

Make Us Prove it!

Don't forget our trial offer. Write today for circular.

LA PORTE MACHINE & TOOL CO., Inc.
LA PORTE IND.

Blomquist-Eck Boring, Milling and Drilling Machines



"Inflexible Rigidity—Lasting Accuracy"

Let us tell you of the many *advantages* of this machine and all the *economies* it can effect in your operations. Take a minute *now* and write for descriptive circular. Blomquist-Eck engineers are at your service.

The Blomquist-Eck Machine Co.
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AUTOMATIC WOOD-SCREW MACHINERY

For Making IRON AND BRASS WOOD-SCREWS

Machines built to capably produce accurately cut screw slots, screw threads and gimlet points. Modern up-to-date equipment furnished for Wood-Screw Plant installations.

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SCREENS OF ALL KINDS

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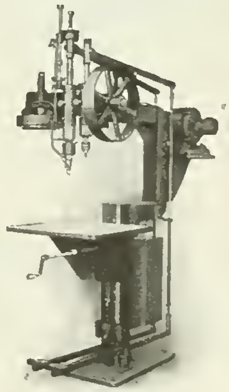
Perforated Metal Machinery Guards

Drives Screws Fast and True



The Reynolds Automatic Magazine Fed Screw Driving Machine has made some remarkable reductions in assembling costs by setting screws 2 to 6 times faster than the most skillful can do by hand. They're set uniformly, to any desired depth and without marring work or screw heads.

Send over-all dimensions of work and length and gauge of screw —for estimate.

The Reynolds Machine Co.
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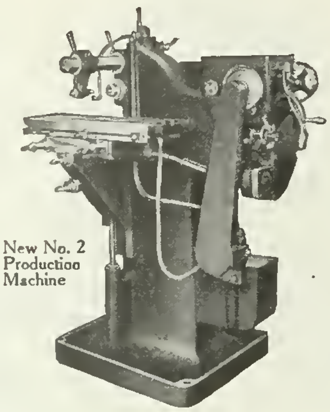
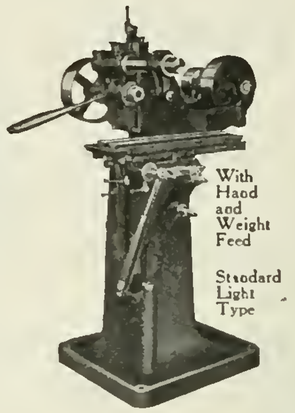

New No. 2 Production Machine

WE BUILD

Light, Medium and Heavy Duty Hand Milling Machines.
Hand and Power Feed Millers.
Spline Milling Machines.
Automatic Milling Machines of many types and designs.
Centering Machines.
Drilling Lathes.
Special Machinery.

Let us tell you more about them

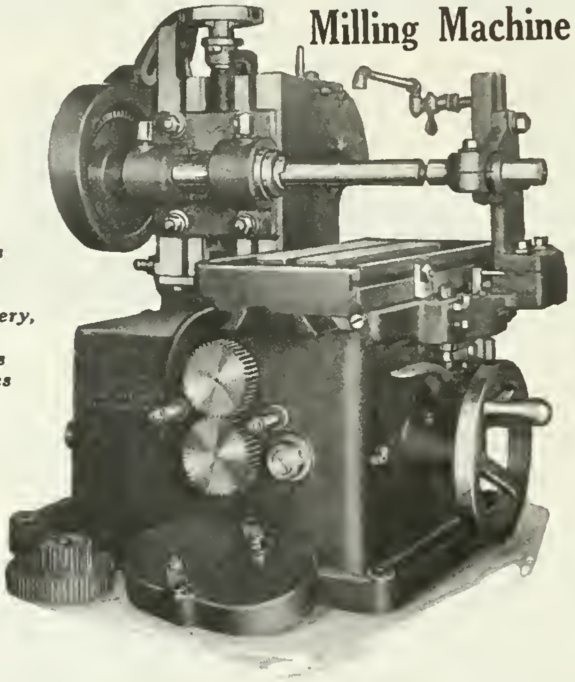
Standard Engineering Works
PAWTUCKET, RHODE ISLAND


With Hand and Weight Feed

Standard Light Type

The WEED Semi-automatic Bench Milling Machine

We are also Builders of Special Machinery, Jigs, Fixtures and Dies



Designed for the accurate and rapid production of interchangeable parts. Quick operating adjustments. Speed and feed to suit the job.

THE WEED ENGINEERING WORKS
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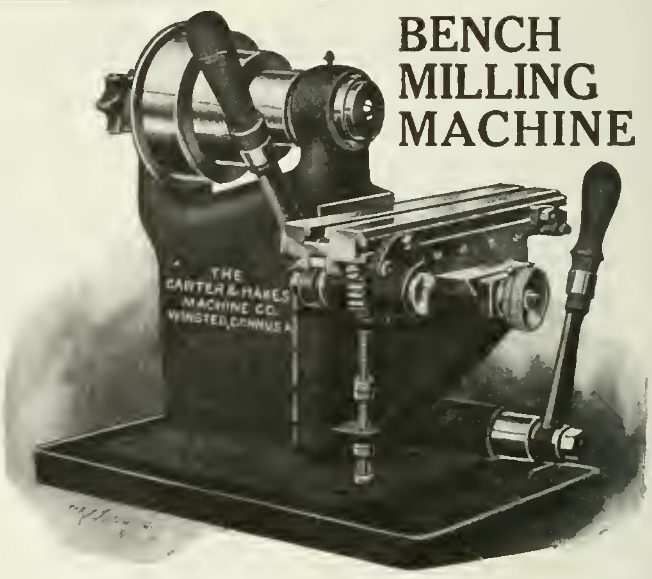
BENCH MILLING MACHINE



For Small Work in Large Quantities

This machine is built with the same care as our larger millers; it is accurate and right in every particular; highly profitable on a wide variety of small work. Can be had with floor column if desired. Ask for complete description.

THE CARTER & HAKES COMPANY
Sterling Place WINSTED, CONN.

Let us show you records of BRIGGS MILLING

on jobbing and manufacturing—keyseating, slotting, trueing, surfacing, etc., with gang and form cutters—and on just plain milling on a production basis.

We're not bragging—we know you'll be interested.

GOOLEY & EDLUND, Inc.
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OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
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Paris Turin Zurich Barcelona Petrograd
Write for List of Domestic Agents

100% Increase in Production

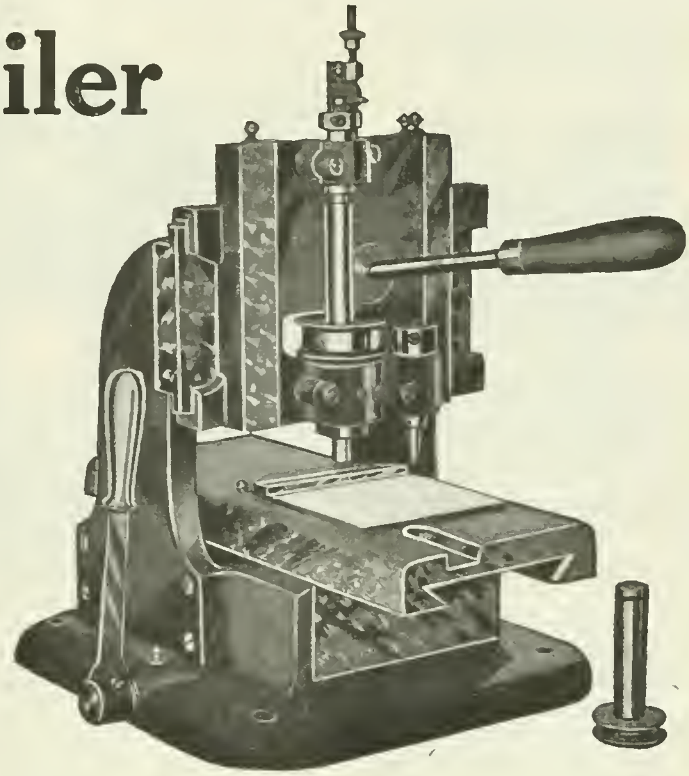
This Kempsmith No. 33 Production Miller milling feet on motor frames, doubled production by using two spindles and cutters instead of one. Result: Heavier feed, increased speed, twice the output.

Get a Kempsmith estimate on your work. No obligation. We can save time on 80% of your milling operations.

Let us show you.

KEMPSMITH MFG. COMPANY
MILWAUKEE U. S. A.

Bench Profiler



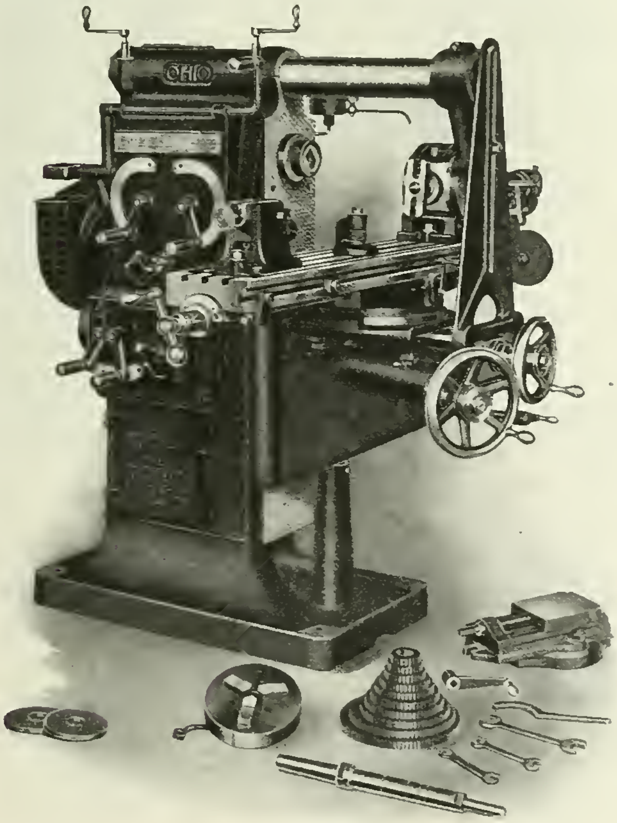
A rigid machine for quickly profiling or vertical milling your small parts. Can be depended on for accurate duplication of form and its handiness and ease of operation keeps the work moving.

Cutter Spindle takes No. 5 B & S Taper. Cutter covers an area 4" x 1¾".

Send for circular.

THE WADE-AMERICAN TOOL COMPANY
49-59 River Street **WALTHAM, MASS.**

A Machine Every Manufacturer Will Appreciate



The Ohio All-geared Milling Machine

A good serviceable machine, which combines all the essentials for modern milling practice in the simplest and most effectual way.

Three shafts—spindle, pulley and one intermediate—provide 16 successive speed changes without stopping the machine.

Oil is fed by gravity—by means of seeps, wicks, tubes and splashing, without pump or other motive part—into 3 successive reservoirs, so arranged that only clean, fresh oil reaches the spindle and main bearings.

All operating levers are handy to working position; automatic brake provides a quick stop for the spindle; every gear in the machine is pack-hardened and Ohio Specialized Construction prevails throughout.

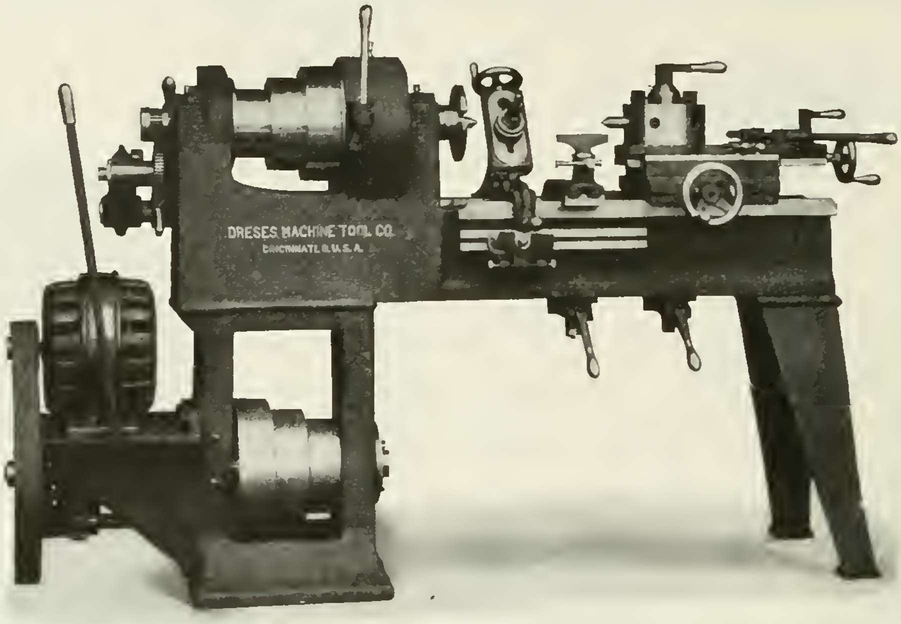
These machines are built in 6 sizes in both plain and universal types—rigid, well-balanced and of best material. Circular on request.

THE OESTERLEIN MACHINE CO.
CINCINNATI **OHIO, U. S. A.**

MILLERS OHIO GRINDERS

"Tools in Which Every Ounce Works"

Motor Driven Turret Lathes and Screw Machines



Geared speed changing devices are not practical for very high speeds. The motor mounted on the headstock looks unsightly and sets up undesirable vibrations. We place the motor on a bracket close to the floor where it takes up little room, reduces the vibration and allows a long belt for the pulleys. A rawhide pinion on the armature shaft insures noiseless running. A mechanical friction clutch starting, stopping and reversing device between the motor and lower shaft eliminates an expensive and complicated electrical controlling arrangement. For variable speed motors, single pulleys instead of cone pulleys are used.

THE DRESES MACHINE TOOL CO., Cincinnati, Ohio

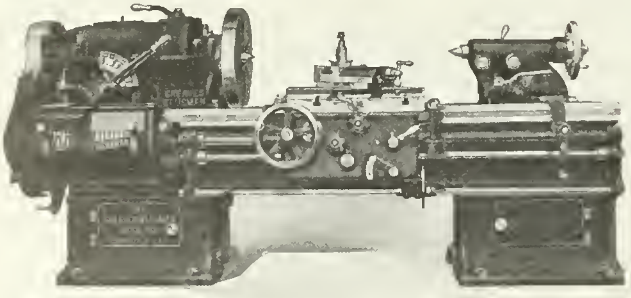
Greaves-Klusman Lathes

Always Ready for Current Demands

G-K "Betterments" always anticipate requirements—as witness the growing tendency of manufacturers to look for greater ruggedness and durability in selecting equipment.

The ribbing in G-K Lathes extends the *full* depth of the bed; the spindle is set *back* of the center line and the feed-rod is supported at *both* ends of the apron.

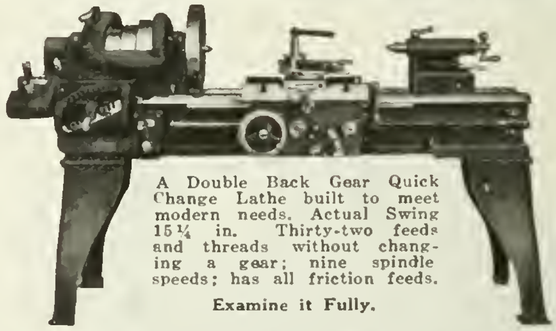
**Heavy Quick Change Engine Lathes—
14", 16", 18", 20", 24", and 30" sizes
Flexible Motor, Geared Motor Drives and Variable Speed Motor Drive**



Circulars or Complete Catalog Sent on Request.

The Greaves-Klusman Tool Co.
CINCINNATI OHIO, U. S. A.

A Remarkable 14-Inch Lathe for $450.00!



A Double Back Gear Quick Change Lathe built to meet modern needs. Actual Swing 15¼ in. Thirty-two feeds and threads without changing a gear; nine spindle speeds; has all friction feeds.

Examine it Fully.

The Carroll & Jamieson Machine Tool Co.
253 Davis Avenue, Batavia, Ohio

HAMILTON LATHES

Standard type machines that give better than average service.
Look them over at our nearest agent.

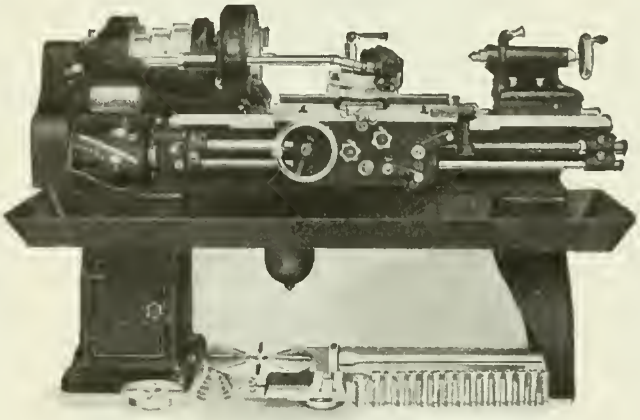
Hamilton Machine Tool Company
HAMILTON OHIO

Steinle Turret Machine Co.

THE FULL SWING SIDE CARRIAGE
TURRET LATHE

STEINLE TURRET MACHINE CO.
MADISON WISCONSIN U. S. A.

Monarch Tool-room Lathes



16"x6' Monarch Tool-Room Lathe with full equipment, including *UNIVERSAL Relieving Attachment, Taper Attachment, Draw-in Attachment, Chasing Dial* and *Chasing Stop*

Many other sizes of Monarch lathes can be furnished with complete tool-room equipment. Complete range of sizes 9-inch to 30-inch swing.

Special features of Monarch tool-room lathes include the following:

Full double plate apron with all drop-forged steel gears and central oiling system for back plate.

Efficient full Universal Relieving Attachment which is quickly attached and removed from the lathe.

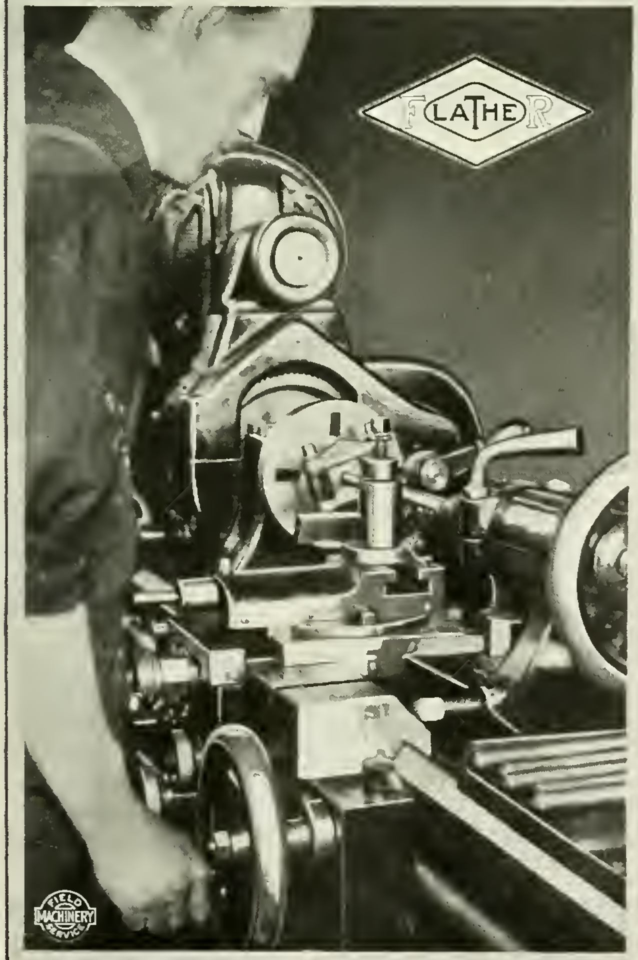
Has all the features required for the rapid accurate making of tools and gauges.

Is constructed of the very finest materials and in sufficient quantity to justify the most modern methods of duplicate quantity production in their manufacture.

Monarch lathes are *manufactured* in quantity, not *built* singly or in small lots. As a consequence, Monarch lathes are always attractively priced. Inspection records which are guarantees of accuracy accompany each lathe showing the accuracy of the lead screw for chasing and of the alignment of the lathe for accuracy in turning, facing and boring.

Few lathes equal, and none rival, the Monarch lathe for accuracy and efficiency.

THE MONARCH MACHINE TOOL CO.
209 Oak Street, Sidney, Ohio, U. S. A.



You've Heard About Instant Control—

Here It Is

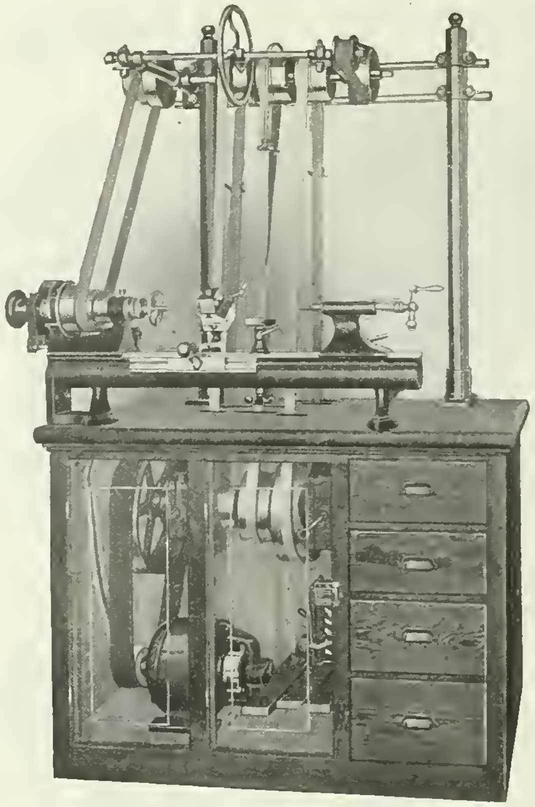
A motor driven Flather Lathe comes close to perfection in the matter of ready control. It is under the positive and instant command of its operator at all speeds, forward or reverse—and you know, if you have ever run a lathe, that ready, easy control contributes much to output. Also Flather motor drive is *safe*—in case of overload or too quick reverse a safety switch throws out, protecting both the machine and work.

Flather Lathes have exclusive advantages that have been developed during the many years we've been building these machines.

Let us send the whole story

Flather & Company, Inc.
NASHUA N. H., U. S. A.

Stark Precision Bench Lathes



STARK TOOL COMPANY

WALTHAM, MASS. **Established 1862**

Originators of the American Bench Lathe

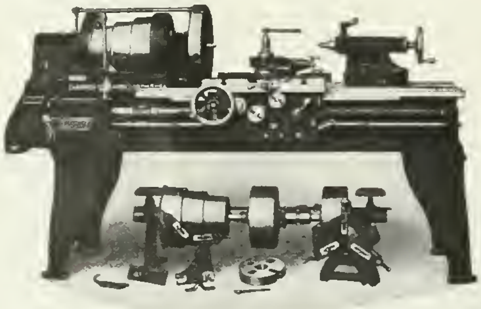
CHAMPION LATHES

More Popular Than Ever

Lathes come and lathes go—but Champion Lathes keep right on the job and are replaced only by more Champions.

One man tells another how useful he finds Champion Lathes, and so the story of their many practical advantages spreads.

It will pay you, too, to investigate the exclusive advantages of Champion Lathes.



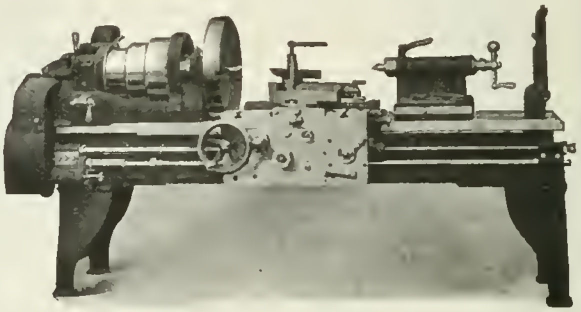
CHAMPION TOOL WORKS

4955 Spring Grove Ave. Cincinnati, Ohio

Bradford Lathes

Standard type engine lathes. Well built, modern machines in sizes from 14 to 42 inches. Cut shows the 20″ standard type 3-step cone, double back geared lathe—a popular size.

Send for a set of circulars of the entire line.



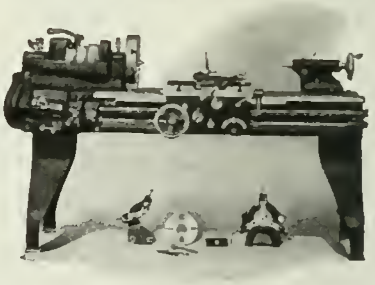
THE BRADFORD MACHINE TOOL COMPANY

Cincinnati **Ohio, U. S. A.**

ROCKFORD "ECONOMY"

Double Back Geared Quick Change Engine Lathes

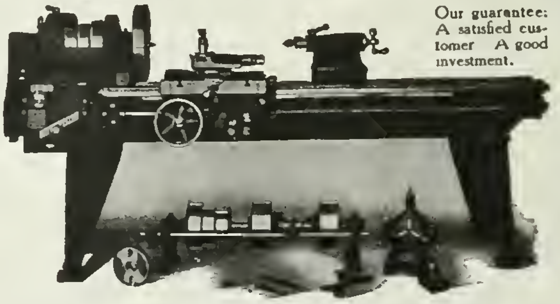
Machines that assure accuracy and fine finish at profitable speeds and on a wide variety of work. Any of 32 feed changes instantly obtainable and chasing dial provides any thread 4 to 56 per inch, including 11½. Can be used for light manufacturing without spoiling them for the experimental department.



Bulletin on Request

ROCKFORD LATHE & DRILL CO., Rockford, Ill.

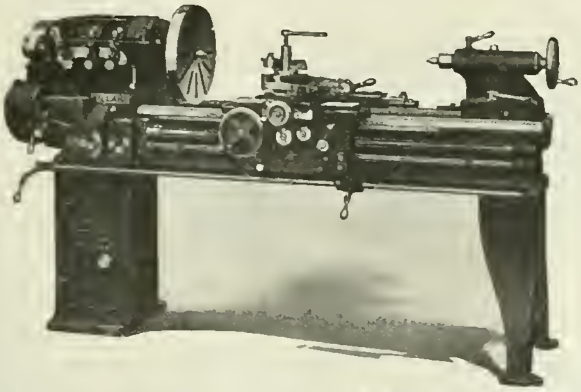
A. V. Carroll Lathes, actual swing 16½", 19" in the patented gap. Sizes 12" to 21". Send for circular and instructions showing how to save 25%—every user of a lathe should have one—mailed free.



Our guarantee: A satisfied customer A good investment.

A. V. CARROLL MACHINE TOOL CO.

Station H **CINCINNATI, OHIO**



"CUT IT SHORT"

It stands to reason you can get somewhere on production by using a WILLARD single pulley drive.

Automobile sliding gears, made of chrome nickel steel, oil hardened and ground, and running in an oil bath. Shafts run on SKF bearings. Apron control. Fool-proof headstock.

Power for roughing; speed and accuracy for finish. "Make it snappy." Time is money.

Write us for particulars.

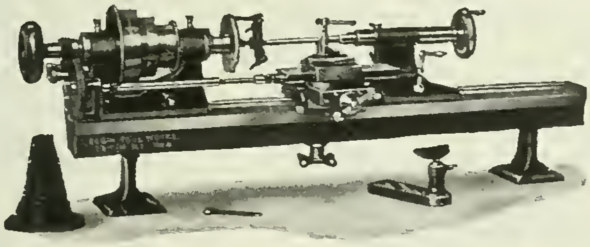
THE WILLARD MACHINE TOOL COMPANY, Cincinnati, Ohio

SIDNEY LATHES

Standard Patterns, Most Needed Sizes

Accurate to .001"; simplified and centralized controls make operation easy; excellent design; careful construction; efficient and economical. 10, 12, 14, 16, 18 and 20 inch sizes. Write for details.

THE SIDNEY MACHINE TOOL CO.
SIDNEY OHIO, U. S. A.



Almost a Complete Machine Shop

An Elgin Precision Bench Lathe with attachments is capable of turning, boring, drilling, milling, sawing, slotting, shaping, grinding, etc. Excels larger tools on production, is unexcelled for precision. Details on request.

ELGIN TOOL WORKS, Inc., ELGIN, ILLINOIS

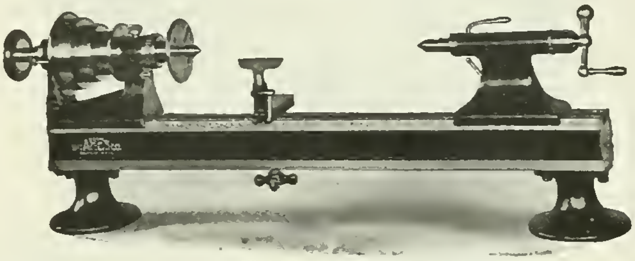
Hand and Power Marking Machines

Before You Decide

on a method of marking any new product or if your present method is not satisfactory get our recommendations and a copy of our booklet: "Cost Reduced; Quality Improved." Write today and let us help you to solve your problems. We also make stamps for every marking purpose.

The Noble & Westbrook Mfg. Co., Hartford, Conn.
"Improved Marking Devices"

Ames Precision Bench Lathes



For Turning, Drilling, Filing, Grinding, Milling and Thread Cutting

There's plenty of work for these versatile machines in tool-rooms and in shops where delicate mechanisms and instruments are manufactured. A wide variety of rests, fixtures, tailstocks, turrets and attachments—including taper, relieving, thread cutting and internal and external grinding—make them practically universal for all work within their range.

Swing over bed is 8⅞", distance between centers 21" and the countershaft provides a choice of 720 or 120 R. P. M.

Let us tell you BC AMES CO WALTHAM MASS U.S.A. *more about them*

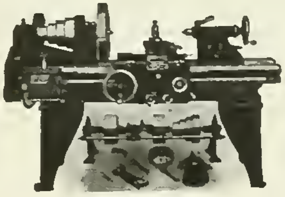
B. C. AMES COMPANY
WALTHAM MASS., U. S. A.

The Automatic Machine Company

BRIDGEPORT CONNECTICUT

Makers of

AUTOMATIC THREADING LATHES
AUTOMATIC HOB THREAD MILLERS
COULTER MULTIPLE SPINDLE PROFILERS
COULTER SHAPING PLANERS
SPECIAL MACHINE TOOLS



Free Catalog No. 79

SOUTH BEND LATHES

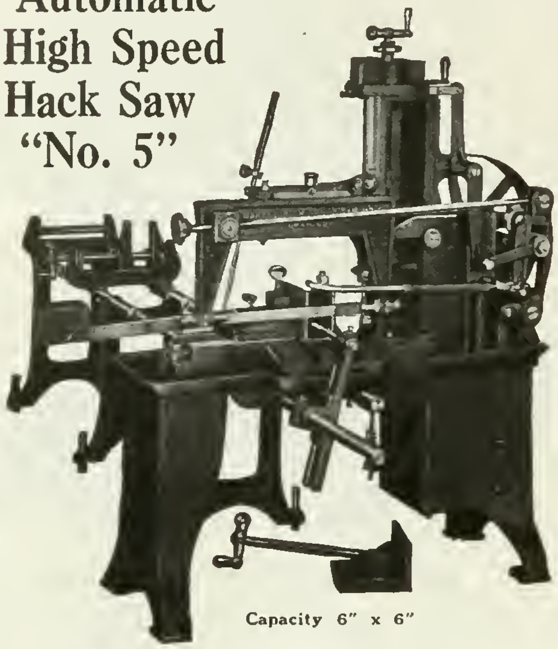
Size of Lathe	Standard Change Gear	Quick Change Gear
13"x 5' Lathe	$304.00	$354.00
15"x 6' Lathe	376.00	431.00
16"x 8' Lathe	452.00	512.00
18"x10' Lathe	656.00	721.00

SOUTH BEND LATHE WORKS
420 Madison Street South Bend, Ind.
New York Salesroom—166 N. Centre St.

Do you Use Lots of Duplicate Pieces?

Marvel Automatic High Speed Hack Saw "No. 5"

The No. 5 Marvel Automatic High Speed Hack Saw cuts bar stock into duplicate pieces to length desired. Automatically opens vise after each cut, feeds bar to gauge, closes vise, and resumes cutting, all automatic, and at tremendous cutting speed. The most economical method of cutting duplicate pieces from bars of steel or other metal. Automatic Stock Feed, Swivel Chuck, Adjustable Stroke, Variable Blade Pressure, Draw Cut and Automatic Stops are outstanding features, and provision is made for shifting the frame so as to use up the entire blade.



Capacity 6" x 6"

This machine is furnished belt or motor drive and takes blades 14" x 1" x .049".

Send for the Catalog of Marvel Hack Saws, Band Saws, Shears, Punches and Drill Press Vises and investigate these efficient tools.

Armstrong-Blum Mfg. Co.
343 North Francisco Ave. CHICAGO, ILL.

VICTOR

HACK SAW BLADES

Victor All Hard and Flexible Blades for hand frames and Victor All Hard Blades for light machine work are made of special tungsten alloy steel and give you special service.

Victor Service includes full information on hack saw blade use, advice on metal cutting, price lists, etc. Write us and let us help you to lower production costs.

VICTOR SAW WORKS
MIDDLETOWN, N. Y.

2009-28

QUALITY

HACK SAWS

"True to the Name"

Specify Quality on your next order and Settle Your Hack Saw Problem.

Napier Saw Works, Inc.
(The Hack Saw Specialists)
Office & Factory, Middletown, N. Y.

Lea Simplex Cold Saws

Our booklet "Economy in Cold Sawing" presents some interesting facts on the Lea-Simplex method of handling this frequently neglected operation.

Write for a copy today.

The Earle Gear & Machine Company
4707-15 Stenton Avenue PHILADELPHIA, U. S. A.
Also Manufacturers of Cut Gears, Special and Bridge Operating Machinery and Earle Centrifugal Pumps

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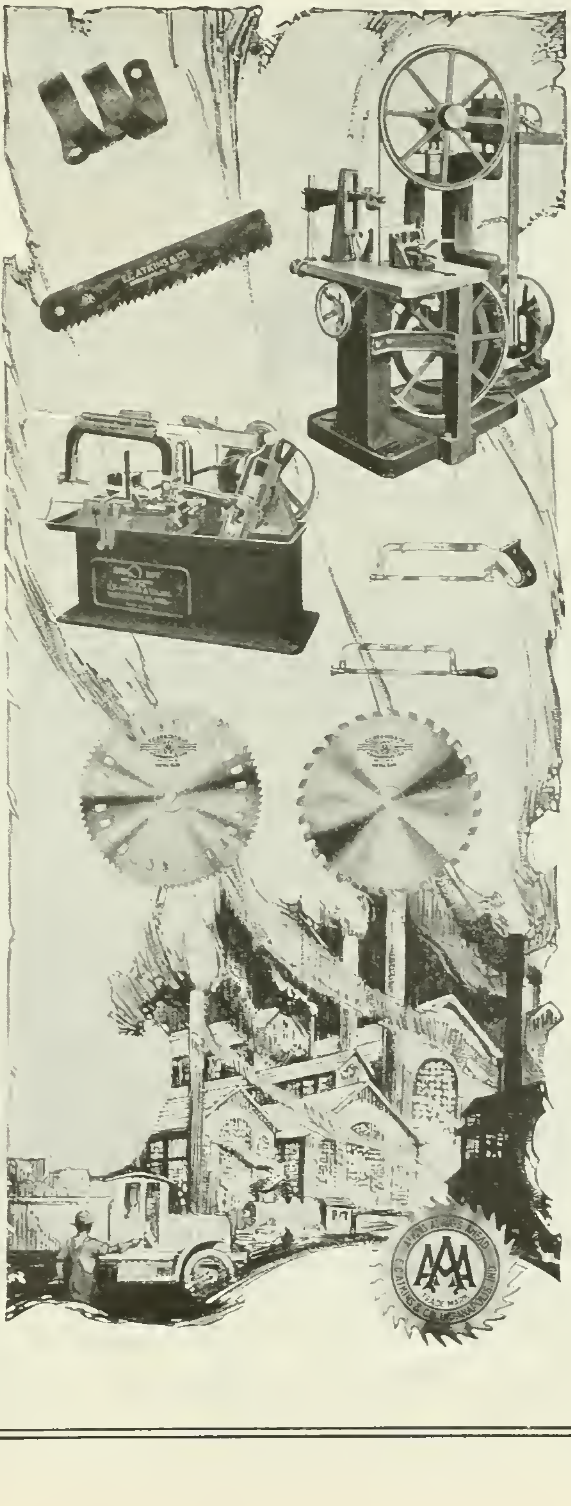
BARNES
SAWS FOR METAL
BAND HACK
MANUFACTURED BY
DETROIT W. O. BARNES CO., INC. MICH.

ATKINS

METAL CUTTING SAWS

Have Made Sawing Easier and Faster



These better saws and machines are made to save you time, labor and material. It costs you money to use a cheap metal cutting saw or machine. A really good one is an economy.

Labor is scarce. Time is money. Your product is too valuable to trust to poor metal cutting saws and machines. Atkins will save you money and we solicit your inquiry for specific facts covering,

Kwik-Kut Hack Saw Machines
Metal Cutting Band Saw Machines
Non-Breakable Hack Saw Blades
Power Hack Saw Blades
Circular Saws for all kinds of Metal Cutting
Band Saws for Metal Cutting
Frames for Hack Saws

Let us send you informative literature on any metal cutting job. Write us today.

E.C. ATKINS & CO.

ESTABLISHED 1857 THE SILVER STEEL SAW PEOPLE

Home Office and Factory, INDIANAPOLIS, INDIANA
Canadian Factory, Hamilton Ontario
Machine Knife Factory, Lancaster N.Y.

Branches Carrying Complete Stocks In The Following Cities:

Atlanta
Memphis
Chicago
Minneapolis
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San Francisco
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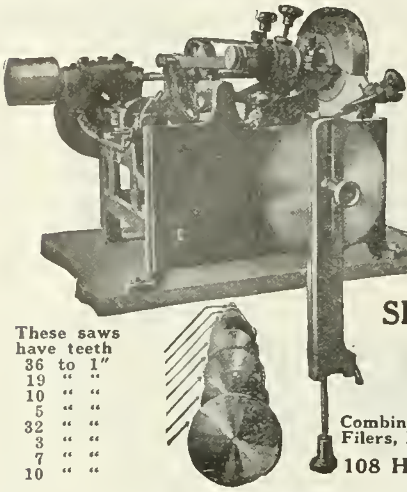
Paris, France
Sydney, N. S. W.
Vancouver, B.C.



SAW SALVAGE REDUCES COSTS 40% to 80%

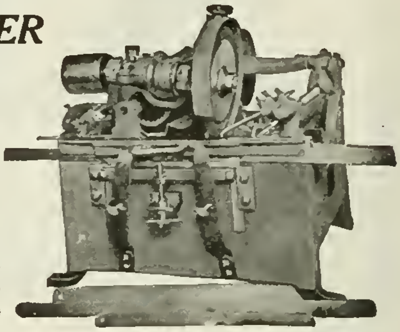
$10.00 WORTH OF SAWS CAN BE RECLAIMED FOR 25c.

IT DOES NOT COST OVER 5c. TO RESHARPEN A
SLITTING, MILLING, SCREW-SLOTTING, HACK OR BAND SAW

The Wardwell Mfg. Co.
Specialty Manufacturers

Combination Band Saw Filing and Setting Machines, Circular Saw Filers, Hack Saw Grinders, Metal Cutting Band Saw Grinders, etc.

108 HAMILTON AVE. CLEVELAND, OHIO



STAR
HACK SAWS

TRADE MARK

The Blade With a Reputation

Star Hack Saw Reputation is built upon the metal cutting performance record of forty years. Stars cut faster and cut longer. Personal service, information, advice and price lists on All Hard and Flexible Hand Blades, and on Power Blades, sent on request.

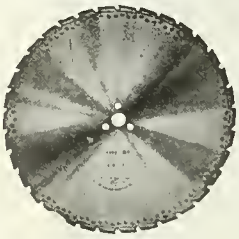
Clemson Bros. Inc.
Middletown, N.Y.

2008-28

STERLING
HACK SAW BLADES

Finest grade rolled high-tungsten alloy steel, made by special machines and processes. Free-cutting, long-lasting, tough. Sterling Hacksaw Blades, Frames and Machines are for sale everywhere. Ask for them.

Diamond Saw & Stamping Works
357-361 Seventh St. BUFFALO, N. Y.



HUTHER
SAWS

Do You Saw Switches, Rails, Frogs, Alloy Steel Spindles?

The economical way is to use a Huther Inserted Tooth Milling Saw on your cutting-off machine. Inserted teeth of high speed steel are almost unbreakable, and wear down 1¼" before renewal is necessary. Cut very thin, and fast. Send for one on free trial—keep it only if it *saves* you money.

Details on request.

Huther Bros. Saw Mfg. Co., Inc.
ROCHESTER, N. Y.

The
HIGLEY
COLD METAL SAW

Catalog furnished by

Vandyck Churchill Co.
New York Philadelphia New Haven

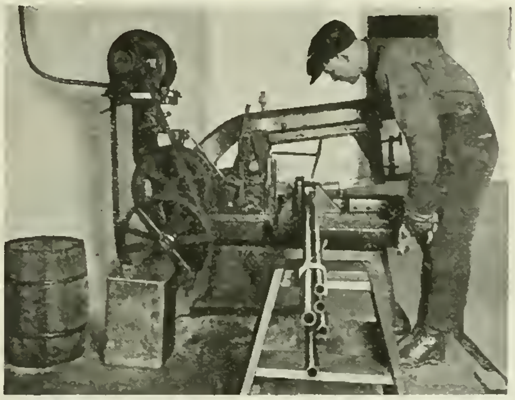


Photo and data obtained at the New York plant of the O. T. Hungerford Brass and Copper Co.

Peerless Hack Saws

Exclusively at "Hungerford's"

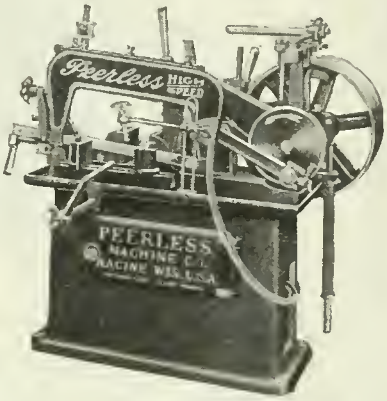
The 4½-year-old machine shown is one of the busiest among the many Peerless Machines in this busy shop—used exclusively for cutting steel tubing ¼″ O. D. and No. 20 Birmingham Wire Gage with .035″ wall up to 6″ O.D. with .075″ wall.

When photographed No. 18 Gage Seamless Steel Tubes 1″ O.D. with .049″ walls were being cut, *six at a time*—the work held securely in a vise, Aqualene fluid for lubricant and cutting time for each set of six lengths, one minute.

Fast, Accurate, Economical and Universal

Peerless Metal Cutting Machines are used for slotting, shaping, etc., as well as sawing *at any angle.* Automatic lift, positive feed control and other features permit big output with minimum blade breakage; assure clean, true cuts at little cost. Let us tell you all about them.

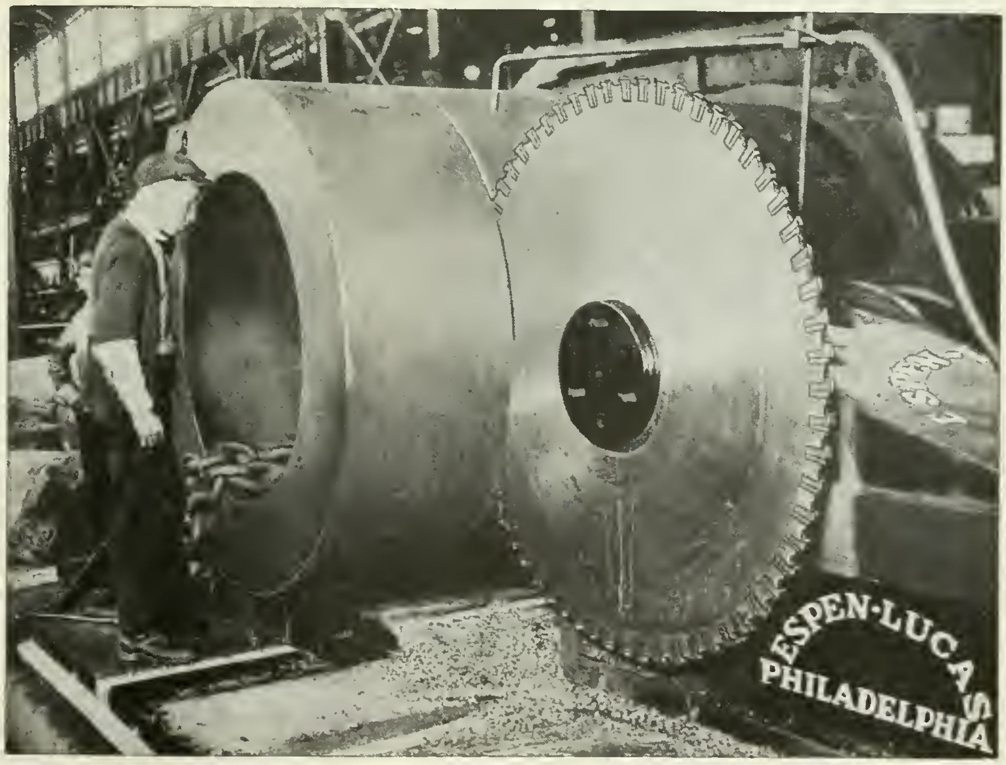
PEERLESS MACHINE COMPANY
17th and Northwestern R. R. RACINE, WIS.



FAST AND ECONOMICAL SAWING

Tell us your needs, we have the knowledge, experience and will to correctly advise.

190 types and sizes of Sawing Machines for sawing all kinds of metal.



THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues PHILADELPHIA, PA.

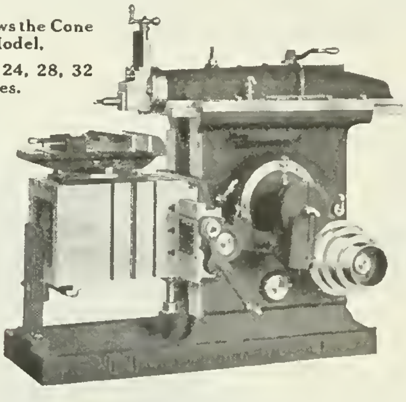
Columbia Shapers

Heavier, More Powerful,
More Productive

Generous proportions, high class workmanship and many special features guarantee greater efficiency and ease of operation.

Send for circular 7; study the details of Columbia "Quick Change Feed," "Single Lever for Locking Cross Rail to Column," etc.

Cut shows the Cone Drive Model,
16, 20, 24, 28, 32 inch sizes.

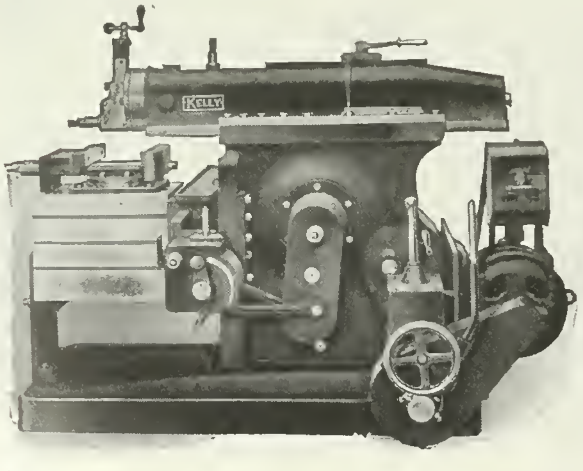


The Columbia Machine Tool Co.
HAMILTON, OHIO

24-Inch Back Geared Kelly Crank Shaper

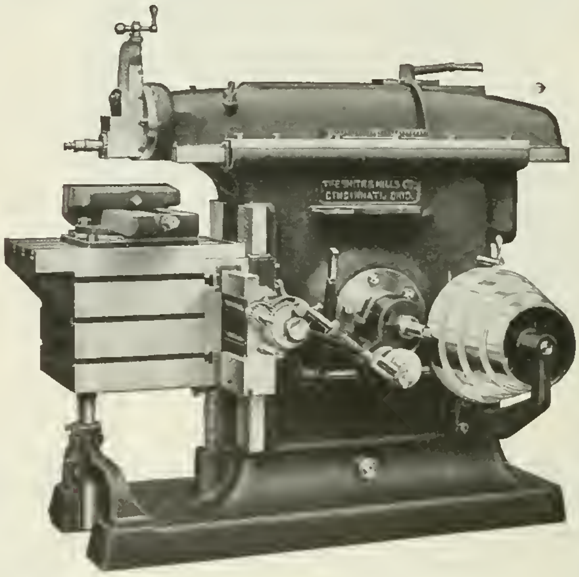
Note these convenient left side controlling devices: starting box—rheostat or drum controller; silent chain or gear drive, clutch and brake attachment for starting or stopping shaper independent of motor.

And, in addition, broad, heavy base, main gear centrally located; stiff heavy ram supported full length of stroke; broad hand scraped bearings, etc. Better have a Kelly catalog before you when choosing a shaper. Sizes 15" Single Geared to 26" Back Geared. Write for a copy.



THE R. A. KELLY COMPANY
XENIA OHIO, U. S. A.

Shapers Exclusively



Crank Sizes: 12", 14", 16", 20", and 25"—Either Cone Driven or through Speed Box, 28" and 32" B. G.
All Geared Single Pulley Drive

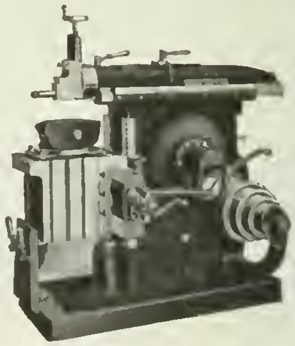
The Smith & Mills Company
CINCINNATI OHIO, U. S. A.

FOREIGN AGENTS: G. & F. Limbourg Freres, Brussels, Belgium; Burton, Griffiths & Co., Ltd., London, England; Van Rietschoten & Houwens, Rotterdam, Holland; Reid Bros. (Johannesburg) Ltd., Johannesburg, South Africa; J. Lambercier & Co., Geneva, Switzerland; Zurich, Switzerland; V. Lowener, Copenhagen, Denmark; Christiania, Norway; Stockholm, Sweden; H. P. Gregory & Co., Sydney, N. S. W.; Rene Berndes Co., Havana, Cuba; Horne Company, Ltd., Tokyo Japan; Daniele Stussi, Milan, Italy.

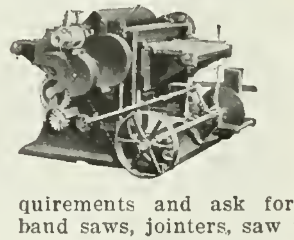
The John Steptoe Company
2961 Colerain Avenue Cincinnati, Ohio, U. S. A.

When you are in the market for a *Shaper, Milling Machine, Lathe* or *Die Slotter* send for catalogue and prices of

Steptoe's Medium Price Line



Crescent Wood Working Machinery



is popular because the machines are durable and always please our customers. The time will come when you will need additional equipment to help you speed up production so you had better get a little ahead of your requirements and ask for catalog today describing band saws, jointers, saw tables, planers, planers and matchers, disk grinders, swing saws, post borers, shapers, variety wood workers, hollow chisels, mortisers, universal wood workers, table cut-off saw.

THE CRESCENT MACHINE CO.
56 MAIN STREET LEETONIA, OHIO

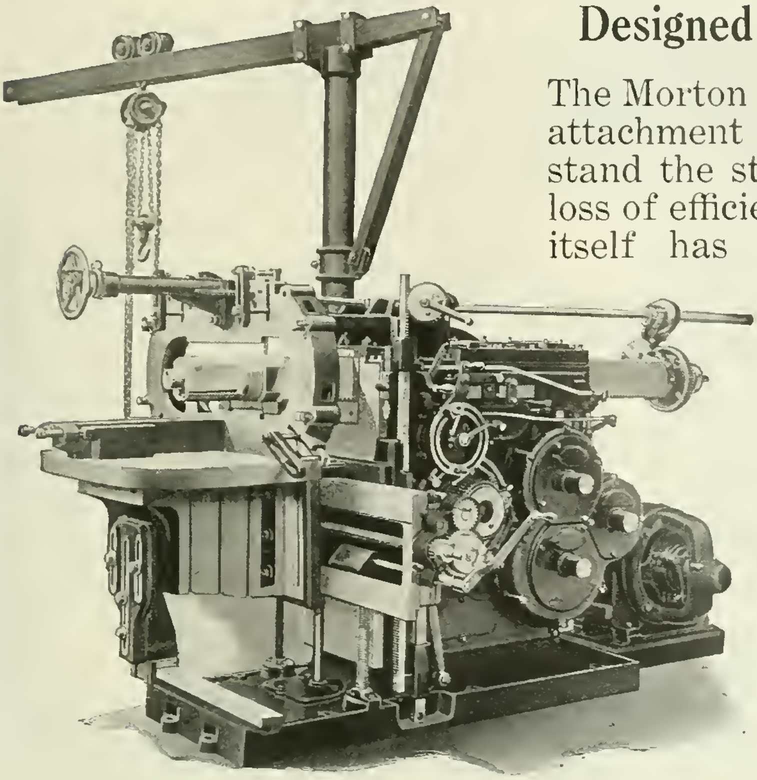
The Morton Draw-cut Shaper

Designed for Railroad Shop Service

The Morton railroad shaper with driving box attachment was especially developed to stand the strains of severe service without loss of efficiency. The draw-cut principle in itself has many advantages—it permits deeper, smoother, more accurate cuts than are possible to a push cut shaper—it takes less space, uses less power than a planer with capacity for the same work.

Bulletin 6 D gives interesting details.

Morton Manufacturing Company
Muskegon Heights Michigan, U. S. A.



A Point to Remember—

Contract Shops have need for the Rhodes for its flexibility, versatility, speed and ability to keep costs low.

It operates in two planes, horizontal or vertical; is either a 7″ shaper or 3½″ slotter; can be changed from one to the other in a very few minutes; tilts 0° to 10° from vertical; comes equipped with rotary table and vise; etc.

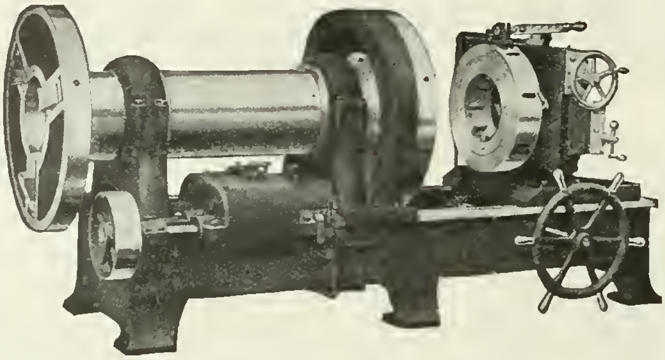
Manufacturing plants find it an economical producer of small accurate work in quantity.

May we tell you all about it? Write for catalog M-22.

The Rhodes Manufacturing Co.
HARTFORD CONNECTICUT
"You Can Do It With A Rhodes"

RHODES
SHAPER and SLOTTER

PEERLESS B&K DUPLEX P.D.O.G.



No Frills

Frills have no place on a pipe machine, because they cannot stand the hard knocks. A pipe machine should be a no-frill machine, every part will sooner or later be called upon to buck right up to hard work. The die-head should be equipped with a practical die adjusting device. The cut-off is equally important. The gripping chucks should grip without slipping. The speed changes should be easily obtained. The oiling system should flood the dies and cut-off tool. All these things go to make up a dependable, lasting pipe machine, and are explained fully in our catalog, which will be mailed to you if you want it. Do you want it?

BIGNALL & KEELER MACHINE WORKS, Edwardsville, Ill.

Sales Agents: Manning, Maxwell & Moore, New York, N. Y.

Chicago Philadelphia Boston St. Louis Pittsburgh Cleveland New Haven
Cincinnati Buffalo Syracuse Detroit Milwaukee San Francisco Seattle

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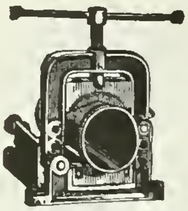
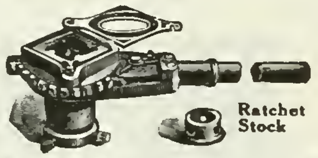
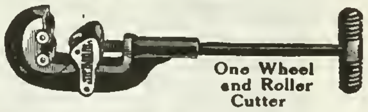


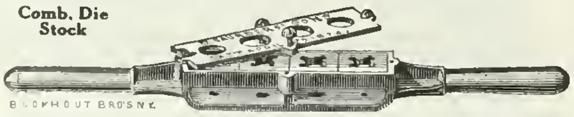


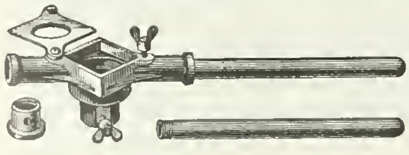

One Wheel and Roller Cutter

SAUNDERS' TOOLS
Will Stand the Strain

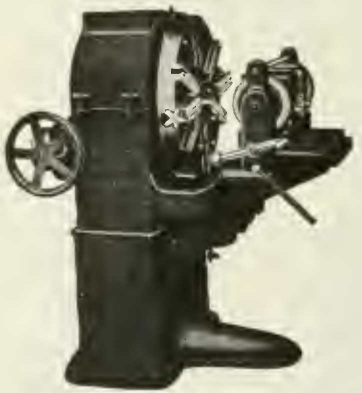
They are the Result of Sixty Years' Practical Experience

Write for Catalog "P"





D. Saunders' Sons, Inc.
YONKERS, N. Y., U. S. A.



ARMSTRONG No. 3 Pipe Threading Machine

POWER ONLY

Threads Pipe 1 inch to 6 inches right or left.

MANUFACTURED BY
THE ARMSTRONG MFG. COMPANY
BRIDGEPORT, CONN.

Hurlbut, Rogers Cutting-off Machines

It will pay you to investigate the special and patented features of Hurlbut, Rogers Cutting-off Machines.

Write for Catalog

THE HURLBUT, ROGERS MACHINERY CO.
NASHUA, N. H., U. S. A.

Threading Machines

Pipe-"Better Threads at Lower Cost"-**Bolt**

Belt or Motor Driven—Range 1/8" to 24"

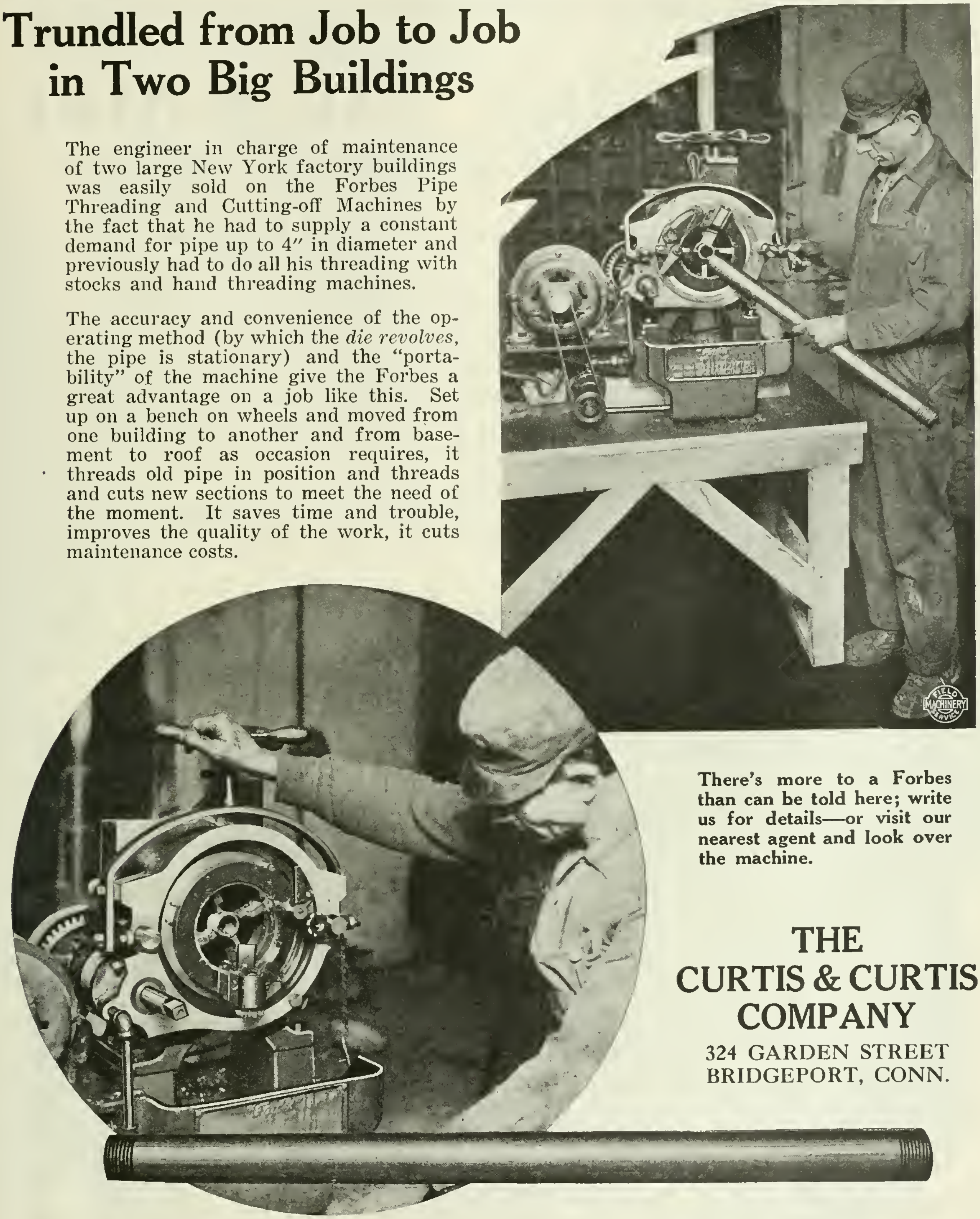
Write for our 1923 Catalog

WILLIAMS TOOL CORPORATION
Canadian Plant: Brantford, Ont. ERIE, PENNA.

Trundled from Job to Job in Two Big Buildings

The engineer in charge of maintenance of two large New York factory buildings was easily sold on the Forbes Pipe Threading and Cutting-off Machines by the fact that he had to supply a constant demand for pipe up to 4″ in diameter and previously had to do all his threading with stocks and hand threading machines.

The accuracy and convenience of the operating method (by which the *die revolves*, the pipe is stationary) and the "portability" of the machine give the Forbes a great advantage on a job like this. Set up on a bench on wheels and moved from one building to another and from basement to roof as occasion requires, it threads old pipe in position and threads and cuts new sections to meet the need of the moment. It saves time and trouble, improves the quality of the work, it cuts maintenance costs.



There's more to a Forbes than can be told here; write us for details—or visit our nearest agent and look over the machine.

THE
CURTIS & CURTIS
COMPANY
324 GARDEN STREET
BRIDGEPORT, CONN.

The New FORBES

PIPE THREADING and CUTTING-OFF MACHINES

A Bradley Hammer

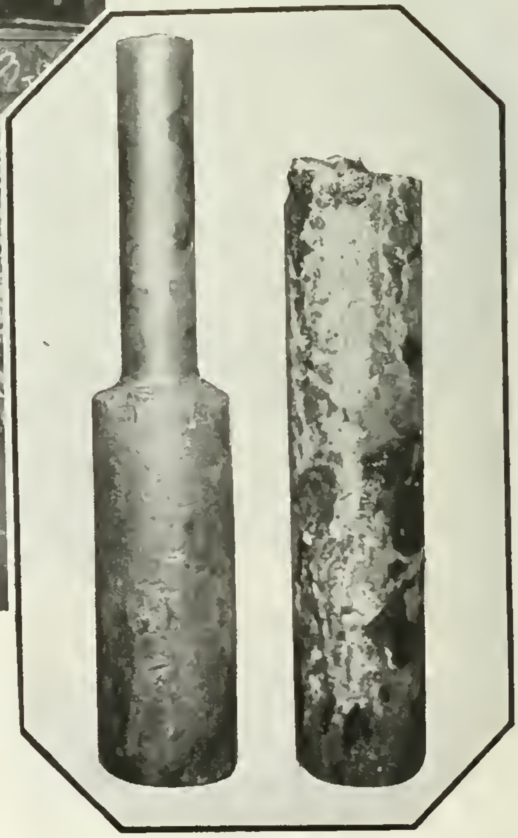
Draws Them Down—700 in 8 Hours

These cylindrical shafts for De Laval Cream Separators are drawn down from steel billets 2½" in diameter to 1¼" in little more than 4 seconds each. A production rate that sets a profitable pace for the upsetting operation which follows.

Two Bradley Hammers were installed by the De Laval Separator Company, (Poughkeepsie, N. Y.) over five years ago; both of them maintain the Bradley tradition of profitable production and low manufacturing costs.

Accurate, powerful, productive and convenient, profitable one man units for drawing down, welding, tool dressing, die work, etc.

"Forge Ahead with a Bradley Hammer"



Details are interesting—if you handle this kind of work write us

C. C. BRADLEY & SON, Inc.
SYRACUSE NEW YORK
ESTABLISHED 1832

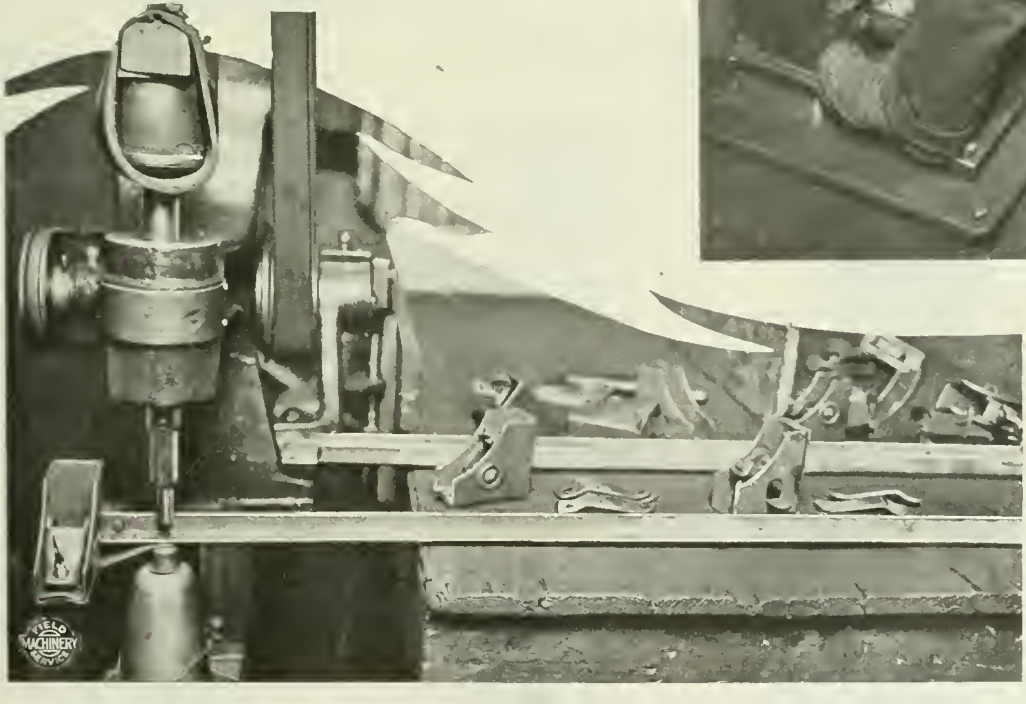
HIGH SPEED HAMMER

A Metal Bed Manufacturer Discovers Something

The Mersereau Metal Bed Company of Jersey City, N. J., makes about one hundred different kinds of metal beds. In the assembly of the better grades, a patented corner is attached to each of the four corners of the frame.

This is a riveting job, and until one year and a half ago a press was used to head the rivets. Then a High Speed Riveting Hammer was installed—which now does the work better, faster, at lower cost and to the complete satisfaction of this company.

The actual work is riveting corners of 13 gage stock to 1/8" cross angle irons with two 1/4" steel rivets—and one man heads 4000 rivets in a nine-hour day.



If you are riveting, by press or by hand, let us show what a High Speed Riveting Hammer will do for you. Just send a sample of your work.

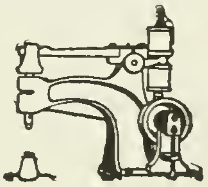
THE PRINCIPLE IS RIGHT

THE HIGH SPEED HAMMER COMPANY, Inc.

ROCHESTER NEW YORK

CHICAGO BRANCH: C. W. Schuchardt, Mgr., 25 South Clinton St. AGENCIES: Burton, Griffiths & Co., Ltd., London, E. C., for the British Isles. Aktiebolaget Rylander & Asplund, Stockholm, Sweden, for Sweden and Finland. China and Japan Trading Company, Ltd., Yokohama, Kobe and Osaka, Japan, for Japan and Dependencies.

THE HAMMER WITH THE HUMAN STROKE

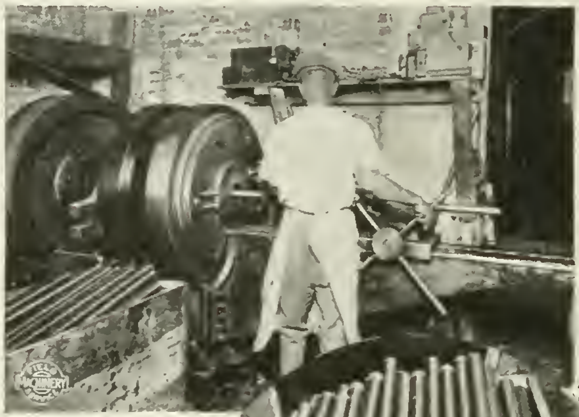


A Good Example of Etna Swaging

The work is reducing 28¾″ lengths of No. 19 gage welded steel tubing from 1⅜″ to 1⅛″ in diameter; **and the output** is one hundred and twenty tubes per hour, two per minute, with one Etna Swaging Machine. Easy work—and satisfactory.

In Etna Swaging thousands of blows impart to the work the quality of a forging. The speed and simplicity of Etna Machines assure rapid and economical output.

Let us tell you all about swaging and its advantages.



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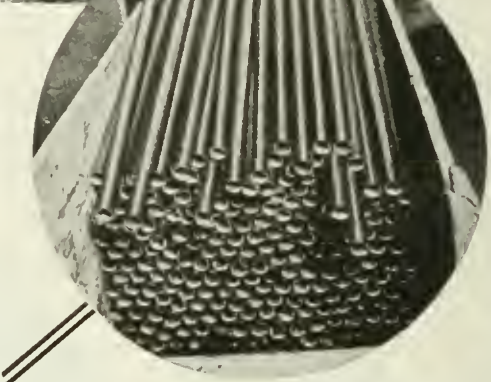

THE ETNA MACHINE COMPANY

Maplewood Ave. and Castle Blvd. **TOLEDO, OHIO**

Automatic Threading Machine

Threads—Knurls—Beads

All kinds of Screw Caps and Necks ½″ to 5″ diameter. Automatic chute feed takes irregular pieces with flanges. Ask for Bulletin No. 200.

THE V & O PRESS CO.

PRESSES—Sheet Metal Working Machinery—DIES

MAIN OFFICE AND FACTORY, HUDSON, N. Y.
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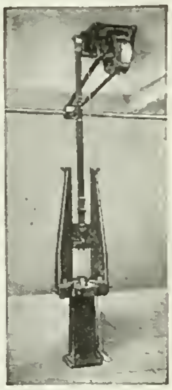
KING-SPRAGUE....................Los Angeles, San Francisco
MILLHOLLAND SALES & ENGINEERING CO......Indianapolis



"PECK" Automatic Drop Lifters

will convert those hand or foot drops and unsatisfactory automatics into

PRODUCTIVE AUTOMATIC DROPS

Capacity 15 to 5000 pounds

DROP PRESSES for all purposes

MINER & PECK MFG. CO.
DERBY, CONN.

Little Giant Power Hammers

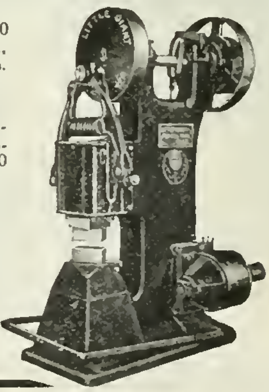
Motor or Belt Driven

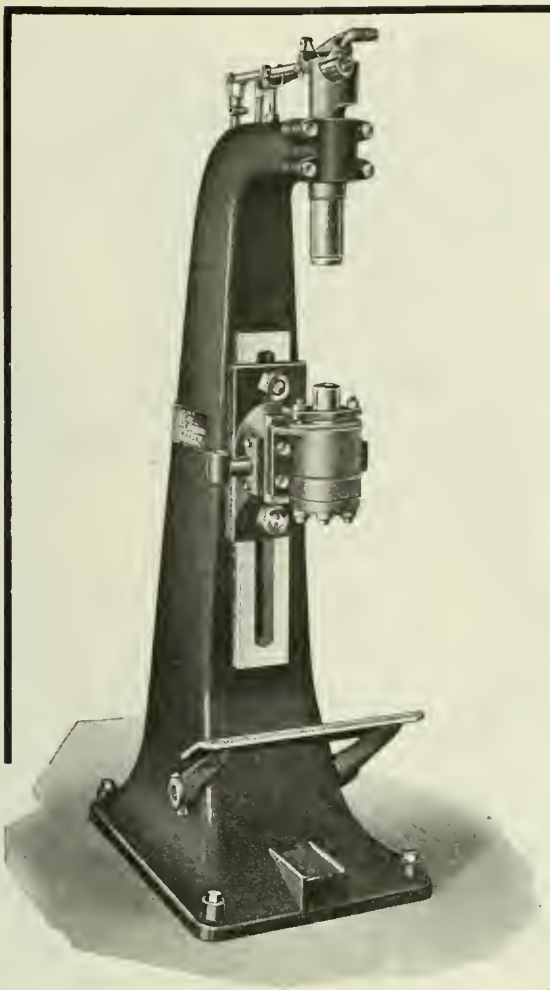
25 lb., 50 lb., 100 lb., 250 lb., 500 lb., and 1000 lb. models.

Guaranteed FOREVER against defective material and workmanship. Sold on 30 days' trial.

Sold by All Jobbers

Little Giant Company
Established 1876
131 Rock St., Mankato, Minn., U. S. A.





The Findlay Pneumatic Hammer

This riveting machine is correct in principle and design. No rotating parts or gears to break or wear out.

Write for Details

The Findlay Engineering and Manufacturing Company

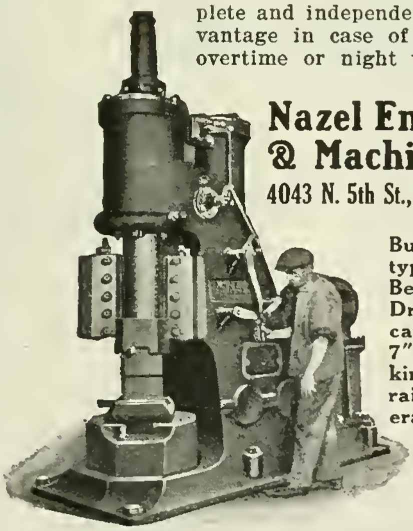
FINDLAY, OHIO, U. S. A.

MOTOR DRIVE

If it's a NAZEL AIR HAMMER geared direct to motor you have at once Economy of Power. Only when hammers are in operation and then only in proportion to work being done is power used.

Unrestricted Choice of Position. Hammers with motors attached can be placed anywhere where electric current is available. No obstruction to cranes. The entire absence of belting or piping enables cranes to be used with greater freedom above and around hammers.

Separate Unit. Each hammer complete and independent. Greater advantage in case of an emergency, overtime or night work.



Nazel Engineering & Machine Works
4043 N. 5th St., Philadelphia, Pa.

Built in three types. Six sizes, Belt or Motor Driven, with capacities up to 7" square for all kinds of machine, railroad and general forging.

Write for the NAZEL Hommer Book It's Free

NAZEL HAMMERS require no storage tanks, independent compressors or piping

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Finishing the Picture With Good Equipment

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"West" Hydraulic Tire Setters
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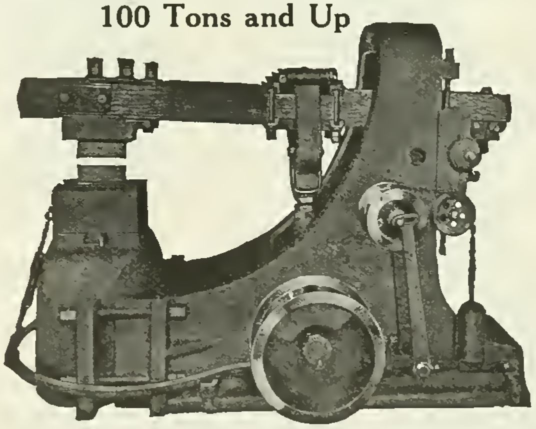
100 Tons and Up



One Size of Rochester Helve Hammer.

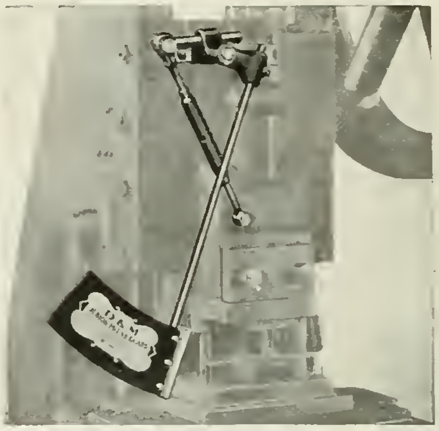
Get Our Descriptive Matter, Prices and Discounts.

SPECIAL HEAVY MACHINERY

BUILT TO ORDER

THE WEST TIRE SETTER CO.
ROCHESTER, N. Y., U. S. A.

A Simple, Positive, Automatic Press Guard That Will Not Retard Production



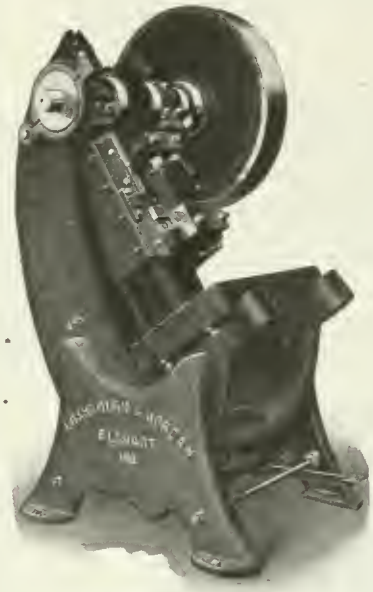
The D. & M. Junior Punch Press Guard is simple (only nine working parts), easily adjusted and inexpensive. There are no sliding parts, nothing to get out of order and it is easily installed.

Our 30 day free trial offer is always open. Let us send you details. Give name, size and stroke of press.

TAYLOR-SHANTZ COMPANY

485 St. Paul Street ROCHESTER, N. Y.

A Quality Inclinable Press Backed by a Real Guarantee



No. 5 Flywheel Press Inclined

You can't overload a Loshbough-Jordan Press while operating within its rated speed. Any shaft or frame failing under this condition will be replaced gratis.

Let us send you description of the L-J features that protect the operator and assure long service and satisfactory output. Or better, let us send you a press on 30 days' free trial.

Loshbough-Jordan Tool & Machine Co.

ELKHART, IND., U. S. A.

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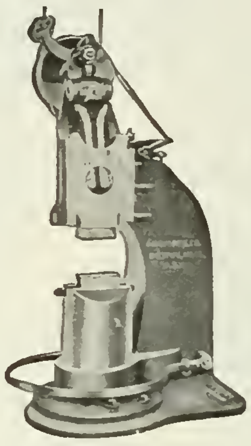

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For General Forging

A Paying Investment if used but an hour a day. 50 to 500 lbs.

Belt or Motor Driven

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Forging Rolls
Drop Hammers
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Plate Shears
Multiple Punches
Multiple Tapping Machines
Punches and Shears, Etc.

WILLIAMS, WHITE & CO.

MOLINE, ILL., U. S. A.

THE BULLDOZERS

The *Improved* Wiesman Safety Guard

Automatically sweeps the operator's hand safely aside when in danger.

Protects operator at all times. (Also when the press repeats.) And does NOT retard production.

A simple, convenient device attached in one hour without drilling any holes in the press.

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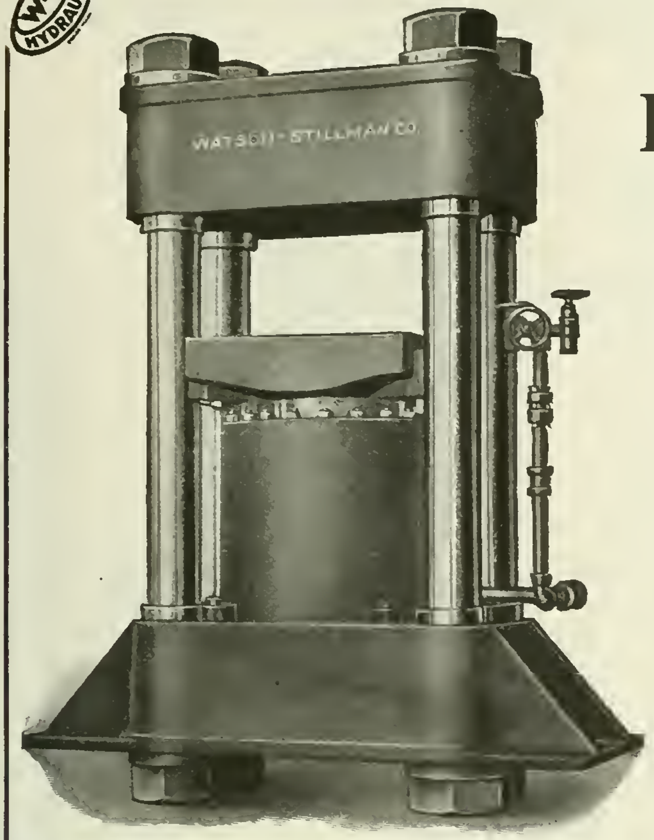
Take advantage of our 20-day free trial offer at our expense

THE WIESMAN MANUFACTURING COMPANY

31 to 35 S. St. Clair Street DAYTON, OHIO



1800-Ton Hydraulic Die Press

W·S HYDRAULIC

This 1800-Ton Hydraulic Die Press

is just an example from our large line of Hydraulic Presses designed for die forming, forcing, etc., and by the addition of plates to the platens, adaptable to a wide range of heating and chilling operations. Nothing but the best grade of material is used throughout these presses, making them machines of long service.

Other machines of our manufacture are benders, bulldozers, jacks, pit jacks, shaft straighteners, rail benders, punches, shears, wheel presses, forcing presses, forging presses, crankpin presses, pumps, accumulators, valves, etc.

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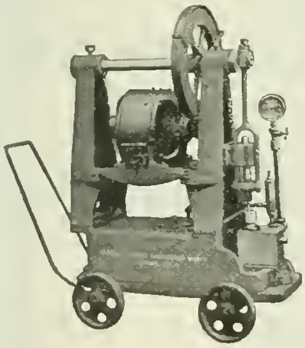
THE WATSON-STILLMAN CO.
192 Fulton Street, New York
McCormick Building, Chicago
Philadelphia, Widener Bldg.

433



ELMES

Portable High Pressure Pumps

are built for the *most severe service* with forged steel pressure cylinders, renewable valves and seats and bronze fitted throughout.

CHARLES F. ELMES ENGINEERING WORKS
Hydraulic Machinery—Special Machinery
Est. 1851 222 N. Morgan St., Chicago, U. S. A.

HYDRAULIC MACHINERY

Riveters, Pumps, Accumulators and all types of Presses
Punches and Shears Trimming Presses
Steam, Steam Drop and Board Drop Hammers
CHAMBERSBURG ENGINEERING CO. CHAMBERSBURG, PA.

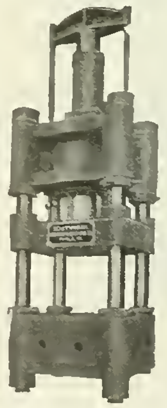
DO IT HYDRAULICALLY—

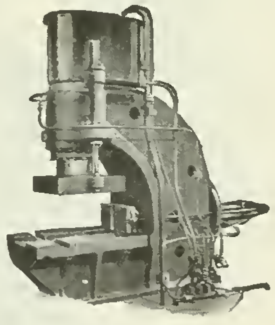
Your forming, forcing, pressing, flanging, bending, broaching, etc. It's the easier and more economical way. We furnish complete equipment for pressures from 250 lbs. to 3000 tons. Details on request.

THE HYDRAULIC PRESS MFG. CO.
Mount Gilead, Ohio
39-41 Cortlandt Street NEW YORK CITY
"For Your Pressing Needs"

HPM

HYDRAULIC & POWER TOOLS
and SPECIAL MACHINERY





Broaching Presses
Auto Body Presses
Punches, Shears
Plate Bending Rolls

Forcing Presses
Forming Presses
Extrusion Presses
Flanging Presses
Etc., Etc.

SOUTHWARK
FOUNDRY AND MACHINE CO.
ESTABLISHED 1836
PHILADELPHIA, PA.

Fisher Bldg., Chicago. Swetland Bldg., Cleveland

THE "TOLEDO"
PRESSES FOR EVERY PURPOSE!

The "Toledo" Horning and Wiring Presses; 10 sizes, 1000 to 13,000 pounds. Detachable Swinging Beds can be fitted to these presses.

More than two thousand standard patterns and a staff of press work experts to develop new designs or modify old ones to meet your needs—Toledo Service guarantees satisfaction in press work production.

The Toledo Machine & Tool Company
TOLEDO, OHIO

Chicago Office: 549 West Washington Blvd.
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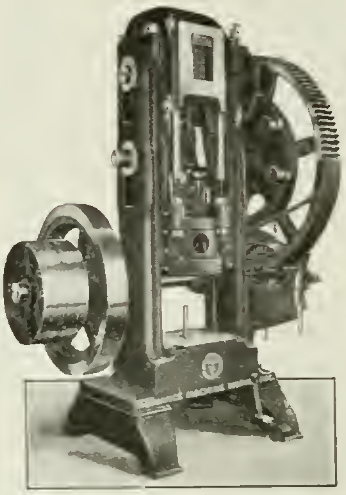
Founders and Machinists and Engineering Specialists on Equipment for Sheet Metal Products

The World's Standard

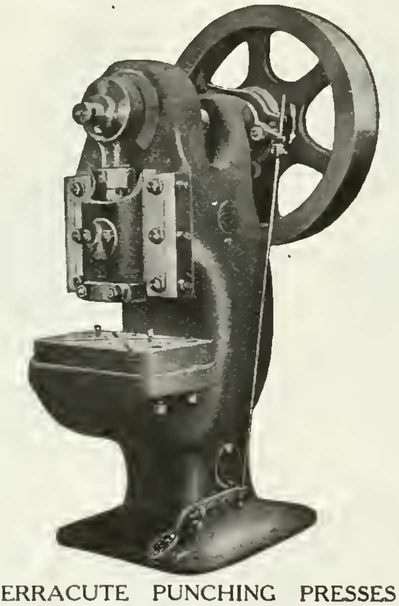


"ADRIANCE"
Combined Drawing and Reducing Presses

Built in four sizes to meet requirements of the trade. These presses are very efficient in operation and have excess power for depth of draw compared with stroke of crank. Upper crankshaft operates blank-holder, lower crankshaft, the inner plunger. Unique construction of these presses readily accommodates dies to the usual trade requirements.

ADRIANCE MACHINE WORKS, Inc.
Established 1888—Incorporated 1913
78 RICHARDS STREET BROOKLYN, N. Y.

FERRACUTE
PRESSES
For Cutting and Forming Metals



THE FERRACUTE PUNCHING PRESSES have a world-wide reputation for efficient action, correct proportion and beauty of design, the metal being put where it belongs, giving the most strength for the least cost. A number of sizes, with or without gearing.

FERRACUTE MACHINE CO., BRIDGETON, NEW JERSEY

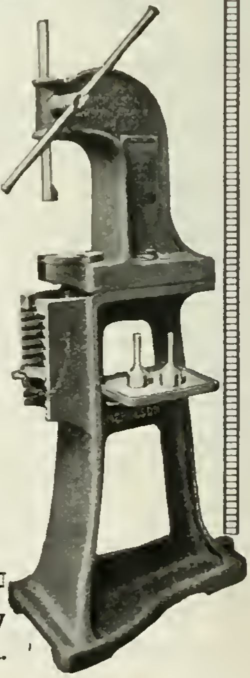
NICHOLSON TOOLS
For Economy

Mandrel

MANDRELS—Install a set of nine Nicholson Mandrels and save the cost of—and space occupied by—several hundred solid mandrels. You'll be able to fit *every* round or square hole between ½" and 7". No longer is it necessary to turn solid mandrels to size. A light hammer blow tightens or releases a Nicholson Mandrel.

ARBOR PRESSES—Have time saving advantages appreciated by production men. Nicholson Arbor Presses can be used for punching, broaching, bending and straightening. There's an adjustable shelf with captive leaf to accommodate any length shaft; tool rack on every stand to keep drivers and tools within easy reach; five sizes to choose from.

Arbor Press



Standard equipment in railroad, shipyard and machine shops all over the world. Send for catalog.

W. H. Nicholson & Company
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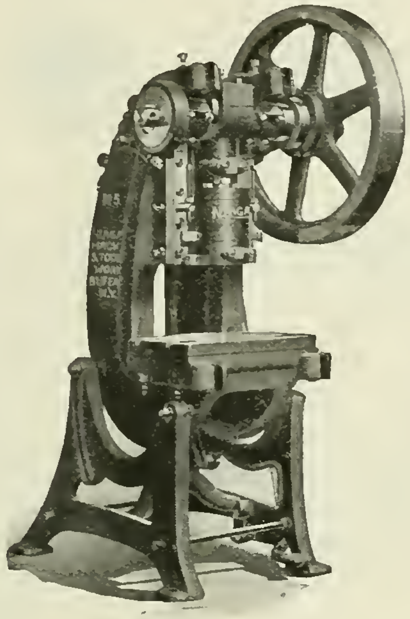
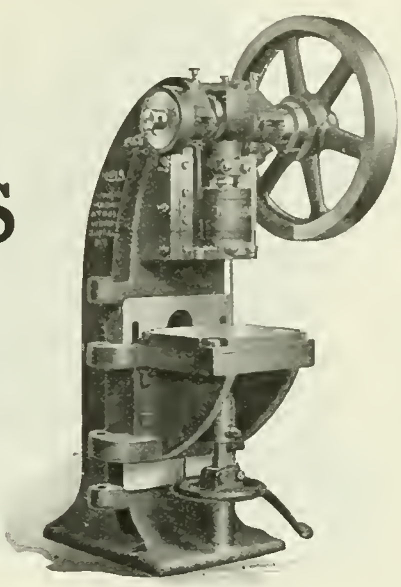
SHEET METAL WORKING MACHINES & TOOLS



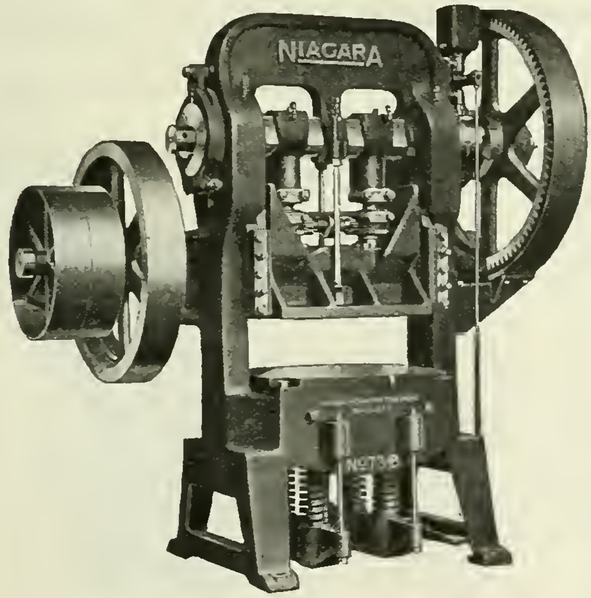
INCLINABLE PRESS

POWER PRESSES



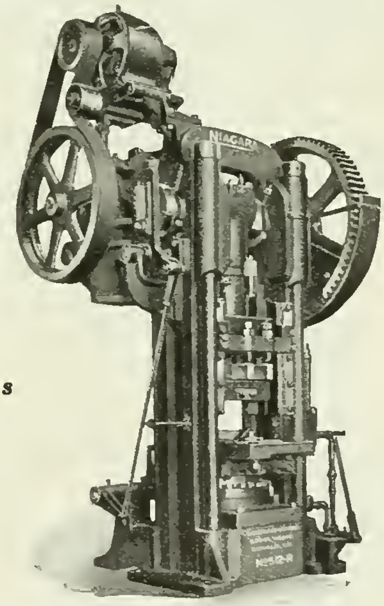
HORN PRESS

- Inclinable
- Horn
- Side Seaming
- Punching
- Arch
- Straight Sided
- Double Crank
- Trimming
- Riveting
- Reducing
- Toggle
- Double Action Cam
- Straight Line
- Bending
- Sprue Cutters
- Gang Punches



DOUBLE CRANK PRESS

Send for Bulletins on the above.



STRAIGHT SIDED PRESS

Niagara Machine & Tool Works

Established 1879

BUFFALO, N. Y. U. S. A.

NIAGARA

60258

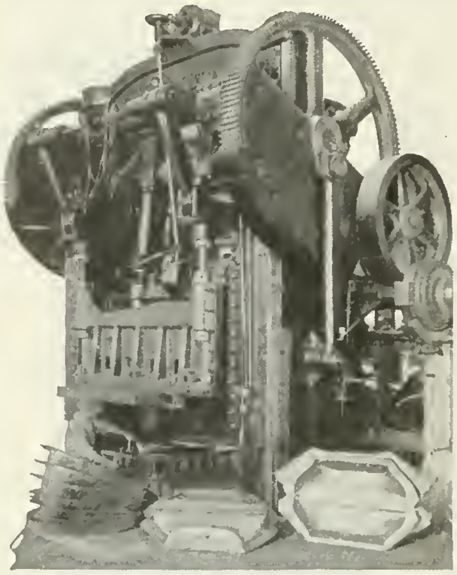


Photo by courtesy of our customer PATENTED

Drawing Two Cowls

Bliss presses are widely used in the manufacture of automobile parts. They have had such an important part in making the pleasure car the light and strong vehicle it is to-day, and the motor truck the powerful and dependable factor in transportation that much need not be said as to their merits in the Automotive Industry.

The bliss No. 409-D Patented Double Crank Toggle Drawing Press shown is producing two cowls at one time. bliss Presses economically meet every stamping need in the manufacture of automobile parts.

Bliss for Machinery

E. W. BLISS CO. MAIN OFFICE AND WORKS **BROOKLYN, N. Y., U. S. A.**

SALES OFFICES
DETROIT Dime Bank Bldg.
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CHICAGO Peoples Gas Bldg.
PITTSBURGH Oliver Bldg.
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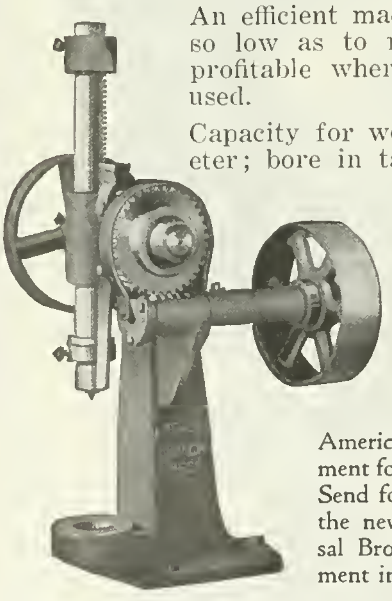
ITALY, 345 Via Nizza, Turin
FRANCE, 54 Blvd. Victor-Hugo, St. Ouen, Paris

No. 315

The American Power Broach and Assembling Press



An efficient machine at a price so low as to make broaching profitable wherever it can be used.

Capacity for work to 6″ diameter; bore in table 2½″ diameter; maximum stroke 14″ developing approximately 2 tons pressure.

Price, $120.00
F. O. B. Ann Arbor

American Broaching Equipment for all classes of work. Send for circular. See also the new American Universal Broach Press advertisement in this issue.

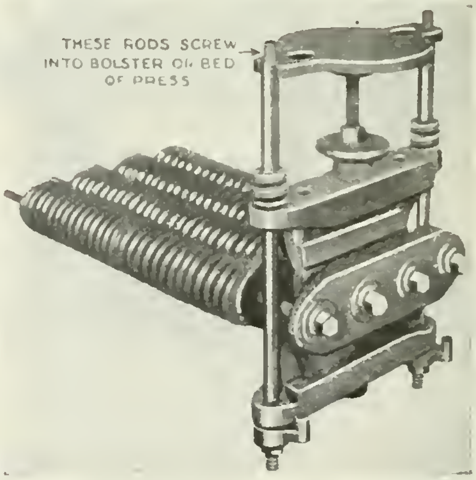
American Broach & Machine Co.

Builders of All Types of Broaching Machines and Broaching Tools

ANN ARBOR MICHIGAN

Detroit Office, 2496 E Grand Blvd., Phone Empire 5673.
Cleveland Representative, M Jaeger, 342 Engineers Bldg.
Chicago, T. J. Davis, 550 W. Washington Blvd.
Toledo, National Supply Co., 136 Huron St.
Minneapolis, Northern Machinery, 5th Ave. S and 6th St.

The King Pressure Toggle



A Permanent Attachment that equips a Single Action Press to produce Toggle Press jobs.

More Uniform Work with a Saving of 25% to 60% in Production Cost and 40% to 60% in First Cost of Equipment.

R. D. KING, Chicago, Ill.
1620 Monadnock Block

To Producers of Pressed Metal Parts

¶ Eight years ago, this month, we first marketed Pneumatic Die Cushions to supply even pressure on the blanks in metal drawing operations.

We started under the name of the Strand Machinery Co., with one type and one size die cushion; today we manufacture twenty-two distinct types and over eight hundred sizes, also Pressure Pad Controls, etc., to serve varied purposes and to equip all types of presses.

Marquette Die Cushions have made possible many developments in modern methods of metal drawing operations, and most recognized leaders in the trade have long ago adopted Marquette Die Cushions as standard equipment.

Write for our new catalogue.

Marquette Tool & Mfg. Co.

321 W. Ohio Street CHICAGO, U.S.A.

A MODERN PLANT FOR THE MANUFACTURE OF

Automatic Feeding Devices for Punch Presses

Also

Reels and Power Winders

Write or send us samples today.

Others have profited by increasing their production. Why not you?

F. J. Littell Machine Co.

4125-27 Ravenswood Avenue, Chicago

Dept. M

ATLAS Arbor Presses

Up to 40 Tons

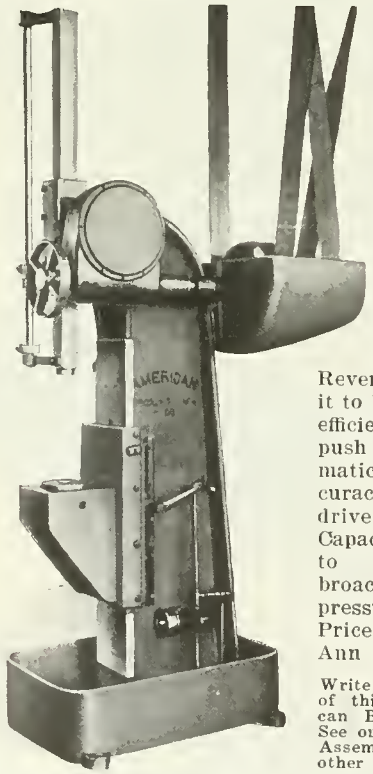
Atlas Arbor and Straightening Presses are powerful, convenient machines with unusual capacity both in the hand and power types.

The cut shows the No. 3 Arbor Press equipped (like all our hand presses) with our patent leverage device which enables the operator to exert enormous pressure witn comparative ease; either simple or compound leverage is instantly available.

Send for the Catalog

ATLAS PRESS COMPANY

Kalamazoo Mich., U. S. A.



The "American" reputation for efficient economical broaching equipment is justified by the

New American Universal Broach Press

Reversible knee enables it to be used with equal efficiency for pull or push broaching. Automatic stop insures accuracy; friction clutch drive gives easy control. Capacity, push broaches to 20" long; pull broaches to 28" long; pressure to 8 tons. Price $695.00 F.O.B. Ann Arbor.

Write for further details of this and other American Broaching Equipment. See our Power Broach and Assembling Press on another page of this issue.

American Broach & Machine Co.

Builders of All Types of Broaching Machines and Broaching Tools

ANN ARBOR MICHIGAN

Detroit Office, 2496 E. Grand Blvd., Phone Empire 5673.
Cleveland Representative, M. Jaeger, 342 Engineers Bldg.
Chicago, T J. Davis, 550 W. Washington Blvd.
Toledo, National Supply Co., 136 Huron St.
Minneapolis, Northern Machinery, 5th Ave. S. and 6th St.

POWER PUNCHING & SHEARING MACHINERY

Helve and Drop Hammers
Spacing Tables

THE LONG & ALLSTATTER CO.

HAMILTON, OHIO

PRESSES—Foot and Power.
WIRE FORMING MACHINES—Standard or Special.
TUMBLERS - All kinds.
BALL BURNISHING EQUIPMENT.

BAIRD MACHINE CO.
BRIDGEPORT, CONN.

PRESSES AND SHEARS

SHEET METAL WORKING MACHINERY

THE D. H. STOLL COMPANY Inc.

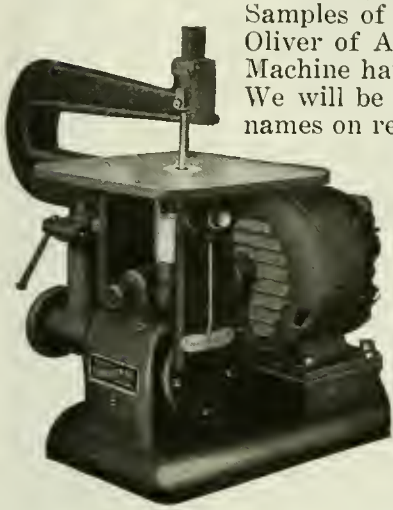
Military Road and Grote Street BUFFALO, NEW YORK

AN OLIVER OF ADRIAN PRODUCT

"This Oliver is the handiest machine we ever had in the shop."

"We wonder how we ever got along without it. Saves an average of 50% of time on practically every die job."

Samples of what users of the Oliver of Adrian Die Making Machine have to say about it. We will be glad to give their names on request.



Saws out the contour of die blanks, cams, templets, gages and experimental parts and will file and lap them to exact size with any desired clearance in a fraction of the time required to drill, chip and hand file.

Made in two sizes and eight types.

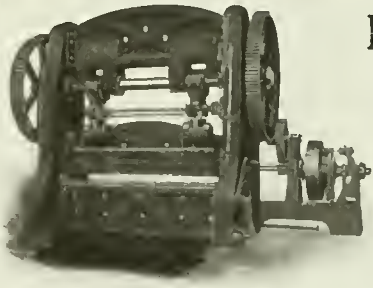
We carry in stock a large and complete line of saws, files and lapping stones made especially for machine use, guaranteeing maximum output and continuous service.

OLIVER INSTRUMENT COMPANY

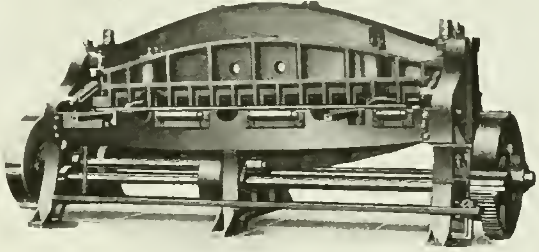
1410 East Maumee St. ADRIAN, MICHIGAN
NEW YORK BRANCH, 139 Lafayette Street, Tel., Canal 3982
C. D. Proctor, District Sales Representative.

L & N

Power Brake Squaring Shear Open Back Press



Power Brake. No. 810



Squaring Shear. No. 310

Open Back Press No. 324

We manufacture power brakes, or forming presses and squaring shears in capacities from 16 gauge to ⅜ in., from 4 feet to 12 feet in length. We also manufacture Mitre Presses, special sheet metal machines, forming and mitre dies, and shear blades.

Loy & Nawrath Division
Birmingham Iron Foundry
DERBY CONN.

The Skill is All in the Machine

ROTARY SWAGING is the modern and economical method of forming solid or tubular circular metal sections without waste of stock. The Langelier Swaging Machine reduces or tapers to a circular section, square, round, hexagonal, or similar shapes, hot or cold. We build special swaging equipment for Tungsten Filament Wire.

Our policy is to equip the machines in every detail with work holding and feeding devices that will enable them to give the most efficient service with unskilled help at a low upkeep cost.

Machines built to date, have capacity ranging from a pin point to 2½" diameter on solid stock, and to 6" on tubing.

LMCo **LANGELIER MFG. COMPANY**
Arlington, Cranston, R. I., U. S. A.

Buffalo

"Armor Plate" Power Punches, Shears and Bar Cutters

Write for Catalog 51

BUFFALO FORGE COMPANY
Buffalo N. Y.

Nos. 1, 2 and 5

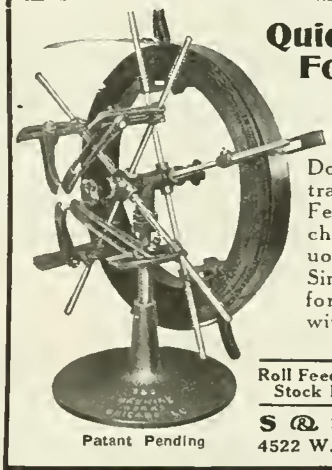
DO THAT JOB QUICK

of cutting round rods up to ¾" dia. Flats 5/16" thick and under in iron and mild steel, gold, silver, copper, brass, aluminum, card, fibre or hard rubber sheets—use

HERCULES SHEARS and ROD CUTTERS
PLAIN OR COMBINATION
W. M. & C. F. TUCKER, Hartford, Conn.

Nos 3 and 4

Quick Loading Reels For Coiled Stock



Patent Pending

S&S

Double Swivel Reels as illustrated are for use with Roll Feeds and Automatic Machines. They insure continuous production.

Single Inclinable Reels are for Hand Feeding or for use with Inclined Punch Presses.

Also Other Sizes

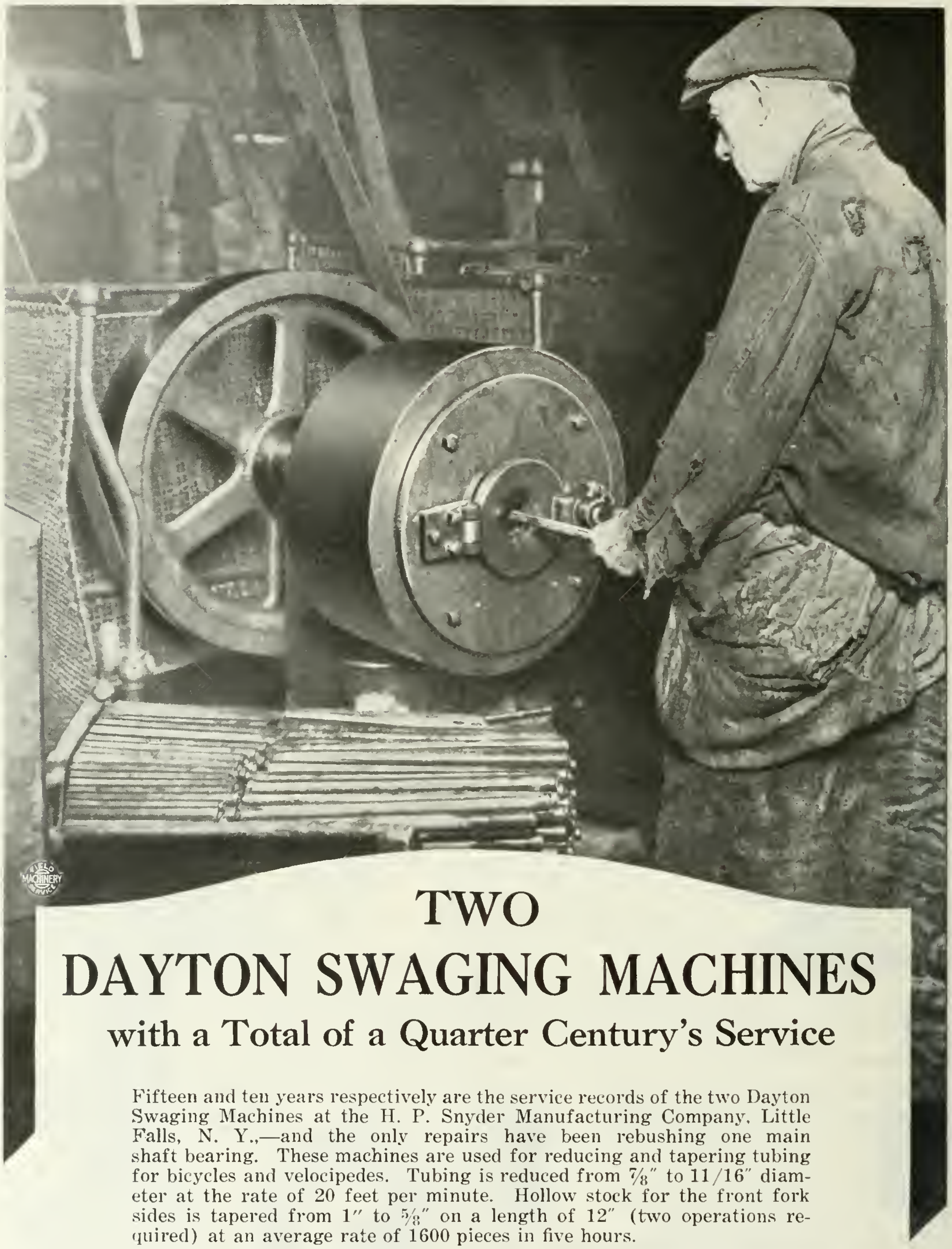
Roll Feeds, Dial Feeds, Hopper Feeds, Etc., Stock Reels, Labor Saving Machinery.

S & S Machine Works
4522 W. Lexington St. CHICAGO, ILL.

MERRELL Pipe Threading and Cutting Machinery

Hand or Power Operated

THE MERRELL MFG. COMPANY
15 Curtis Street TOLEDO, OHIO



TWO

DAYTON SWAGING MACHINES

with a Total of a Quarter Century's Service

Fifteen and ten years respectively are the service records of the two Dayton Swaging Machines at the H. P. Snyder Manufacturing Company, Little Falls, N. Y.,—and the only repairs have been rebushing one main shaft bearing. These machines are used for reducing and tapering tubing for bicycles and velocipedes. Tubing is reduced from 7/8" to 11/16" diameter at the rate of 20 feet per minute. Hollow stock for the front fork sides is tapered from 1" to 5/8" on a length of 12" (two operations required) at an average rate of 1600 pieces in five hours.

Profitable production, long service, low costs—make Dayton Swaging Machines popular on all kinds of work. Let us tell you about them.

THE TORRINGTON COMPANY—Excelsior Plant—57 Field St., Torrington, Conn.

SUCCESSORS TO EXCELSIOR NEEDLE CO.

Chic
Toledo, Swaging Co., Ltd., White Friars Lane, Coventry, England. Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France. Agent
Minneapolis, 'y, Belgium, Spain, Portugal and Switzerland.

Kobert

Electric Riveting

Our heading stands for two things, an Electric Riveting Machine and a production method. These are the result of ten or more years of hard work starting in the "pole line" hardware business. Here's the story—

A line of fittings, fabricated from steel, was designed to compete with the malleable cast parts then commonly used. All went well until it was discovered that some of the cold-riveted parts wouldn't stay together; they either worked loose or fell apart and nobody could tell *when* it would happen. Cold riveting was a total failure on this work but something *had* to be done. Hot riveting was obviously the thing but either the design of the parts or size of rivet barred its successful employment. Riveting of some kind was necessary, but what? Everything was tried. Stuck, absolutely stuck! That is, until a transformer was rigged up so close to the riveting press that parts could be heated electrically and flipped into place before the rivet could cool. The result of this was pretty good but the method unsatisfactory. Thought, work, experiments followed—then the transformer was made a part of the riveting press and rivets heated *after* assembling.

The next step was the construction of the "dual head," a device in which one unit was designed and built *solely* for carrying electric current to the rivet. When the proper temperature was reached, the operator could shift to the second unit and operate it to set the hot rivet. The dual head was a *very* important development.

The automatic duel head, safety release and other improvements came later. After a number of machines had been in successful operation on our own work for some months, we built a few for people who had asked for them. We watched these machines in operation, made some improvements, built some more machines, finally we had the present Kobert Electric Riveting Machine. This type machine has been in successful operation in a number of different industries for more than 5 years.

There you are. Haven't been able to tell the *whole* story or even show a picture, but you can easily see a Kobert Electric Riveter in operation—ask any of our dealers. At the same time get the Green Book, it's worth reading.

Kobert Machine Company, Inc.

98 Union St., Worcester, Mass.

Chicago:
Neff, Kohlbush & Bissell

Philadelphia:
Swind Machinery Co.

Detroit, Pittsburgh, Cleveland, Cincinnati:
Motch & Merryweather Machinery Co.

Master Cams That Take Their Turn on the Rowbottom Milling Machine

Automatic canning machinery requires many cams of many kinds and this group of "masters" shows only a few of the patterns in use in a big plant building this type of machinery.

The variety is great enough, however, to give some idea of the work done here on the Rowbottom Cam Milling Machine, for not only are all the cams cut on the Rowbottom, but the master cams themselves are accurately and economically produced on the same machine.

The range and simplicity of Rowbottom Cam Milling Machines transform the manufacture of cams in quantity, from a difficult and expensive to an extremely satisfactory and highly profitable class of work.

"Rowbottom for cams" is a good motto to tie to, whether you use Rowbottom Cam Milling Machines in your own plant or let us handle your work in our contract department.

Details of the machines, estimates on special work, on request.

THE ROWBOTTOM MACHINE COMPANY
WATERBURY, CONN., U. S. A.
Factory: WATERVILLE, CONN.

Rowbottom for Cams

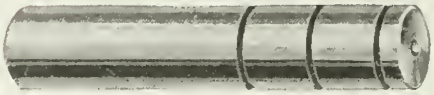
Special Equipment Section

Special Machinery
Screw Machine Products
Drop Forgings
Fixtures
Tools, Dies, Jigs
Castings
Die Castings
Stampings
Contract Work
and
Designing

Leader Pins—Bushings—Dowel Pins

Hardened and Ground, Carried in Stock

Leader Pins

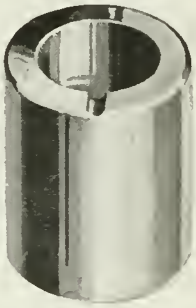


Made of steel, carbonized, hardened, ground and lapped on centers to ± .0002″ of dia.

In complete range of sizes from ½″ x 4″ to 1½ x 9″. Immediate shipment from stock.

Larger sizes on order.

Bushings



Danly Standard Straight, Shoulder and extra long bushings in wide range of sizes.

Dowel Pins

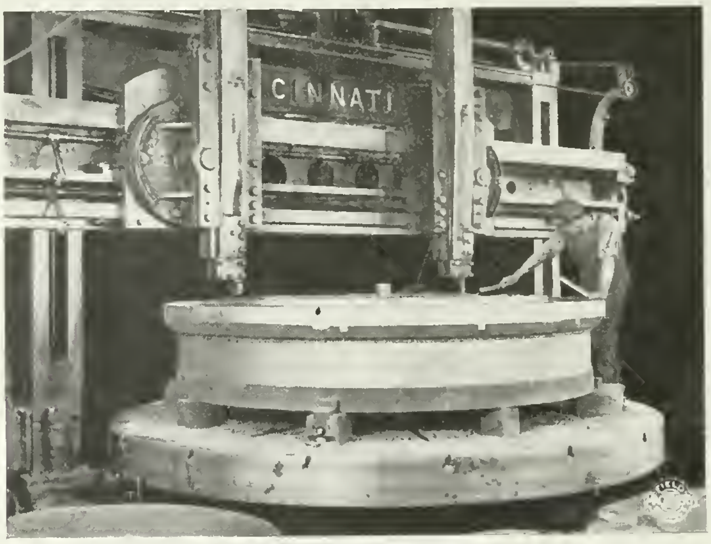
Hardened, drawn and accurately ground to ± .0001″ of diameters.

Also stocked .001″ over size. In stock from 3/16″ x ⅞″ to ½″ x 2¾″. Boxed and labeled; dozen to box.

DANLY MACHINE SPECIALTIES

(Division of Ludwig & Ludwig)

4911 Lincoln Ave. **CHICAGO, ILL.**



Kent-Owens

SPECIAL MACHINERY

Builders for Production

Behind the Scenes

A complete installation of machines of the class and quality of the big boring mill here shown enables us to build any kind of standard or special machines up to 100 tons economically and efficiently in any quantity.

"Building for production" means building machines of a class and character to advance the standards of industry, at a price that is only made possible by expert service and efficient equipment.

We are ready to discuss your project, advise on its execution, estimate on the work and guarantee satisfaction. Come and see us when you're out this way.

THE KENT-OWENS MACHINE CO., Toledo, Ohio, U.S.A.

To cut production costs, run your business under two roofs— yours and ours

OUR specialty is tooling equipment for special work; Jigs, Dies, Gages and Fixtures, also Machines and Special Tools. We specialize in one direction for the same reason Henry Ford does— to get production. And we get production with special equipment—tools made for the work.

Standard equipment won't give you production on special work. Why not, therefore, put your tool-room under our roof? We can save money for you through our wide experience in designing and building special equipment; we have in many instances doubled and trebled production.

Send samples or blueprints of your product; state equipment used; tell us your needs. If we can increase production and lower costs by special equipment we'll tell you how—or return sample with a frank statement that we can't improve on your own methods.

THE STEEL PRODUCTS ENGINEERING COMPANY
SATISFACTION
PRODUCTION
EFFICIENCY
WE DESIGN and BUILD • SPECIAL • MACHINERY
SPRINGFIELD OHIO

The Steel Products Engineering Co.

SPRINGFIELD, OHIO, U. S. A.

REPRESENTATIVES: Hess-Schenck Company, Cleveland, Ohio. J. L. Lucas & Son, Inc., Bridgeport, Conn. Haberkorn & Wood, Detroit, Mich. McCoy-Brandt Machinery Co., Pittsburgh, Pa. Scott-Bansbach Machinery Co., Chicago, Ill. M. J. Walsh Machinery Co., Milwaukee, Wis. Buckner-Woodard Co., Seattle, Wash. Simmons Machine Tool Corporation, Buffalo, N. Y. Triplex Mch. Tool Corp., 5 Church St., New York, N. Y.

DU PONT ENGINEERING COMPANY

Only One Standard

A degree of quality that will assure absolute satisfaction is our only standard in producing every job we do.

Complete equipment, experienced workmen, and capable supervision permit us to handle your machinery or machine parts, castings, patterns or special apparatus requirements quickly, economically and satisfactorily.

Can we serve you? We will gladly estimate on that job you have in mind.

DU PONT ENGINEERING COMPANY

WILMINGTON SHOPS
Wilmington, Del.

We Solicit Inquiries for the Manufacture of High Grade Mechanical Products

Our equipment lends itself particularly to such specialties as Special Machinery, Screw Machine Products, Worms, Worm Gears, Thread Milling, Grinding, Tools, Jigs and Fixtures for manufacture of interchangeable parts, heat-treating, development of mechanical ideas, Wicaco Piston Rings.

Wicaco Screw & Machine Works, Inc.
Stenton Avenue and Louden Street
PHILADELPHIA PENNA., U. S. A.

Better Work in 85% Less Time

Details are confidential, but a glance will show you there are 5 working and 1 loading positions. The machine cut machining time from 10 to 1½ minutes per piece *and* improved the quality of the product.

No, Mr. Manufacturer, this case is not exceptional. We've done even better on occasion and increases of 25 to 80% are every day occurrences.

Why not consult us about YOUR Production Problems?

Manufacturers' Consulting Engineers
McCarthy Building
O. C. Kayle SYRACUSE, N. Y. L. W. Moulton

TRADE MEHL MADE MARK

HIGH GRADE
JIGS, FIXTURES, DIES, GAGES AND SPECIAL MACHINES
SEND FOR FREE ILLUSTRATED PROSPECTUS
MEHL MACHINE TOOL & DIE CO.
Established 1913
30 Minutes from New York City ROSELLE, NEW JERSEY

JIGS TOOLS DIES

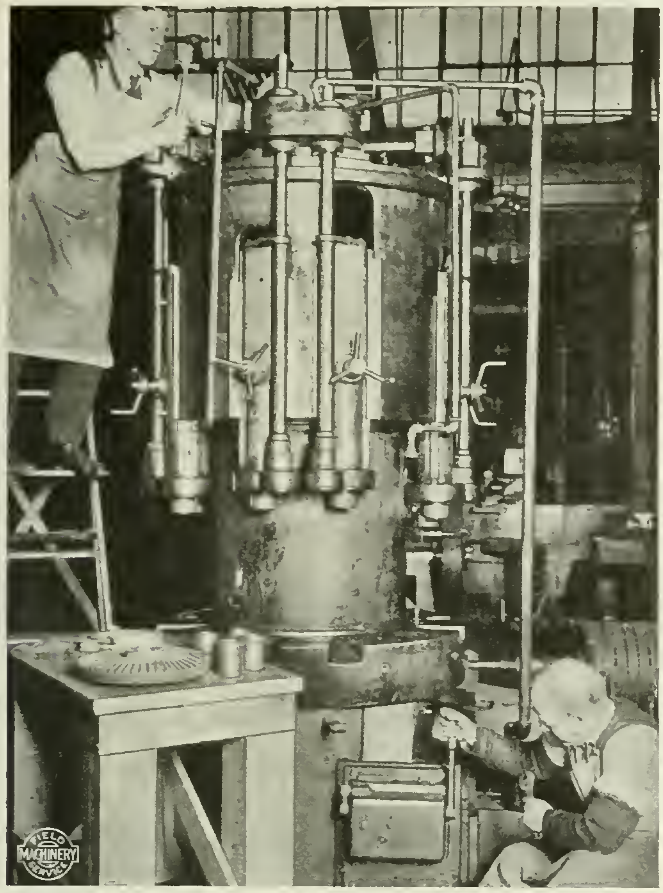
We can give you excellent service, making and designing Dies, Fixtures, Special Machines, Jigs, Small Tools, Gauges and Stampings.

AMERICAN TOOL & MFG. CO.
Urbana, Ohio
A Card will bring our Catalogue

Designers and Builders of Special Machinery, Dies and Tools.

Let us figure on your requirements.

THE BUDD-RANNEY ENGINEERING COMPANY
Columbus, Ohio



Do You Drill Connecting Rods?

You have heard of continuous milling operations. This special machine has been designed and built by The Columbus Die, Tool & Machine Company for continuous drilling operations, drilling both ends of a connecting rod simultaneously.

But that's only one example of where a special machine designed and built in our plant has effected a noteworthy saving in production costs. Tell us about your problems and ask for suggestions on special machinery for speeding up rates of production.

The Columbus Die, Tool & Machine Company
COLUMBUS OHIO

A MODERN well equipped Boiler, Machine and Blacksmith Shop enables us to build many kinds of special machinery.

Regular line of manufacture includes:

- Foundry Cupolas and Ladles
- Core Oven and Cars
- Tanks and Stacks
- Tumbling Barrels
- Sand Blast Machinery
- Dust Collectors Cloth Screen Type
- Overhauling of Steam Shovels and Locomotive Cranes.

J. W. PAXSON COMPANY
Nicetown Lane and D Street PHILADELPHIA, PA.

LET US BE YOUR TOOL-ROOM

Dies, Tools, Jigs, Gages, Fixtures, Etc.

We have the reputation for producing tools that are foolproof, easy to manipulate and give the largest possible production.

Quality—Prompt Delivery—Fair Price

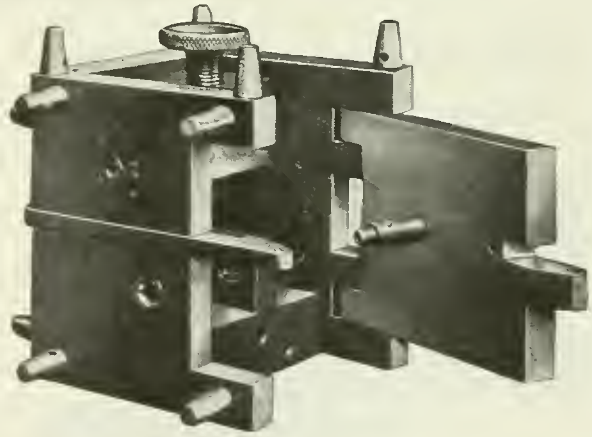
Arthur Brock, Jr., Tool & Manufacturing Works
533 North 11th Street Philadelphia, Pa., U. S. A.

OUR SPECIALTY

Special Machinery made to your blueprints. Contract work—large or small quantities.

Let Us Quote You

DAVENPORT MANUFACTURING CO.
MEADVILLE, PA.



NEED HELP?

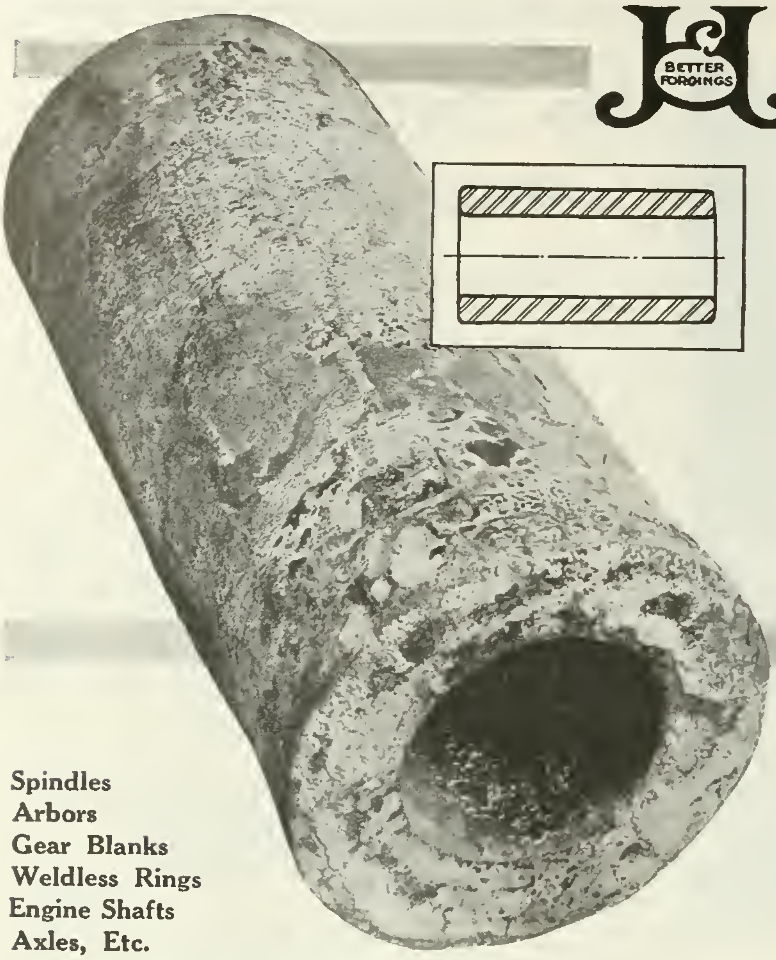
Need overflow capacity for your tool-room? Not enough men to handle the work—satisfactorily—on time?

Reliance Service is ready—modern plant—expert mechanics—ample facilities—ready to make your jigs and dies.

Prompt attention will be given your order—prices are right because we can route special jobs and make production on them.

Send blueprint for estimate

Reliance Die & Stamping Co.
515 North LaSalle St. Chicago, Ill., U. S. A.



BETTER FORGINGS

J & J Forgings Won't Swell Your Scrap Heap

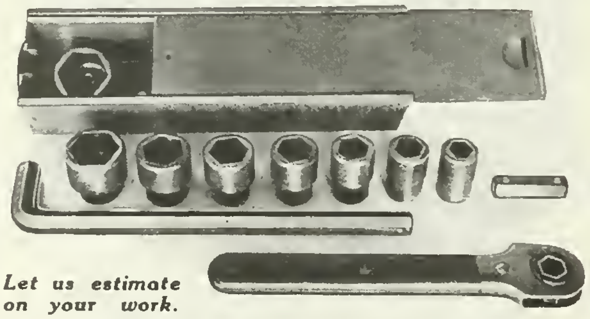
Nothing more annoying than to pay for tons of high grade forgings and see 20 to 25% of the metal go to the scrap heap. Nothing like that occurs in shops that standardize on J & J "Better" Forgings. They're forged so close to finish dimensions that finish machining is all that is necessary—a clear saving of machining time, trouble and metal, which is best appreciated when experienced in your own shop.

Try them on your next order.

Spindles
Arbors
Gear Blanks
Weldless Rings
Engine Shafts
Axles, Etc.

THE JOHNSTON & JENNINGS CO.
INCORPORATED 1894
Addison Road and Lake Shore
R. R. Tracks
CLEVELAND, OHIO, U. S. A.

Efficient Contract Manufacturing Shows Profit All Through



Let us estimate on your work.

Here's a good example of what we mean. This is the "Fit-Em-All" Socket Wrench; the retail price is $2.50. Now consider, that the retailer, the designer (our customer) and we, the *manufacturers*, all find it profitable to make and sell these tools.

The answer? Manufacturing efficiency. The kind that is absolutely necessary in a successful contract shop.

We offer a complete contract manufacturing service, design, development, model making and building of special machines. Precision jig, fixture, tool and die manufacturing. Special stampings.

PRECISION ENGINEERING CO.
JAMESTOWN NEW YORK

The World's Headquarters For Sheet Metal Products

We operate large Iron and Steel Foundries, have a complete Pattern Shop, and a Machine Department with a large range for both small and large work.

THE ADAMSON MACHINE CO.
Engineers, Machinists—Iron and Steel Founders
AKRON, OHIO, U. S. A.

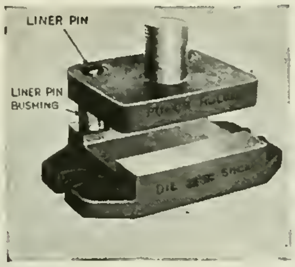
Do You Want Real Service? **Dies, Tools**

Special Machinery—Small Stampings. Production Work on Machine Parts. Real Service at the Right Price.

With fine equipment and a splendid organization we guarantee satisfaction. Let us quote you on your requirements.

THE BANNER DIE, TOOL & STAMPING COMPANY
COLUMBUS, OHIO

WHETHER you want help or want work—want to buy a book, a tool or a machine—in fact, whatever small bit of advertising you are thinking about, send your order to MACHINERY'S Classified or Want Section.



DIAMANT

STANDARD PUNCH and DIE SETS

Patented U. S. Patent Office.

Rear or diagonal steel liner pins and bushings insure accuracy on all press operations.

The strength and rigidity of these sets enable us to recommend them for heavy duty service with assurance that they will outlast sets of lighter construction.

All sizes in stock for immediate delivery.

Our product is our best advertisement.

Our service department will advise economical size.

DIE SETS DIAMANT TOOLS

DIAMANT TOOL & MFG. CO., Inc.
95 Runyon Street NEWARK, N. J.

Safeguard Your Reputation with Dyson Forgings

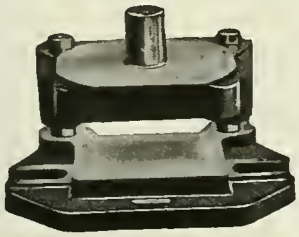
Be as careful of the quality of the steel going into your product as you are of the machining operations.

For a given size, a Dyson Forging is stronger than ordinary steel; for a given strength you may use less material.

Dyson Forgings—anything from a 3″ nut to a 5-ton shaft. Rough machined. Heat-treated. Get an estimate.

JOSEPH DYSON & SONS
CLEVELAND OHIO

U. S. SUB PRESSES



Guaranteed to align perfectly

Best gray iron castings, carefully machined and parallel; liner pins are tool steel, hardened and ground. Produced in quantity, sold direct, cost less to buy than for you to make. Before experimenting, send for list of sizes and prices.

U. S. Tool Co., Inc.
117 Mechanic St., Newark, N. J.

FREDERIC C. DANNEMAN
124 Baxter St., New York City
Sole Distributor
for Greater New York
Phone, Franklin 5624
Carries stock for immediate delivery

Flat Die Forgings to Any Blue Print or Any Grade of Steel

THE MACHINERY FORGING COMPANY
5450 Hamilton Ave. CLEVELAND, OHIO

Do the Machines You Build Require

HOLLOW BORED FORGINGS and STEEL SHAFTS?

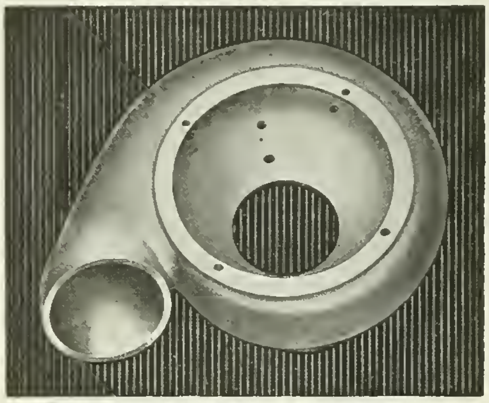
If so, it may pay you to submit your blueprints and let us quote on such items as Lathe Spindles, Piston Rods, Rams, Clutch Shafts, etc.

AMERICAN HOLLOW BORING CO., Erie, Pa.

DOEHLER

The World's Largest Producer of

DIE-CASTINGS



Doehler Die-Cast Aluminum Vacuum Cleaner Housing

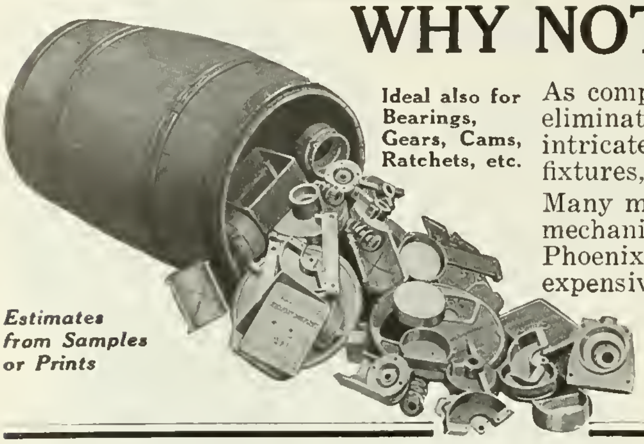
The purchase of Doehler Die-Castings is not merely the purchase of a quantity of finished metal products.

It is also an investment in the reputation, the resources, the experience, the service, of the Doehler organization—the largest producers of die-castings in the world.

Your return on this investment is the security which reputation, resources, experience and service give—the knowledge that the Doehler name and responsibility are back of every Doehler Die-Casting you use.

DOEHLER DIE-CASTING Co.
BROOKLYN. N.Y.
TOLEDO. OHIO.

WHY NOT USE DIE CASTINGS?



Ideal also for Bearings, Gears, Cams, Ratchets, etc.

As compared to sand castings Die Castings are stronger and eliminate finish machining; as a substitute for machining intricate interchangeable parts they save the expense of jigs, fixtures, etc., and of individual inspection for accuracy.

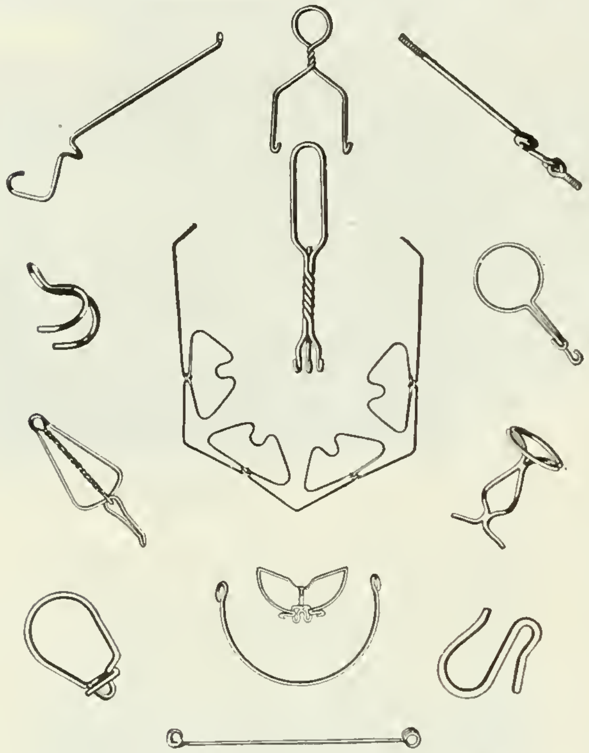
Many manufacturers of automobiles, telephones, typewriters, mechanical actions, precision instruments, etc., endorse Phoenix Die Castings. Why not try them on some of your expensive parts?

Estimates from Samples or Prints

PHOENIX DIE CASTING CO.

Established 1907

BUFFALO, N. Y.



ANYTHING IN WIRE

Odd and unusual wire bends, or twists, metal ribbon products made on automatic machines in shorter time than you'd believe possible and at reasonable prices. Let us estimate on your work.

Eastern Tool & Manufacturing Company
135 Bloomfield Ave. BLOOMFIELD, N. J.

Something Special?

If you have an idea to be developed, a mechanism perfected, unusual tools to be made, a machine built—there are concerns who specialize in doing just these things.

MACHINERY'S Special Equipment Section is designed to bring together purchasers and makers of products of special nature. It groups the advertisements of manufacturers who have a service to offer rather than standard tools or machines.

Look them up in MACHINERY.

Guaranteed. Die Castings

Low Price
Quick Delivery

By a New Method

REPUBLIC DIE CASTING CO., INC.
128-138 MOTT ST., NEW YORK CITY

LIGHT STAMPINGS

of all kinds. We can also furnish Dies and Tools. Our low overhead insures a reasonable price.

Send Samples or Blueprints for estimate.

THE SAFETY WIRE GAS GLOBE CO.
COLUMBUS, OHIO

Brass, Bronze and Aluminum

CASTINGS

TIFFIN BRASS & BRONZE CO.
TIFFIN, OHIO

FRANKLIN DIE-CASTINGS

Make Easy Work of Castings Difficult to Machine

We think that anyone who studies the drawing of this cream separator part will agree with us that it was difficult to machine. That is why die-castings were later specified. And this part represents only one of many problems that Franklin Die-Castings have solved.

We originated the die-casting process in 1892 and for over thirty years have been reducing costs and simplifying output in many fields of industry.

We cast in aluminum tin, lead and zinc base alloys. Quotations furnished on receipt of samples or blueprints.

Write for booklets,
"Franklin Die-Castings in Modern Inventions"
and "Die-Casting."

FRANKLIN DIE-CASTING CORPORATION
Gifford and Magnolia Streets
Syracuse, N. Y.

Since 1919

SUPERCAST
QUALITY
DIE CASTINGS

Dependable SUPERCAST Die Castings

THE SUPERIOR DIE CASTING CO.
CLEVELAND

DIE CASTINGS

Prompt delivery guaranteed. Send samples, blueprints or sketches for estimates.

MT. VERNON DIE CASTING CORPORATION
MOUNT VERNON, N. Y.

ELECTRIC STEEL CASTINGS

Farrell-Cheek Steel Foundry Co.
SANDUSKY, OHIO

ALUMINUM CREAM SEPARATOR DISTRIBUTORS MADE BY THE PERMANENT MOULD PROCESS

(The distributor of a cream separator revolves at a very high rate of speed. It must be strong to withstand this speed and perfectly balanced. Also, it must be free from porous spots where milk can collect and sour.

Permanent Mould Aluminum Castings are *guaranteed* to be free from porous spots or blow-holes. They are stronger than either pressure aluminum die-castings or aluminum sand castings. This manufacturer of cream separators naturally chose to have his distributor parts made as Permanent Mould Aluminum Castings in preference to porous aluminum die-castings. Incidentally we were able to save him forty per cent of the weight of the distributor as formerly purchased in a sand casting and give him a casting as accurate as the best pressure aluminum die-casting he could buy.

You doubtless have parts that can be made more economically as Permanent Mould Aluminum Castings without sacrificing strength. Send sample or blueprint for quotation or write for further information and sample castings.

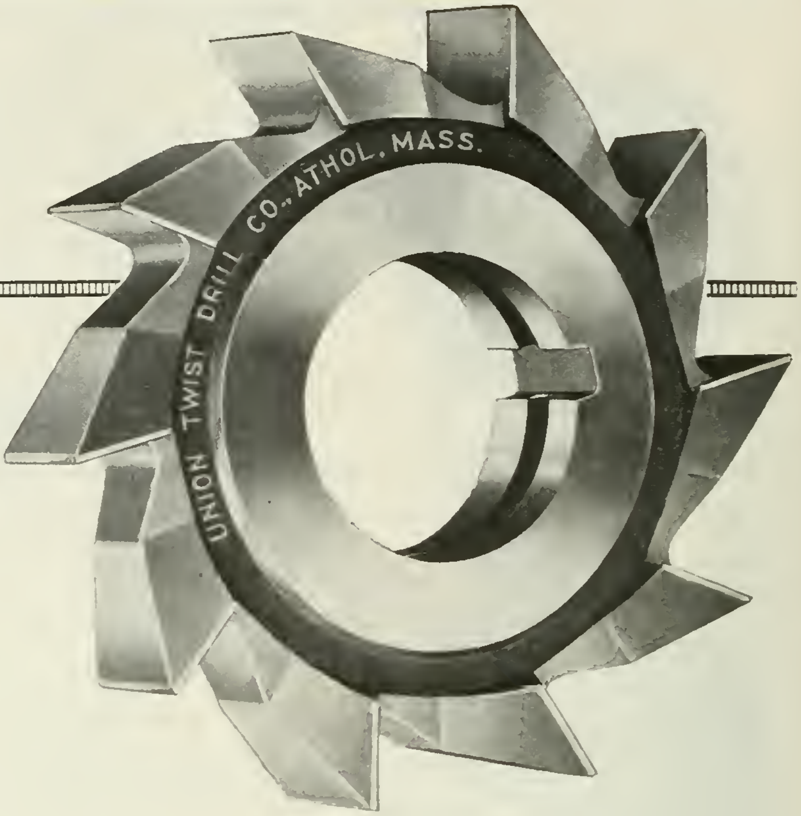
The Bronzo Alumina Corporation
Permanent Mauld Aluminum Castings
BUFFALO, N. Y.

DETROIT
F. H. Bourke,
1577 Cadillac St.

PHILADELPHIA
J. T. Lloyd,
5452 Chestnut St.

NEW YORK
E. F. Whitaker,
15 Park Row

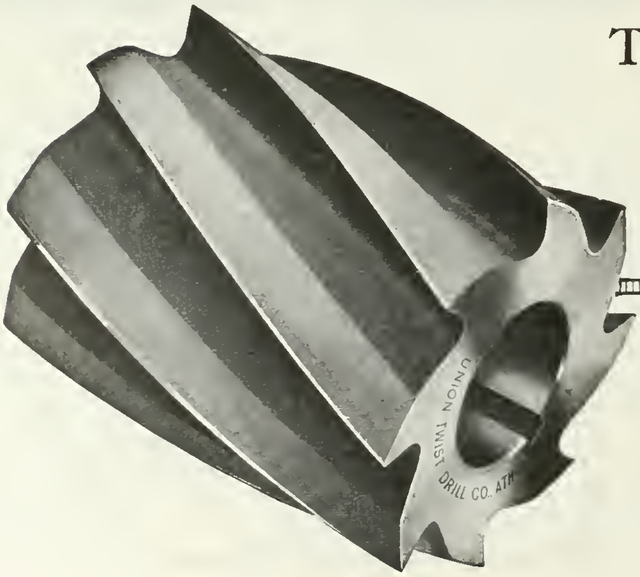
Union High Power Cutters



Tools that put Profits into Production

When we first developed Union High Power Cutters it was hard to convince manufacturers that our statements were not claims, but facts. Time and service, however, have proved that Union High Power Cutters cut faster, longer and require less power than ordinary cutters. Their wide-spaced, undercut teeth are stronger, have a shearing action without drag, and take less time to grind. The extra chip clearance prevents chips clogging and retarding the cutting action of the teeth and provides a better finish.

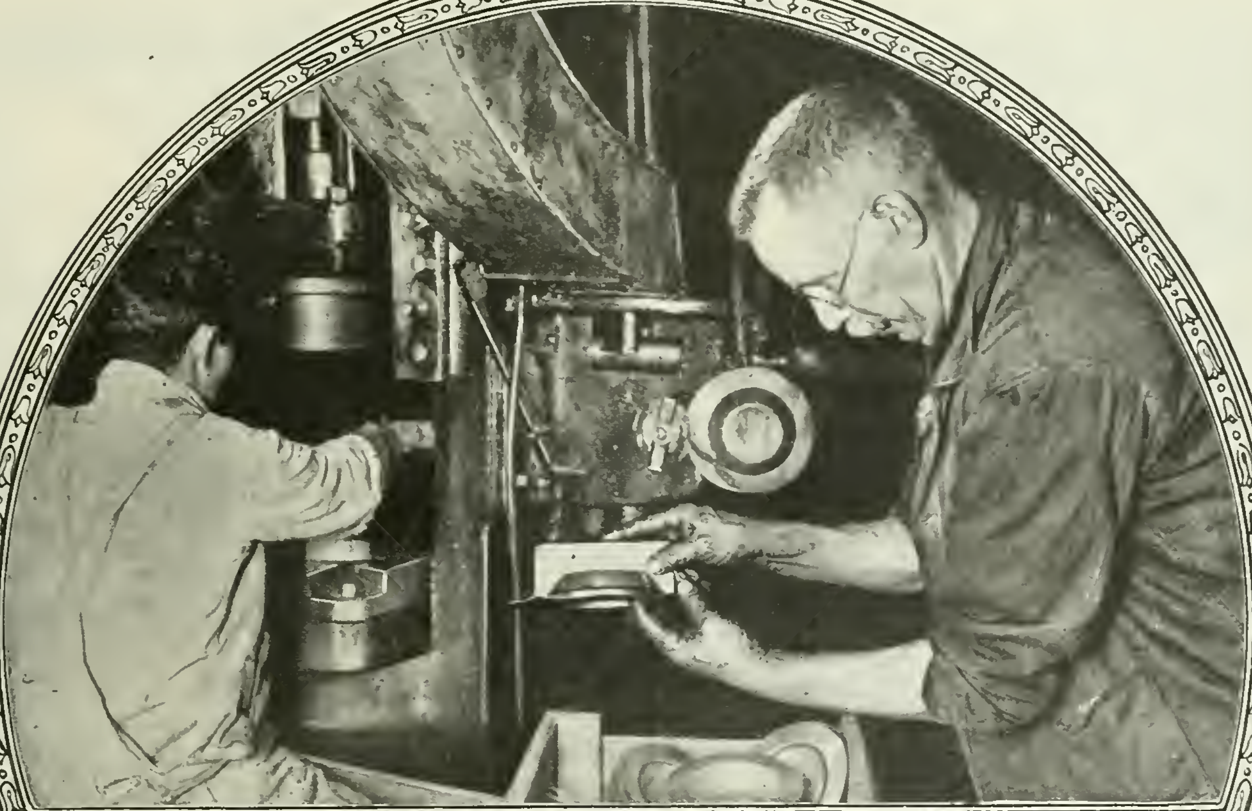
Users of Union High Power Cutters find that they permit increases in output, as high as 100% in some cases, with less heating of tools and work. A trial order will show you.



Twist Drills, Reamers,
Gear and Milling Cutters,
High Power Cutters, etc.

Union Twist Drill Co.

Athol, Massachusetts
U. S. A.



"Consider the Brass"

Quality in brass stampings is determined by the efficiency of the press, the expertness of the operator, and the **way the brass acts.** This depends on uniformity of temper, gage and width—and these, in turn, on the way the brass is made. The foundry, the metallurgical laboratory—all influence the result.

So—"Consider the Brass" —and its maker.

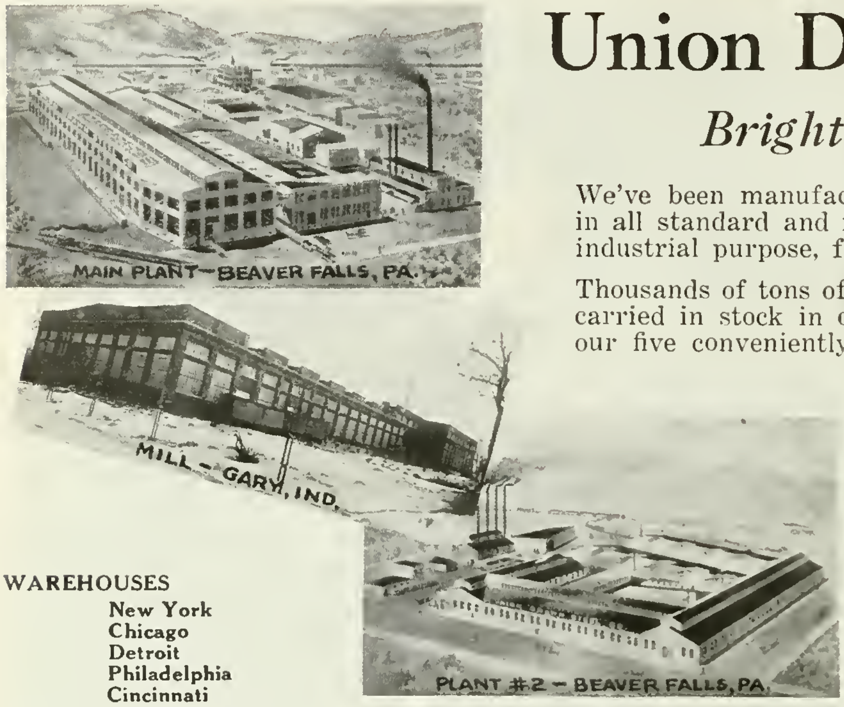
Long established, with a large and complete organization and well equipped plants producing uniformly high quality products in huge volume, we can guarantee that every step in the manufacture of Chase Brass is right. We can give you quality insurance that helps make press work profitable.

Are you on the list for the Chase Diamond?
All the news about brass, especially Chase Brass.

CHASE METAL WORKS
Division of Chase Companies Inc
WATERBURY CONNECTICUT

PLANTS
CHASE METAL WORKS Trade CHASE Mark CHASE ROLLING MILLS

New York Chicago Rochester Philadelphia Boston Pittsburgh St. Louis
The Chase Companies of California
San Francisco Los Angeles
The Ohio Chase Company, Cleveland



Union Drawn Service

Bright Finished Steel

We've been manufacturing cold-finished steel and iron in all standard and many special analyses required for industrial purpose, for the past thirty-four years.

Thousands of tons of finished and semi-finished steel are carried in stock in our three mills; thousands more in our five conveniently located warehouses.

In order to assure alloy steels with the exact physical properties specified by our customers we maintain also an extensive and up-to-date metallurgical laboratory and a modern heat-treating plant.

Our experience, our resources and our good will are yours to command.

WAREHOUSES
New York
Chicago
Detroit
Philadelphia
Cincinnati

Free Cutting Screw Stock, Cold Drawn Elevator Guides and Turned and Polished Shafting, Rounds, Flats, Squares, Hexagons, etc., in Bright Finish Bessemer, O. H., Nickel, Chrome and Vanadium Steel of unsurpassed quality. Catalog and quotations on request.

UNION DRAWN STEEL CO., Main Office **Beaver Falls, Pa.,** Works **Beaver Falls and Gary, Ind.**

OTHER OFFICES AND WAREHOUSES—New York, 460-466 Washington St. Philadelphia, Ninth and Willow Sts. Cincinnsti, 2225-47 Bogen St. Chicago, 570 West Adams St. Detroit, 237 Jos. Campau Ave. SALES OFFICES—Boston, Boston-Massachusetts Trust Bldg. Buffalo, White Building. Cleveland, Kirby Building. PACIFIC COAST REPRESENTATIVES—Milton Pray Co., Monadnock Bldg., San Francisco; Washiogton Bldg., Los Angeles, and L. C. Smith Bldg., Seattle, Washington.

The Quest for Superiority In a Cutting Tool

The aborigine's quest for superior metals was often beset with peril—but he considered it worth while.

Today his crude ores and metals are made into myriad servants by the methods of modern man. One of the best results from such modern methods is

UTICA TOOL STEEL

—an ideal steel for threading tools, taps, gauges, punches, twist drills, reamers, form cutters, etc., or wherever a keen, durable cutting edge is desired. Free from tendency to warp or twist, crack or check when quenched in oil.

May we talk over your steel requirements with you?

See our many other wonderful steels

LUDLUM SPECIAL STEELS LUDLUM STEEL COMPANY **STEELS** SPECIAL PURPOSES WATERVLIET-N.Y.-U.S.A.

STEEL BEARING BALLS

BRASS AND BRONZE BALLS

STEEL BURNISHING BALLS

ASK FOR PRICE LIST 104

THE ABBOTT BALL CO.
ELMWOOD HARTFORD, CONN.

C H E C K S

TIME—TOOL—PAY—IDENTIFICATION

No matter what size, style or shape check you require, sunk or raised letters, you'll find *PANNIER* a thoroughly dependable source of supply. Good facilities for quick deliveries and the assurance of dependable workmanship.

Been making them for MASTER PANNIER MAKERS *a quarter of a century.*

PANNIER BROS. STAMP CO., Pittsburgh, Pa.

Red Cut Cobalt

HIGH SPEED STEEL

Increased Their Output Almost Double

A specialty metal products manufacturing company of Ohio, have been using **RED CUT COBALT BITS** for facing, turning and boring forged steel gear bands for over two years and the results show typical Red Cut Cobalt performance.

The operation consists of removing 445 inches off diameter—the width of cut being 1″—the speed 118 feet per minute.

With **RED CUT COBALT BITS** between 18 and 21 pieces per hour are obtained—the highest number with other steels ranging from 10 to 12 pieces per hour.

There is probably an operation in your plant, too, where similar results can be obtained with **RED CUT COBALT.** Our Representative will be glad to demonstrate its efficiency and economy any time, on any operation you may select.

VANADIUM-ALLOYS STEEL COMPANY
LATROBE, PENNA.

WAREHOUSES:
Latrobe Chicago Detroit Springfield, Mass.

BRANCH OFFICES:
New York Boston Philadelphia Buffalo Pittsburgh
Cleveland Cincinnati Dayton St. Louis

The Reo Motor Car Co.
Lansing, Michigan
uses HOYT *Babbitt and Solder*

HOYT
BABBITT

Where It's Different

As far as outward appearance is concerned, there may be no difference between HOYT Babbitt and that of some unknown manufacturer. But when subjected to the acid test of active service, the inherent high quality of the HOYT product quickly differentiates it. The use of HOYT Babbitt for anti-friction service is your best protection against the too-frequent necessity of rebabbitting—against costly interruption of production.

Protect your investment by demanding only HOYT Babbitt.

GENUINE "A"

Wherever a Genuine Babbitt is desirable

EAGLE "A"

At a price lower than you'll expect

If your jobber can't supply you, we'll tell you who will—write us.

HOYT METAL COMPANY
ST. LOUIS - CHICAGO - DETROIT - NEW YORK
ALSO MANUFACTURERS OF
· SOLDER - SHEET LEAD
BEARINGS *AND*
DIE CASTINGS

CAN YOU IMAGINE A MAN

who would choose an automobile by the price per pound, not realizing that performance is the real test of value? Bearing metal is exactly the same. It isn't what the metal costs, it's how long it performs, that really counts. Cheap metal that breaks down quickly is mighty expensive in the end.

Ajax Bull Bearing Alloy

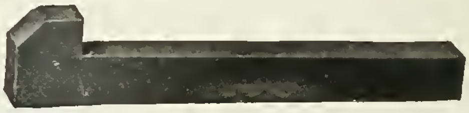
combines low cost and endurance in a surprising fashion. Try it out at our risk.

The Ajax Metal Company
Main Office and Works: PHILADELPHIA, PA.
New York Boston Chicago Cleveland
Washington

MOLTRUP
Finished Machine Keys

Made and stocked in all standard types and sizes. Cold drawn steel is specially selected and prepared for the purpose. Accurate, full size, finely finished and long wearing. We also make them in sizes to meet special requirements. Send for prices.

Also: Ground and Polished Steel for general machinery construction, Cold Drawn Steel Shafting, Free Cutting Screw Steel, Rounds, Hexagons, Squares, Flats, Special Shapes and Finished Machine Racks.



Moltrup Steel Products Co.
BEAVER FALLS PENNSYLVANIA

DISTRICT OFFICES: New York, Woolworth Bldg.; Boston, 201 Devonshire St. Buffalo, 303 White Bldg., SALES AGENCIES: Central Steel & Wire Co., Chicago and Detroit; H. D. Cushman Company, Cleveland; R. E. Murray & Co., 308 McKevitt Bldg., Norfolk, Va.; Union Iron & Steel Co., Cincinnati.

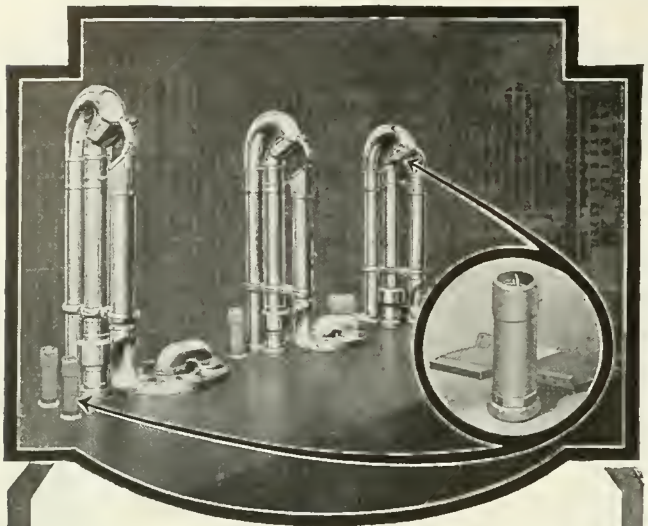
Blue Chip
High Speed
and other
FIRTH-STERLING
TOOL STEELS

THE knowledge, experience and skill of SHEFFIELD combined with the best PITTSBURGH practice have made these steels the standards of QUALITY and UNIFORMITY wherever Tools are used

UNIFORM PRICES
UNIFORM TERMS
UNIFORM DELIVERY
TO ALL USERS

FIRTH-STERLING
STEEL COMPANY
McKeesport, Pa.

NEW YORK BOSTON HARTFORD
PHILADELPHIA CHICAGO CLEVELAND
DETROIT LOS ANGELES



Spaulding Hard Fibre for great strength with light weight

When great strength, long life and light weight are important in the production of a machine part—then Spaulding Hard Fibre frequently becomes the most practical material with which to meet those requirements.

In the carrier system illustrated above, for example, both the doors at the ends of the tubes and the carriers themselves are made of Spaulding Hard Fibre—containing maximum strength and durability with minimum weight and cost.

PHYSICAL PROPERTIES:

Electro Rupture,
200 to 400 volts per 1/1000" thickness.
Tensile Strength,
10,000 to 20,000 lbs. per sq. in.
Compressing Point,
28,000 to 40,000 lbs. per sq. in.
Shearing Strength,
9,000 to 13,000 lbs. per sq. in.

If you are experimenting with the use of hard fibre, we will gladly give you the benefit of our experience if you will write us.

Furnished in sheets, rods, tubes and special shapes.

SPAULDING FIBRE COMPANY, Inc.
318 Wheeler Street, Tonawanda, N. Y.

BRANCH OFFICES AND WAREHOUSES:
484 Broome St., New York City
659-661 W. Lake St., Chicago
15 Elkins St., Boston, 27, Mass.
141 N. 4th St., Philadelphia
Clapp & Lamoree
171 Second St., San Francisco, Cal.
310 East 4th St., Los Angeles, Cal.

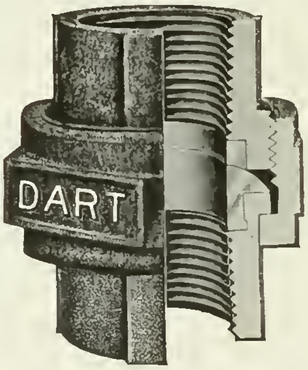
Spaulding HARD FIBRE

IN designing machinery operated or controlled by a spring, it frequently happens that the accommodation of a suitable spring is left to chance. Oftentimes expensive alterations must be made in the original model, and in some cases the entire machine rebuilt through the neglect of what usually appears to be a small item.

Before a casting is made or a part machined, submit your blueprints of new machinery to a spring manufacturer and make sure that he can supply you with an article that will fill your needs. If it happens to be a particular job, specify

CHATILLON PRECISION SPRINGS

JOHN CHATILLON & SONS
Established 1835
85-99 Cliff Street New York City, N. Y.



Dart Unions

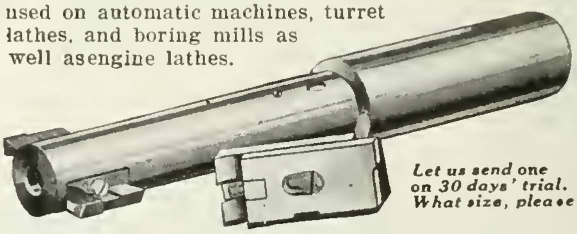
Last Longer than the Pipe

They have bronze to bronze seats that can't rust or corrode; well cut threads that prevent leakage! They won't rust out, can't wear out. Unions, Ells, Tees, Flanges—send for a sample and price list.

E. M. DART MFG. CO., Providence, R. I.
The Fairbanks Co., Sales Agents.
Canadian Factory: Dart Union Co., Ltd., Toronto.

Buy Them "On Approval"

Madison Adjustable Boring Cutters and Bars cut accurate holes of any size; save reaming and grinding; can be set within .00025" in a few seconds time by an ordinary mechanic. successfully used on automatic machines, turret lathes, and boring mills as well as engine lathes.



Let us send one on 30 days' trial. What size, please?

MADISON MANUFACTURING COMPANY
MUSKEGON MICHIGAN

Ettco Self-Gripping Mandrels

Hold Securely Without Distorting the Work

A solid body of alloy steel with three grooves each containing a hardened roller and a long, flat spring. Slip the work into place and, when a cut is started, the rollers automatically grip it. When the job is done slide the piece off *by hand*. That's all there is to it—no hammering, no pressing.

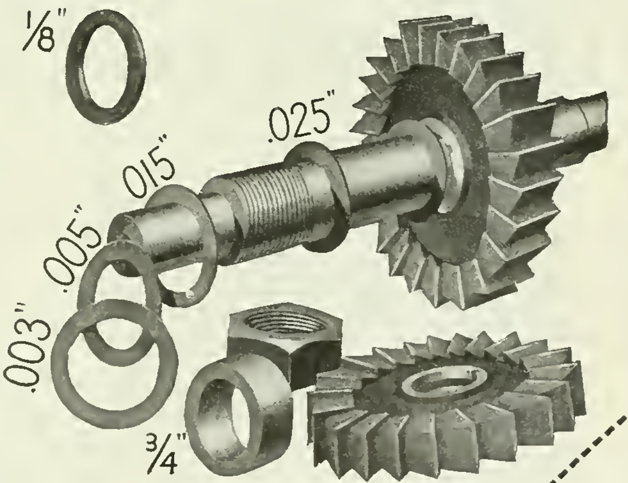
Ettco mandrels do not expand but they *do grip*. Dirt does not bother them nor oil nor grease. They are heat-treated and ground .0002" to .0004" under size.

You try 'em—that's all we ask.

EASTERN TUBE & TOOL COMPANY, Incorporated

594 Johnson Ave. BROOKLYN, N. Y.

SPACERS



Up-to-date successors of the old-fashioned washer—made of good grade open hearth steel—produced by the thousand—marked for identification—sold for a fraction of the cost of home-made product. You can try some of them free, if you'll tell us the sizes you want. Fill in and mail the coupon.

Stock sizes with or without standard keyways—for arbors of the following diameters:

⅜, ½, ⅝, ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1⅝, 1¾, 1⅞, 2, 2¼, 2½, 3, 3½ and 4 inches.

Stock Thicknesses: .003, .004, .005, .010, .015, .020 and .025 inch.

To Order: .0015 to 3.000 inches.

Detroit Stamping Company

3445-3459 West Fort St., DETROIT, MICH., U. S. A.

This Coupon is Provided for Your Convenience

M-8-23

Detroit Stamping Co.
3445-3459 West Fort St.
DETROIT, MICH.

Gentlemen: Please send me price list of your Spacing Washers and free samples from the following sizes..............

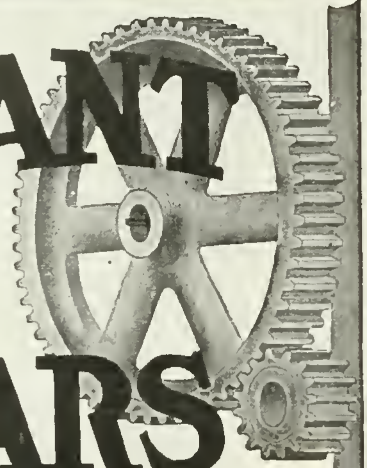
Name..............................

Position..............................

Company..............................

Address..............................

GRANT GEARS



Made in any quantity, from single experimental gears or rush breakdown repair, to production orders; in all sizes from 1/4" to 72".

Ask for latest catalogue

GRANT GEAR WORKS

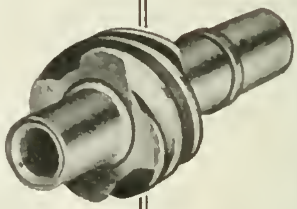
151 PEARL STREET, BOSTON, MASS.

MP
Reg.

Order By Name

Insist on quality—order by name—everything you buy. In no other way can you be sure of results.

Meisel Gears are specified over and over again by old customers who do not ask the price. They know that just as quality is right, prices are reasonable.



Also to your specifications screw machine work up to 5½"; Heat Treating, Broaching, Contract Work, Case Hardening, Tooth Rounding, Splining, External and Internal Grinding. Let us quote on your work.

MEISEL PRESS MFG. CO.
948 Dorchester Avenue
BOSTON, 25 MASS.

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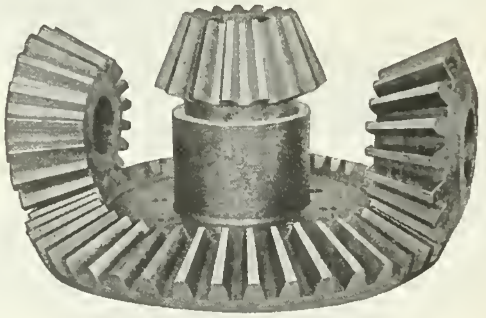
Cincinnati Gears



Our Customers Say—

Cincinnati Gears are accurate, long wearing and moderately priced. Their reports enable us to guarantee *your* satisfaction in these important parts.

Let us estimate on your needs.

THE CINCINNATI GEAR CO.
1825-1841 Reading Road
CINCINNATI OHIO

GENERATED
in our
Gear Cutting Department

(Cut is full size)

Let Us Quote You

MEISSELBACH-CATUCCI MFG. COMPANY
54 STANTON STREET NEWARK, N. J.

Adams-Farwell GEAR HOBBERS

Write for Catalog No. 809

THE ADAMS COMPANY 1910 Market Street
Dubuque, Iowa, U. S. A.

BEVEL GEAR GENERATORS
BEVEL GEARS
CUT THEORETICALLY CORRECT

MEMBER OF AGMA

Special facilities for cutting Worm, Helical, Miter, Internal and Elliptical Gear Wheels.

The Bilgram Machine Works
1231 Spring Garden Street, Philadelphia, Pa.

Unusual Requirements Hold No Terrors for Phillie Gear

MEMBER OF AGMA

PHILADELPHIA GEAR TIME

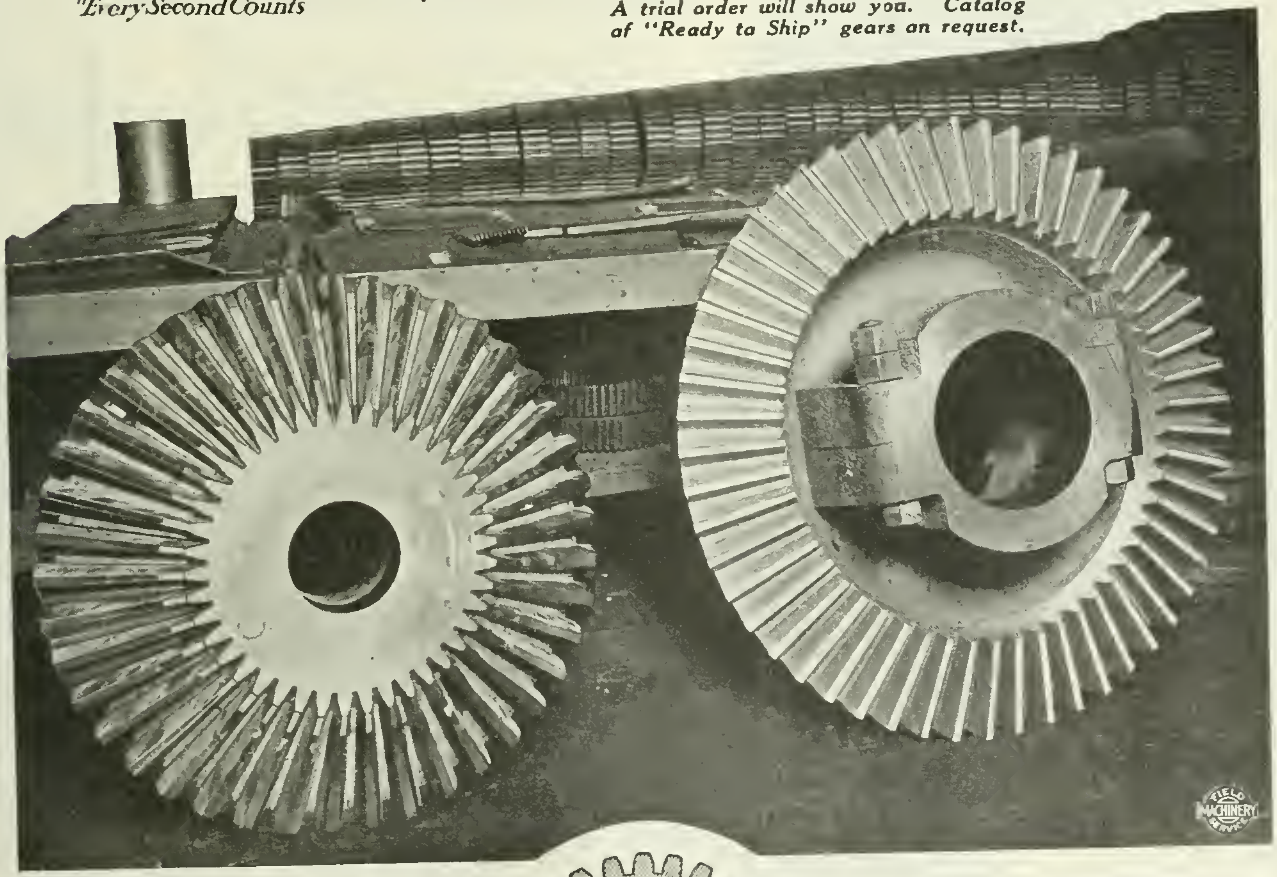
"Every Second Counts"

Specifications for the large bevel rawhide gear shown below gave Phillie Gear no more concern than the ones for the split bevel gear beside it. To be sure, rawhide gears of this size are a little out of the ordinary; but it would be difficult to specify any unusual gear requirement which Phillie Gear has not had to meet at one time or another during the years he has been specializing on gears.

Manufacturers from all parts of the country depend on him. Sometimes the order is merely a broken gear with a tag bearing his name on one side and the sender's on the other; sometimes it's a crudely drafted sketch giving dimensions and a hastily scrawled appeal to "Rush it."

Phillie Gear never lets accuracy be sacrificed to speed. He has the equipment, the men and "know how" to produce gears of all styles and sizes, for every purpose.

A trial order will show you. Catalog of "Ready to Ship" gears on request.



Philadelphia GEAR Works 1120-1128 Vine St Philadelphia

NEW PROCESS
RAWHIDE PINIONS

eliminate the clatter and roar of metal-to-metal gear drives, thereby helping the men to think better and work better. Besides being quiet, their resilience absorbs the variations in load that set up destructive vibrations in the machine and impart a jerky motion to the tool. And *new process* Rawhide Pinions are strong and durable as well, frequently outlasting the metal gears which they replace.

It will pay you to try out a few *new process* Rawhide Pinions on your troublesome gear drives. The improvement which you will immediately notice will be permanent, for they are quiet and efficient even when worn.

**THE MEACHEM
GEAR CORPORATION**

Sole Manufacturers of new process RAWHIDE GEARS and PINIONS. Still made under the direction of the inventors and the men responsible for every stage in their development.

Canal Street and West Shore R. R. SYRACUSE, N. Y.

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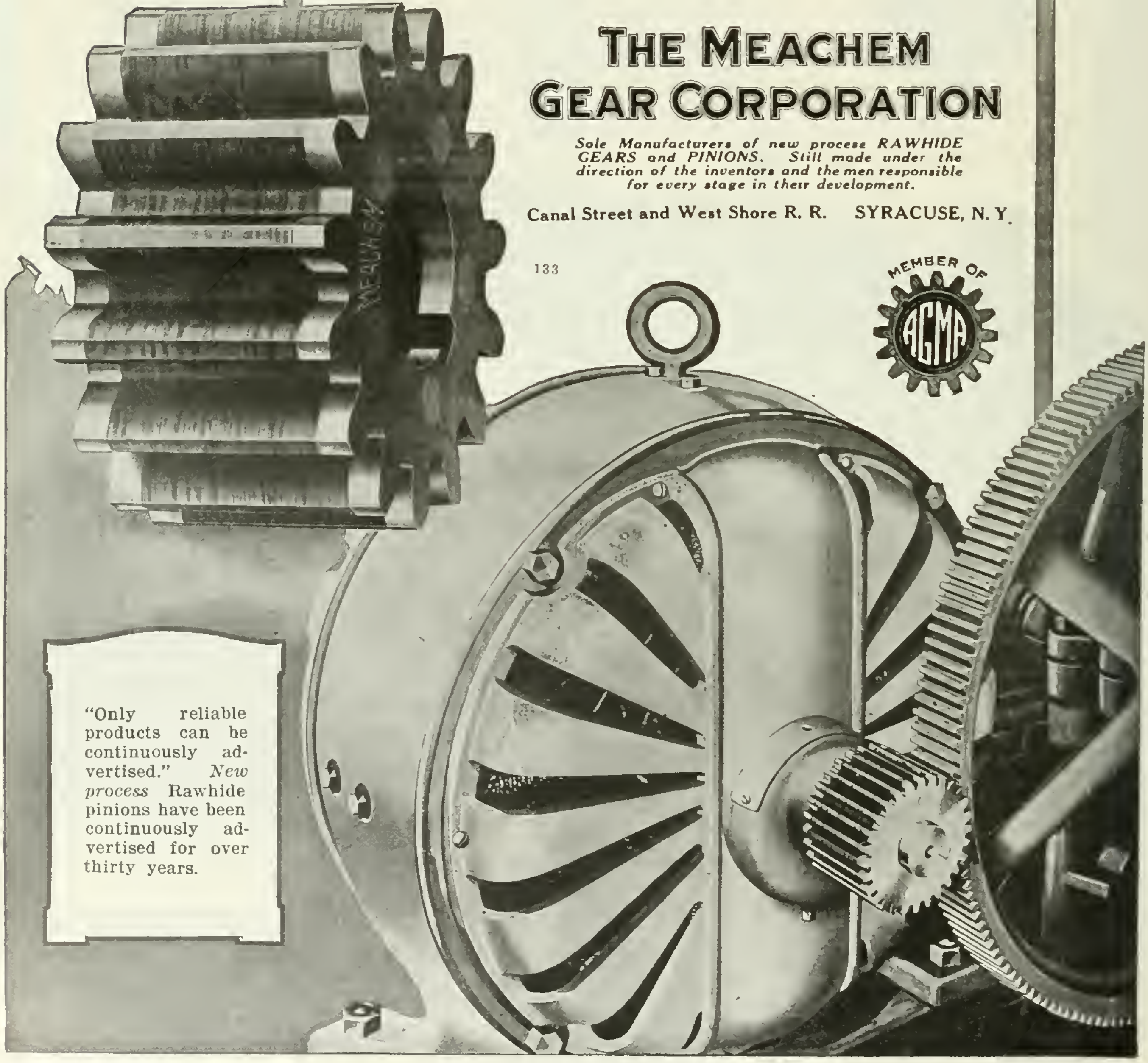
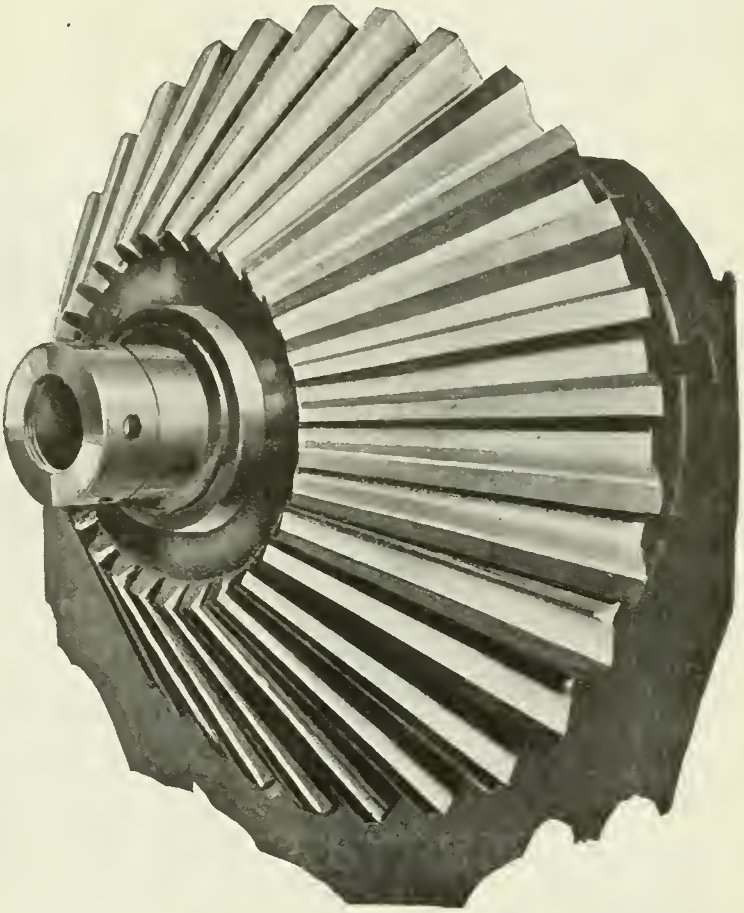


"Only reliable products can be continuously advertised." *New process* Rawhide pinions have been continuously advertised for over thirty years.



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Foote Gears

Quality Gears and Prompt Delivery

FOOTE DEPENDABLE GEARS are highest quality gears. The metal used in them is carefully selected. The gears are accurately cut, closely inspected, and given rigid tests. This is why hundreds of the biggest and best known manufacturers use Foote Gears exclusively.

The Foote Organization can supply your gear requirements with speed and accuracy.

Submit your problems and let Foote quote prices on your requirements.

FOOTE BROS.
GEAR & MACHINE COMPANY

Manufacturers of Rawhide and Bakelite-Micarta Pinions and Cut Gears of all Kinds. Special Machinery Made to Order. Submit your Blueprints

232-242 N. Curtis St. CHICAGO, ILL.

GEAR MANUFACTURERS SUPPLYING FORMICA

Baltimore, Maryland
Murrill & Keizer
Boston, Massachusetts
Union Gear & Machine Co.
Blount Engineering Co.
The Meisel Press Mfg. Co.
Brooklyn, N. Y.
Carpenter-Tew Gear Works
Natiscb Gear Works
Chicago, Illinois
Chicago Gear Co.
Chicago Rawhide Mfg. Co.
D. O. James Mfg. Co.
A. Plamondon Mfg. Co.
Merkle-Korff Gear Co.
Perfection Gear Co. (Specialists in Automobile Timing Gears)
Cincinnati, Ohio
The Cincinnati Gear Co.
Cleveland, Ohio
F. H. Bultman Co.
Cloyes Gear Works
The Horsburgh & Scott Co.
The Stahl Gear & Machine Co.
Detroit, Michigan
Michigan Gear & Engineering Co.
Universal Gear Works
Hoboken, New Jersey
Nilson-Miller Co.
Indianapolis, Indiana
The Stevenson Gear Co.
Newark, New Jersey
Newark Gear Cutting Machine Co.
Pittsburgh, Pennsylvania
The Tranter Manufacturing Co.
Philadelphia, Pennsylvania
Acme Gear Co.
Bilgrim Machine Works
Earle Gear & Machine Co.
Pennsylvania Gear & Machine Co.
Philadelphia Gear Works
The Quaker City Gear Co.
Rodney Davis Co.
Stranaban Gear Co.
Rochester, New York
Luitwieler Pumping Engine Co.
Sodus, New York
Alling-Landler Co.
San Francisco, California
J. J. Schneer Co.
St. Louis, Missouri
Turley Gear & Machine Co.
Syracuse, New York
The Meachem Gear Corporation
Waterbury, Connecticut
Connecticut Gears, Inc.
Worcester, Massachusetts
Worcester Gear Works
Norfolk Downs (Quincy) Mass.
Boston Gear Works

Try Formica Gears— You'll Stick to Them

WE have never heard of a machinery user who has tried Formica silent, shock-absorbing gears and pinions thoroughly, and then returned to rawhide or the older materials. Formica lasts longer and stands up. It costs much less in the long run or figures from the standpoint of cost of service. It avoids shut-down of machinery while new parts are secured or installed. And it does the work as well as any material.

Formica gears are not difficult to cut. The gear cutter of experience gets a perfect result every time—on his ordinary cutting machinery.

Progressive gear cutters push the material because it gives satisfaction, and builds business—and they foresee the time not far distant when it will dominate the non-metallic gear field.

Let Formica engineers give you the facts.

The Formica Insulation Company
4624 Spring Grove Avenue
CINCINNATI, OHIO

FORMICA
Made from Anhydrous Redmanol Resins
SHEETS TUBES RODS

"Peerless" Rawhide Gears and Pinions

Our Specialty
for More than
30 Years

We also manufacture metal gears ¾ inch to 12 feet

Rawhide gears and pinions are ideal where extremely high speeds demand a positive, silent drive.

"Peerless" Rawhide gears and pinions are more than ordinarily durable and elastic because our method of curing the hides retains all the original fiber, and the long period of seasoning to which we submit the blanks before cutting eliminates shrinking and distortion in service. Try them and see for yourself. Specify number of teeth, pitch or outside diameter, face overall, bore and keyseat—we'll do the rest.

Discriminating buyers agree that our product, service and prices are right.

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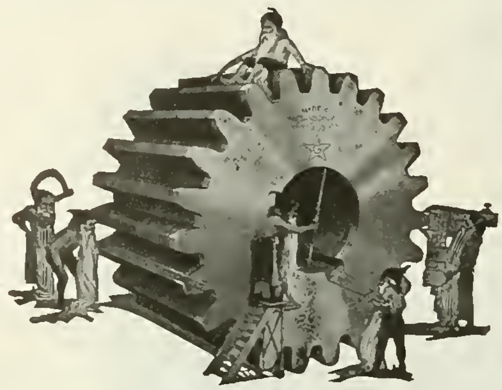
THE HORSBURGH & SCOTT CO.

CLEVELAND, OHIO, U. S. A.



GANSCHOW

"QUALITY"

RAWHIDE AND BAKELITE

PINIONS

WILLIAM GANSCHOW COMPANY

CHICAGO ILLINOIS

THE SIGN OF GOOD GEARS

SYRACUSE D NEW YORK

DIEFENDORF GEARS

Continue in the transmission of power the savings started in boiler plant and engine room. Try them.

All Metals
Bakelite-Micarta, Rawhide
also
Spiral Bevels
4" Diameter and under
High Quality—Prompt Service—
Right Prices

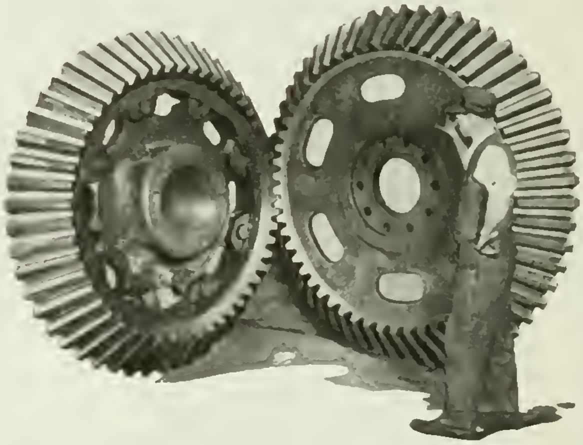
MEMBER OF AGMA

Diefendorf Gear Corporation
Syracuse, N. Y., U. S. A.

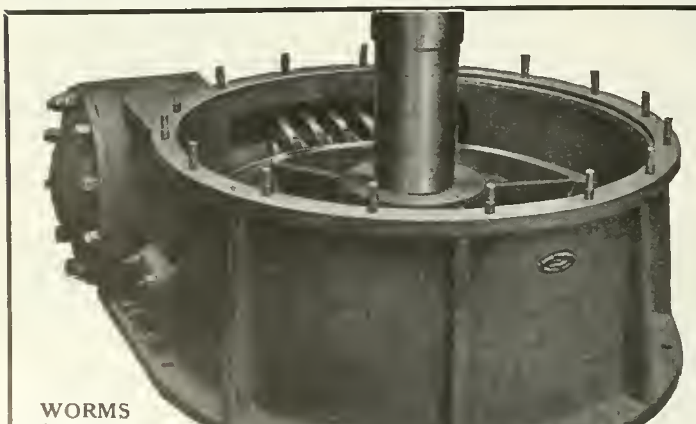
Service—Price

Judge Earle Gears on these two important points. Balance quality and length of service against the purchase price and you'll find that they are distinctly economical.

All sizes. Let us estimate on your needs.



The Earle Gear & Machine Company
4707-15 Stenton Ave. PHILADELPHIA



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Hindley worms have greater number of teeth in contact than ordinary straight worm gears, with the result that loads are distributed over greater area and pressure is lessened. Larger bearing surface extends usual life of gears; and there's only one action—sliding contact.

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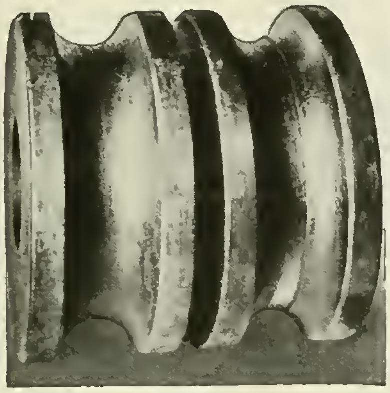

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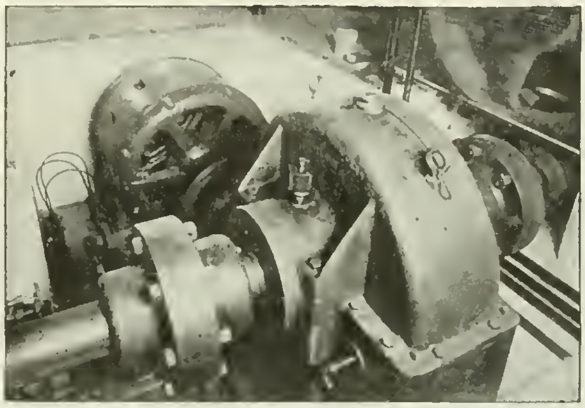

Cleveland Worm Gear Reduction Unit applied to mill line shaft. Motor 400 H.P. at 1200 R.P.M. Ratio in worm drive 14 2/3 to 1.

How long will a worm gear last?

The answer to this question depends upon (a) the accuracy of the gearing, (b) the *correctness* of the mounting, (c) the design and tooth formation of the gearing, (d) *correct* lubrication, (e) proper materials, correctly treated, used in the gearing, (f) use of proper size gearing for the duty imposed. With all these conditions satisfactorily met, if the operator is careful to maintain the oil level in the reduction drive, Cleveland Worm Gearing will *outlast any other form of gearing known*, and, unlike any other, the efficiency will remain constant.

The above illustration shows a Cleveland Worm Drive applied to a mill line shaft driving large rubber mills. The motor is rated at 400 H.P. at 1200 R.P.M. with momentary peak of 800 H.P. The service is unusually severe but there are hundreds of Cleveland Worm Drives which have been in operation for years under similar conditions and show evidence of ability to outlast the life of the machines they serve.

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Cleveland
WORM GEAR
REDUCTION UNITS

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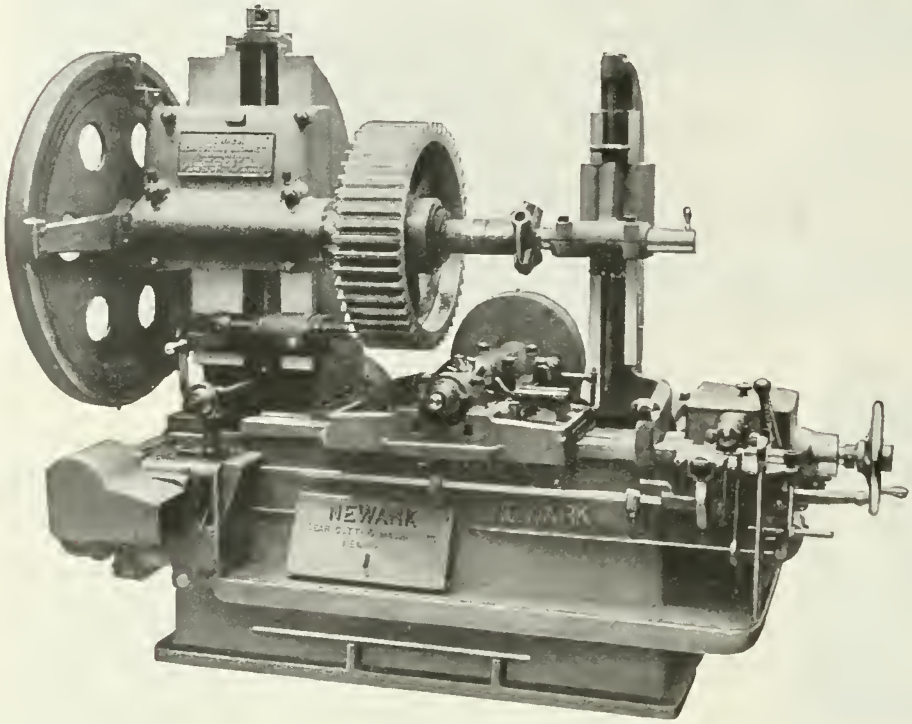

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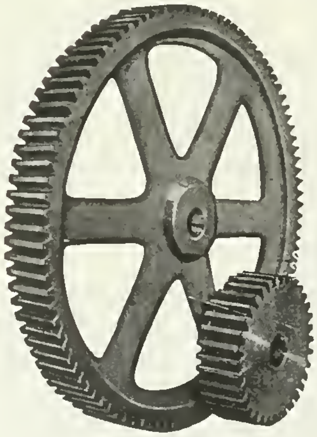

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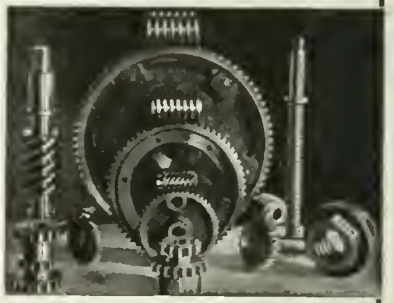

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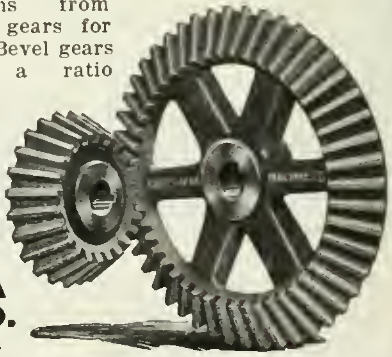

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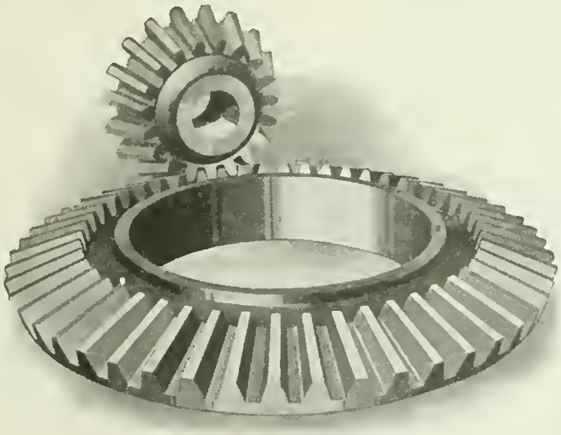

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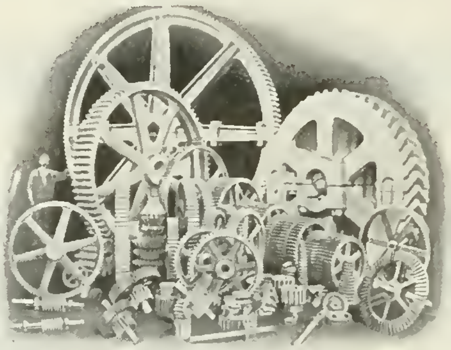

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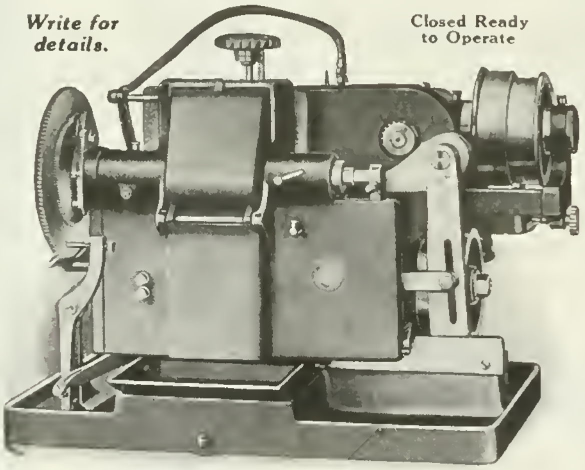

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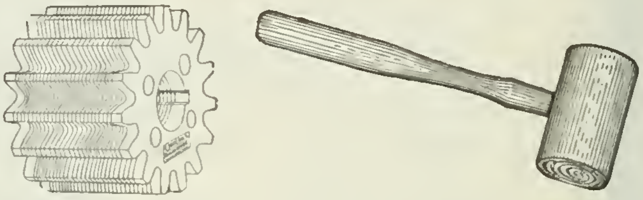

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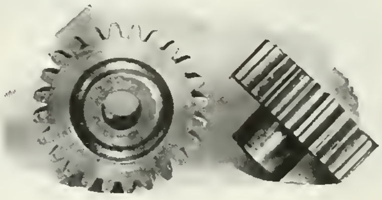

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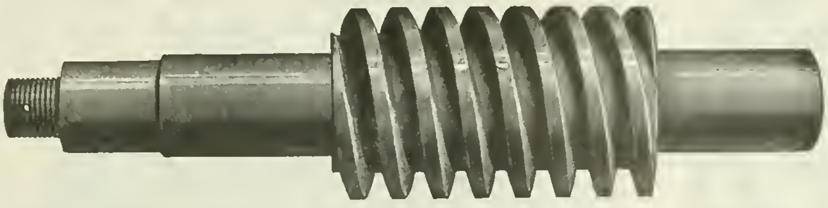

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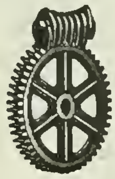

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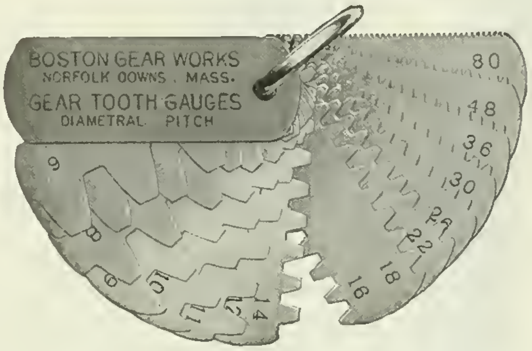

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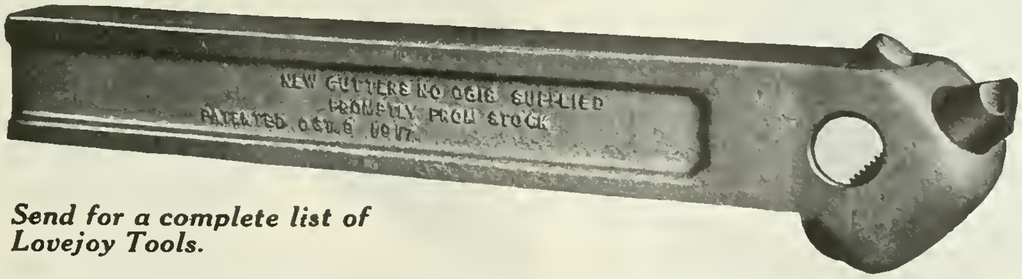

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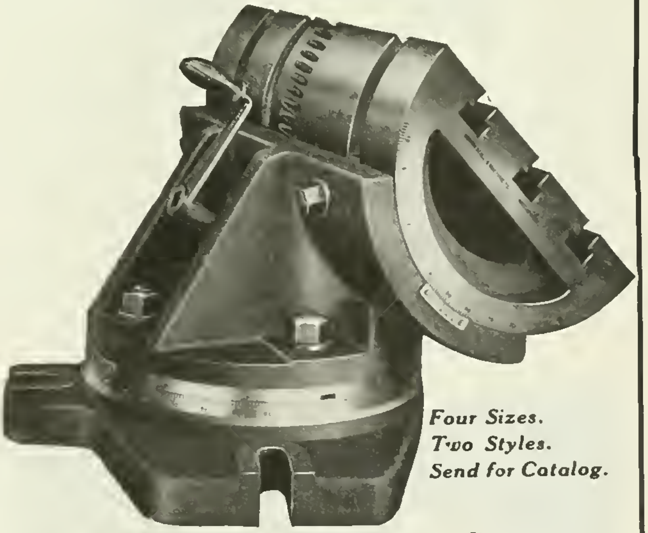

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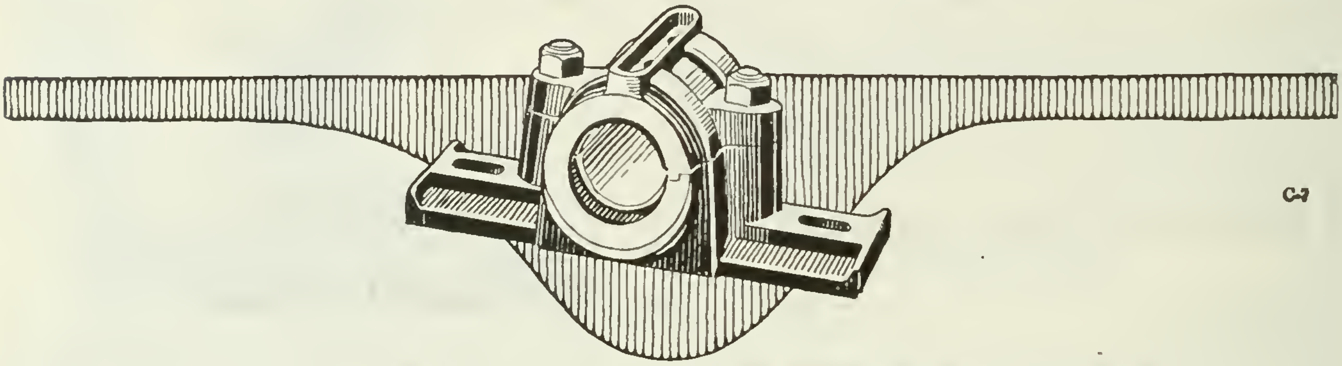

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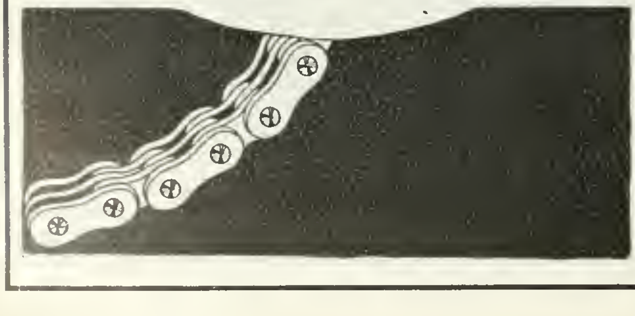

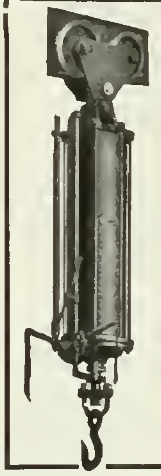

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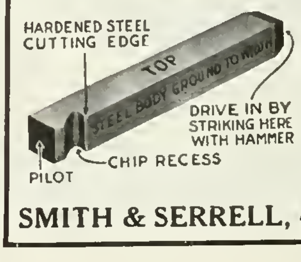
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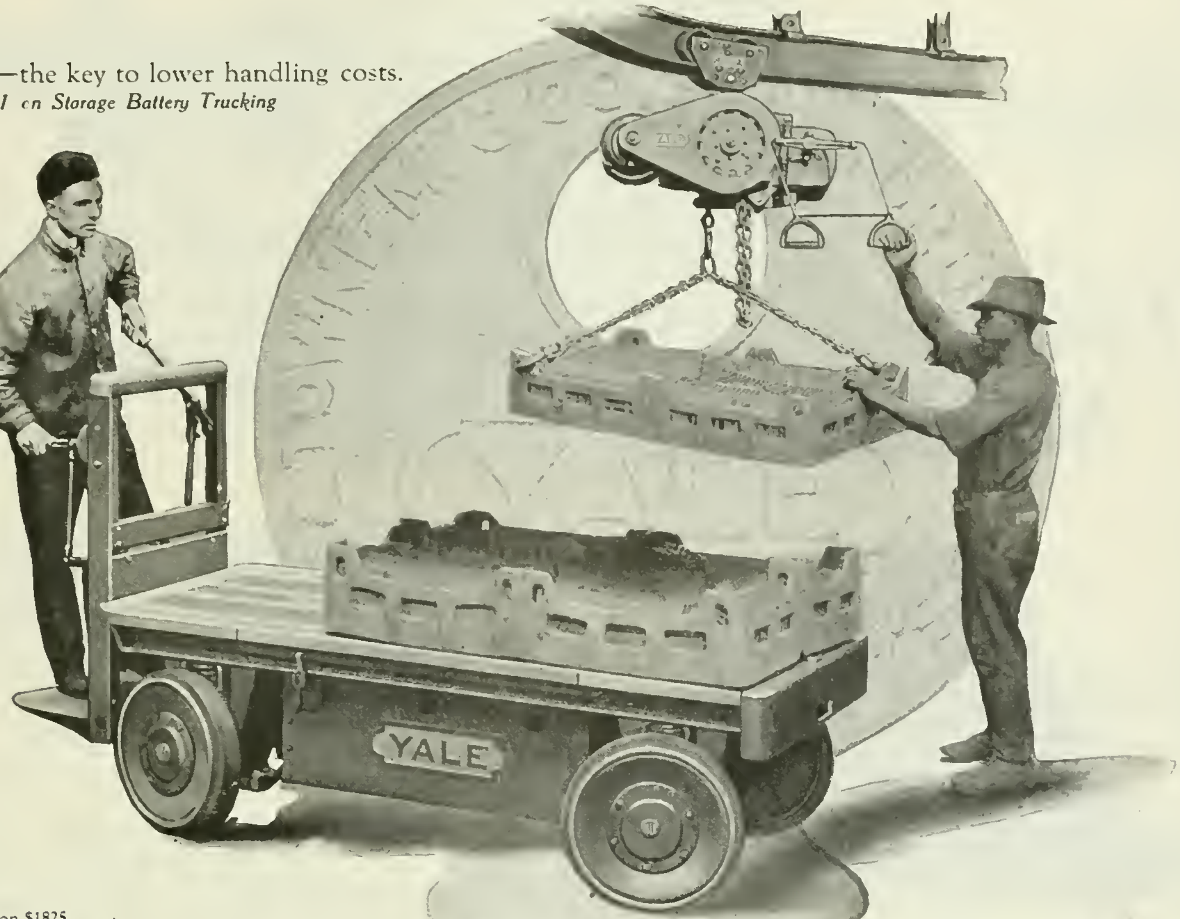

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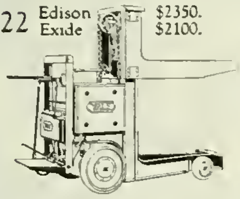

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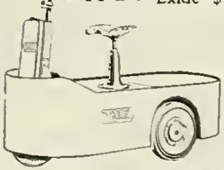

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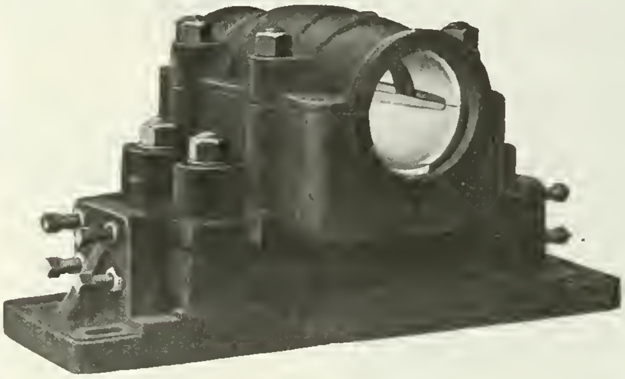

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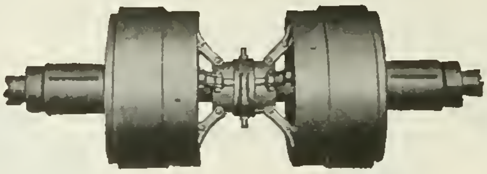


Why so many are in use

Moore & White Friction Clutches live up to specifications; minimize and prevent accidents; save power; require no attention; are practical and positive in operation.

Clutches for low speeds, high speeds and great horsepower.

Let us help you to select the clutch to meet your special needs. Write for the books—they're full of information.

THE MOORE & WHITE CO.

Established 1886

2707-2737 North 15th St., Philadelphia, Pa.

CULLMAN SPROCKETS

In stock and to order.

Let us quote you on your sprocket requirements. Send for catalog.

CULLMAN WHEEL CO.
1339 Altgeld Street
CHICAGO, ILL.

"AETNA" THRUST BALL BEARINGS

STANDARD and SPECIAL DESIGN

Guaranteed to be noiseless. Specially designed for machinery of all descriptions. Put your bearing problem up to us.

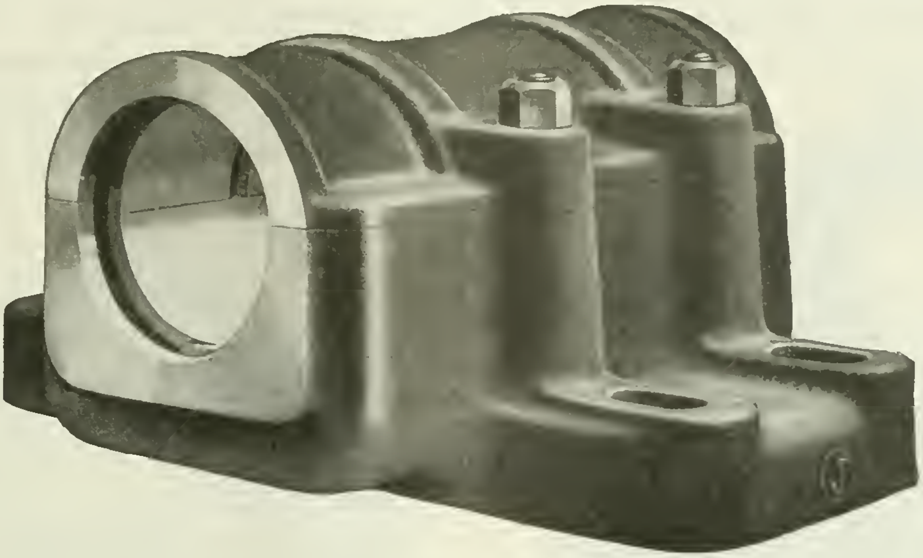
AETNA BALL BEARING MFG. CO., 2737-2745 High St., Chicago, Ill.

ROLLER THRUST BEARINGS

STANDARD DIMENSIONS
or to ORDER.

One—or one thousand

The Gwilliam Company
253 W. 58th St. NEW YORK

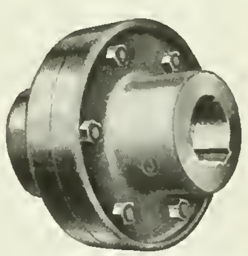


The JONES Rigid Pillow Block —Duplex Ring Oiling

Exceptionally rugged and durable—large oil reservoir—has two rings and a wool felt wick to provide positive and ample lubrication at all times. Bearings are babbitted, actually "lathe bored," and are finished at both ends for smooth collar contact—bases are finished. Strictly a ***Quality*** product in every sense of the word.

Jones Cast-iron Pulley

Jones Spur Gear



Jones Flange Coupling

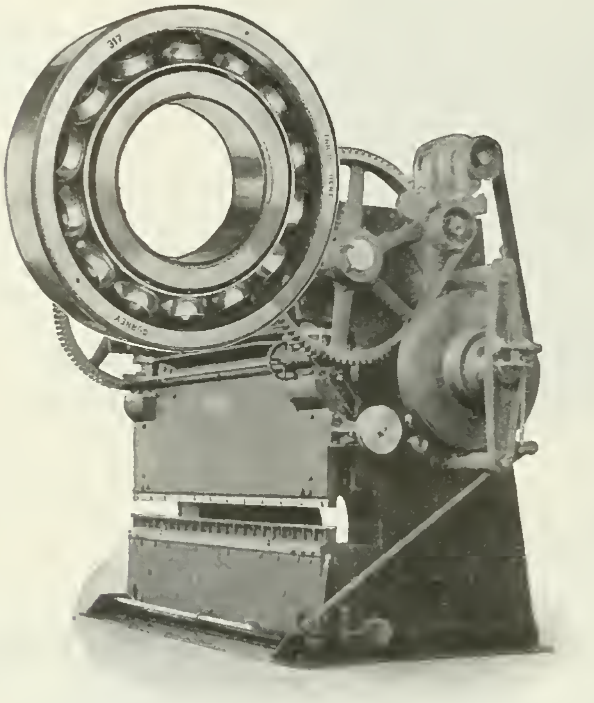
W. A. Jones Foundry & Machine Company

Main Office and Works: 4409 West Roosevelt Road, CHICAGO

Branches: New York—Pittsburgh—Buffalo—Milwaukee

Jones

Power Transmitting Machinery



Cincinnati Brake or Plate Forming Machine

This interesting machine, in order to withstand the tremendous stresses without deflection or distress, is built of steel throughout, instead of cast iron.

It is natural, in such a machine, that all important bearings such as the bearings of the big clutch pulley, the idler on worm shaft—some eight bearings in all—are Gurneys.

Gurney Engineers are experienced in solving difficult bearing problems—let them help you with yours.

Gurney Ball Bearing Co.
JAMESTOWN, N. Y.

GURNEY
BALL BEARINGS

18209

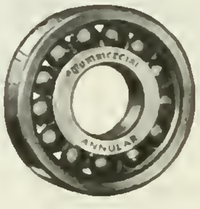
THE
"Commercial"
ANNULAR BALL BEARING

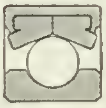
The High Cost

of production can sometimes be materially reduced by the use of Schatz "Commercial" Annular Ball Bearings, correctly designed and adapted in material and workmanship to the service required.

Inexpensive. For moderate radial and radial thrust loads at 3000 r.p.m. or less.

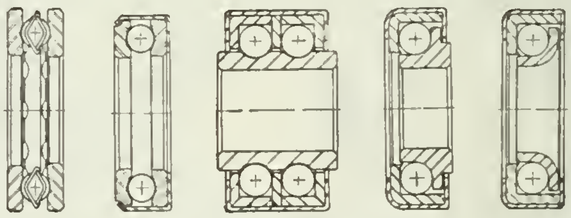
Catalog, discount sheet and samples





The
Schatz Manufacturing Co.
Poughkeepsie, N. Y.

BALL NICE BEARINGS
TRADE MARK REG US PAT OFF



ECONOMICAL—EFFICIENT
BOSTON GEAR WORKS
NORFOLK DOWNS, QUINCY, MASS.
BOSTON NEW YORK CLEVELAND CHICAGO

NICHOLSON COMPRESSION SHAFT COUPLING

No keyways; cannot slip; jaws grip powerfully enough to twist off 5" shaft.

Reducing coupling for shafts of different diameters.

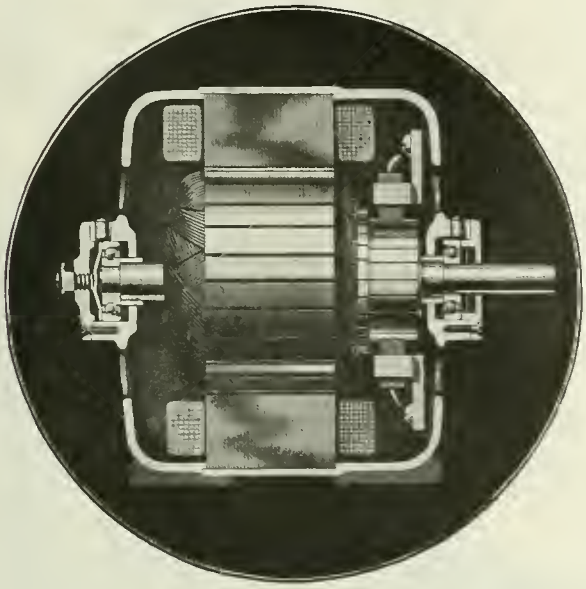
Sizes 1 3/16" to 6 15/16".

Always in stock —Quick Delivery. Write for prices.

The Old Reliable

W. H. NICHOLSON & CO., 112 Oregon St., WILKES-BARRE, PA.

A Good Motor on Machine Tools Maintains Production and Reduces Cost



When the motor stops, the machine stops—production ceases, overhead continues, unit costs rise. Look—then—to the quality of the motor you buy. Be sure it is dependable, economical of current and lubricant, ample in power, capable of standing occasional neglect. And remember—experience proves that most "motor troubles" are "motor bearing troubles," which are anticipated and guarded against in motors built as motors can be, and should be, built.

Fractional H. P. Motors Equipped with

"NORMA" PRECISION BALL BEARINGS

Have Higher Electrical Efficiency
Due to the smaller air gap and reduced magnetic leakage.

Have Higher Mechanical Efficiency
Because friction in the bearings is greatly reduced.

Use Less Current
Because of higher electrical and mechanical efficiency.

Start More Quickly
Because of the reduced bearing friction.

Are More Compact
A shorter shaft is possible—important, often.

Have Magazine Lubrication
Need oiling only at long intervals.

Are More Easily Maintained
Can be quickly opened up, inspected and cleaned.

Are Cleaner
No throwing of oil—the bearings are packed.

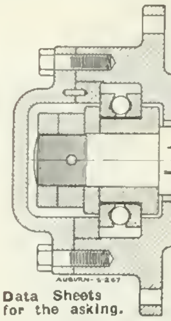
Last Longer
Because friction is minimized and lubrication assured.

Do More Work
Because capable of continuous service.

A booklet will be sent on request. And our engineers will welcome an opportunity to work with yours.

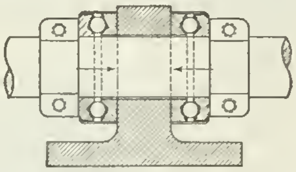
THE NORMA COMPANY OF AMERICA
Anable Avenue Long Island City New York
BALL, ROLLER AND THRUST BEARINGS

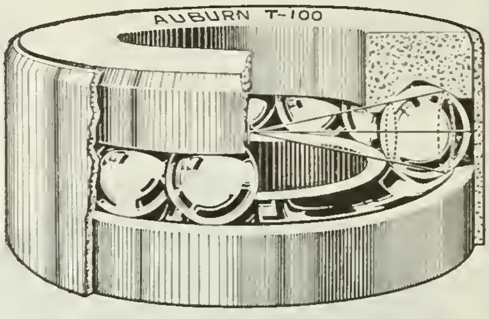
DOUBLE THRUST PROBLEMS answered by AUBURN BEARINGS



Auburn Ball Thrust Bearings answer many difficult problems by the different Styles or Designs in which they are made, each having definite advantages for certain operating conditions.

The illustrations show **AUBURN ANSWERS** to two difficult problems. Write us about your bearing difficulties.





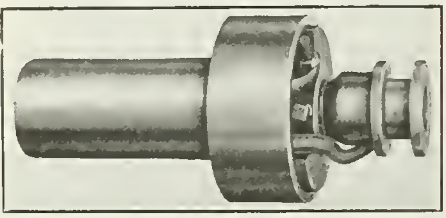
Steel, Brass and Bronze Balls

Data Sheets
for the asking.

AUBURN BALL BEARING CO.

Trade Mark
Established 1893

33 Elizabeth St., Rochester, N. Y.



ACHIEVEMENT has proved that the

CONWAY CLUTCH

can transmit a larger factor of power in a given space allotment.

Easy engagement. Instant release. Fool-proof adjustment. Interchangeable parts. Free idling. Capability for overload in the "pinch."

. . . . . You are missing something, if you try to start and stop excellent mechanisms without CONWAY CLUTCHES.

Incorporate dependability into your product.

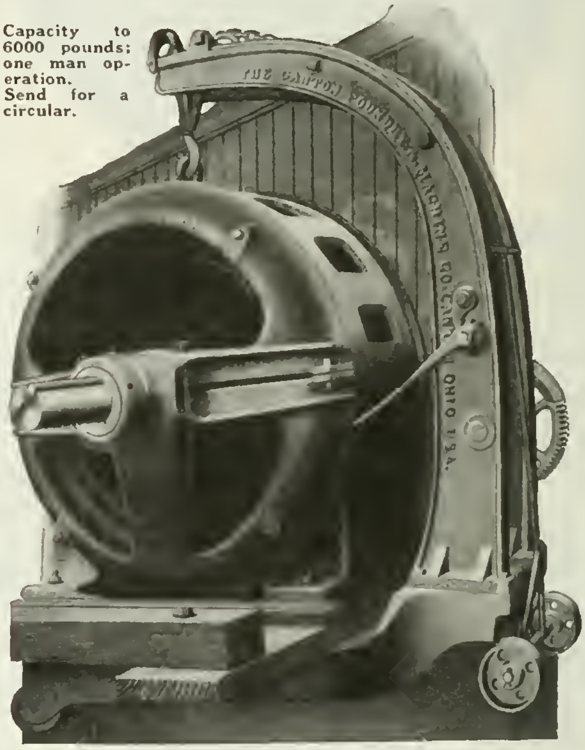
THE CONWAY CLUTCH CO.

1962 W. Sixth St.
CINCINNATI, OHIO

Use a Canton Crane

to simplify setting up parts like this.

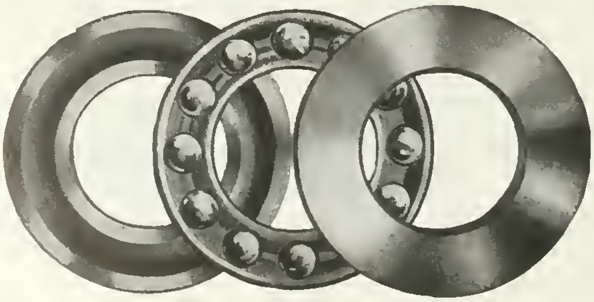
Capacity to 6000 pounds; one man operation. Send for a circular.



CANTON FOUNDRY & MACHINE COMPANY

CANTON, OHIO
New York Office, 203 East 15th Street

THE BEARINGS COMPANY OF AMERICA

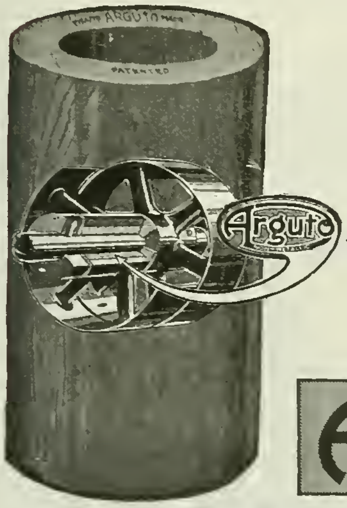


Your present Thrust Bearings sizes duplicated. Thrust Ball Bearings made to your B/P's. Quotations made promptly on all inquiries.

THE BEARINGS COMPANY OF AMERICA

Western Sales Office,
1012 Ford Bldg., Detroit, Mich.

LANCASTER, PA.



Arguto OILLESS BEARINGS
Need No Lubrication

A Quarter Century Without Oil

Think of installing a bearing and forgetting it for 24 years. Not a drop of oil nor any labor charges in a quarter century. This is the record of an Arguto Oilless Bearing. For some 30 years Arguto has been the solution of loose pulley, clutch and other inaccessible bearing troubles and thousands of concerns all over the world have availed themselves of it. For these concerns the oil can *is* abandoned.

We do not recommend Arguto for all bearings; but welcome the opportunity of going over your problems. Write us.

ARGUTO OILLESS BEARING CO.
Wayne Junction —— Philadelphia

CURTIS *Air Hoists*

Economical—Safe—Dependable

The Curtis Air Hoist has been so perfected in its speed regulation, design and mechanical construction that it is the simplest, safest, most economical hoist for light and medium capacities. It effects a decided saving in man power.

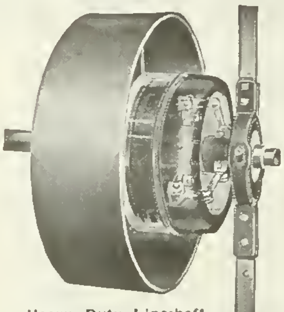
A Hoist to Meet Your Needs

CURTIS AIR HOISTS have been successfully adapted to meet a wide variety of needs in hundreds of the leading industrial plants throughout America.

Our Engineering Department is at your service, ready to study any special conditions you have to meet and recommend suitable equipment. Illustrated descriptive literature and full information on request.

Curtis Pneumatic Machinery Co.
1568 Kienlen Ave., St. Louis, Mo.
Branch Office—530-G Hudson Terminal, N.Y.C.

EDGEMONT CLUTCHES Wherever Power is Applied



Heavy Duty Lineshaft Clutch Pulley Plate "Type C" Equipped with Oil Sleeve

Edgemont Friction Clutches absorb all the shock, take all the abuse of rough service, can be thrown in and out constantly or slip and pick up the load very slowly without injury.

A special woven burn-proof asbestos composition is used as a liner, instead of fibre and wood block, which is easily destroyed by heat under friction.

Simple, fool-proof, positive, economical and above all *safe*. Let us tell you more about them.

Edgemont Clutches, Clutch Pulleys, Cut-off Couplings, Extended Sleeve Clutches and Special Clutches for all Purposes—described in Catalog "G".

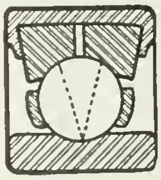
THE EDGEMONT MACHINE COMPANY
2700 National Avenue DAYTON, OHIO, U. S. A.

THE REASON

for the Greater Precision, Less Friction and Longer Life of the

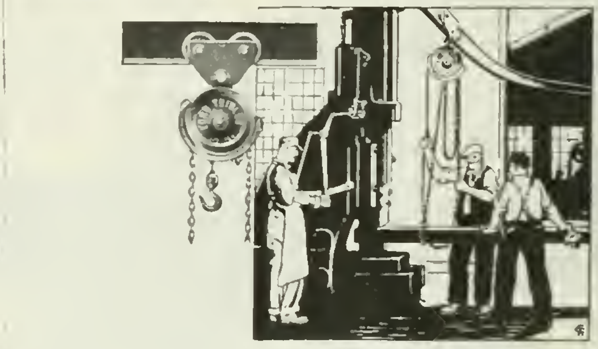
Schatz "UNIVERSAL" Annular BALL BEARING
Registered U.S. Pat Off

is careful manufacturing and the three area contact which withstands thrust loads and provides a greater wearing surface.



THE FEDERAL BEARINGS CO., Inc.
POUGHKEEPSIE
N. Y.

FORD TRIBLOC



Hauling and Holding

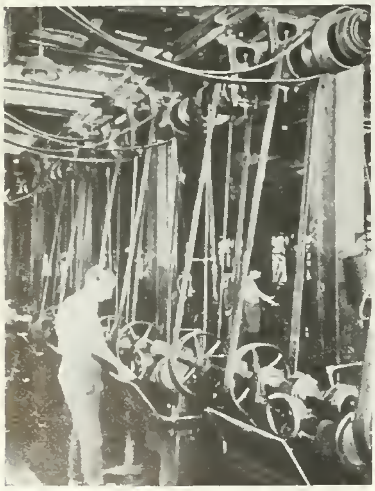
THE Tribloc not only facilitates lifting and lowering—it also facilitates hauling and holding. Suspended from a roller-bearing trolley running on an I-Beam track, the Tribloc with its load can be quickly and easily hauled to any point. There, the load can be lowered or steadily and securely held as illustrated above.

Write for Catalog 5-B for Triblocs in capacities up to 40 tons

2219-D

FORD CHAIN BLOCK CO.
2ND & DIAMOND STREETS PHILADELPHIA, PA.

OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 CHAMBERS ST. NEW YORK, U.S.A.
PARIS BRUSSELS TURIN BARCELONA RIO DE JANEIRO.



600 Hilliard Friction Clutches Increase Machine Efficiency in this Big Plant

This photograph taken in the Coaster Brake Hub Shaving Department of the New Departure Manufacturing Company, Bristol, Connecticut, shows a few of the Hilliard Friction Clutches in this plant.

Positive, easy, individual control for each machine gives increased efficiency; the elimination of elaborate overhead rigging reduces equipment and upkeep costs. Hilliard Friction Clutches are a profitable investment. Let us tell you more about them.

The Hilliard Clutch & Machinery Company
ELMIRA, N. Y., U. S. A.

Performance the Gauge of Bushing Quality

In a record non-stop run of 3155 miles, at an average speed of more than 60 miles per hour, this Stock Duesenberg "Straight-Eight," fed by a supply car, established an endurance record probably never equalled by a motor car.

As parts of this remarkable car, Johnson Bronze Standard Bushings performed 100%.

Johnson Bronze Standard Bushings are made in all types and sizes, to meet your every requirement.

The bushings you require will probably be found in our stock list, obtainable in small quantities at large quantity prices.

JOHNSON BRONZE COMPANY
NEW CASTLE, PA.

JOHNSON BUSHINGS

DIAMOND
Chains and Sprockets

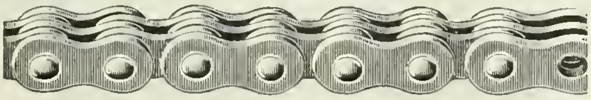
DIAMOND Roller and Block Chains are made in sizes ranging from ⅜" to 2" pitch, and from ⅛" to 1¼" in width. This offers you correct chain models for the widely varying needs of machinery drives. Diamond Sprockets are made in types and sizes to suit various chain drive requirements. Write for DIAMOND Chain catalogs, or send your chain drive specifications for quotations. Ask for a copy of our Chain Data Book.

DIAMOND CHAIN & MFG. CO. Indianapolis, U.S.A.
Makers of High Grade ◇TRADE MARK◇ *Chains Since 1890*

SASH AND CABLE CHAINS

SASH CHAIN

No. 00 SASH CHAIN



No. 110 CABLE CHAIN

THE SMITH & EGGE MFG. CO.
BRIDGEPORT, CONN.
SASH CHAIN ORIGINATORS

Announcement

AN entirely new type of pressed steel shaft hanger combining unusual strength and rigidity with accurate alignment adjustments and a pleasing and graceful design.

This new American Pressed Steel Shaft Hanger is the result of a quarter of a century of experience in power transmission problems.

This shaft hanger is in every way a worthy companion to the American Pulley, for twenty-five years accepted as a standard of pulley excellence.

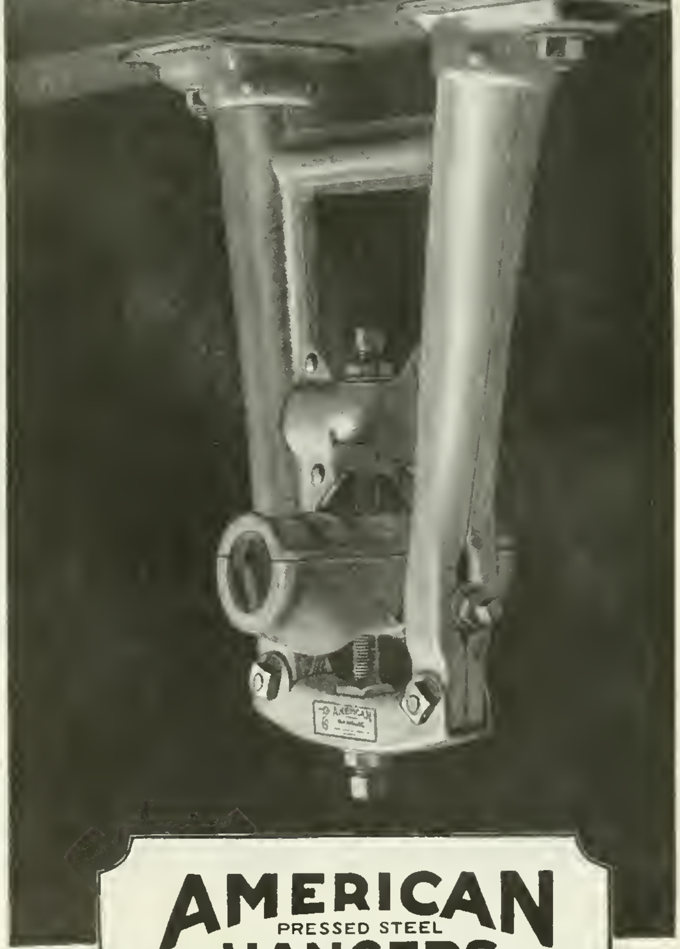
This hanger carries with it the guarantee of The American Pulley Company, the same guarantee which stands back of the American Pressed Steel Pulley.

More complete description of these new American Pressed Steel Hangers is contained in a special folder. A request will bring you a copy promptly.

For complete list of distributers see MacRae's Blue Book.

The American Pulley Company
Manufacturers of Steel Split Transmission Pulleys, Steel Sash Pulleys, Pressed Steel Shaft Hangers, and Pressed Steel Shapes
Philadelphia, Pa.

NEARLY six million American Pulleys in service in the United States and foreign countries attest the success with which this type of pressed steel construction (embodied in the new shaft hanger) has met the demands of industry.



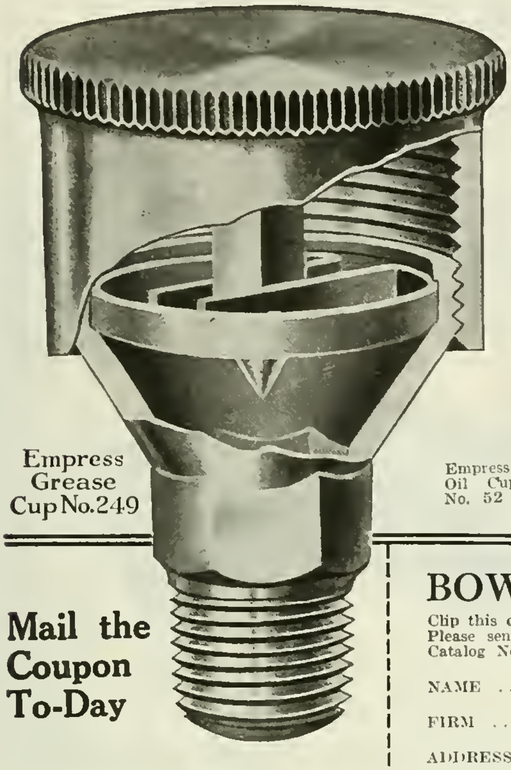
AMERICAN PRESSED STEEL HANGERS

A quick attachment or detachment of link to shackle is made possible by this new Wright hook. Just a small wrench and a very few minutes' time is all that is necessary to install.

It fits every load chain link. Let us tell you more about it.

IMPROVED HIGH SPEED HOIST

GREASE CUPS!



Empress Grease Cup No.249

Empress Cups Insure Perfect Lubrication for Your Machines

They keep the dirt out—let the lubricant in; small but important accessories, they solve the lubrication problem for the machine designer. Specify Empress lubricators.

Empress Oil Cup No. 52

The large cut shows the Empress Grease Cup No. 249; the small one Empress Oil Cup No. 52—two of our most popular cups. Advise the one you want (both if you're interested) and we'll send samples.

REG U S PAT OFF
Empress

Mail the Coupon To-Day

BOWEN PRODUCTS CORP., Auburn, N. Y.

Clip this coupon and attach to your letterhead.
Please send me sample of your Empress Grease Cup No. 249. ☐ Empress Oil Cup No. 52 ☐ and Catalog No. 101 J of your entire line.

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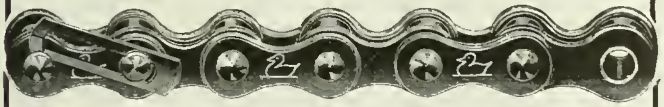
Duckworth Specialty Chains



The above cut represents our No. 190 ½" Pitch Roller Chain, designed particularly for all kinds of Wrapping, Folding, Labeling and Cutting Machines. We have many other models, each especially fitted for some individual task. Our prices are low enough to be attractive and all our Chains are of flawless quality. We shall be glad to send our catalog and offer estimates.

DUCKWORTH CHAIN & MFG. CO.
Established 1871
40 Mill Street SPRINGFIELD, MASS.

ROEPER
ELECTRIC AND HAND POWER
TRAVELING CRANES
MONO-RAIL HOISTS
TROLLEYS
ROEPER CRANE & HOIST WORKS
READING, PA.

THE BANTAM BALL BEARING CO.
TRADE MARK
BANTAM, CONN., U.S.A.

Thrust Bearing Specialists

Bearings Made To Your Requirements

DETROIT OFFICE: 905 Dime Bank Bldg., Detroit, Mich.

PACIFIC COAST:
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F. M. BOYD,
The Avon, 6 East Read St.,
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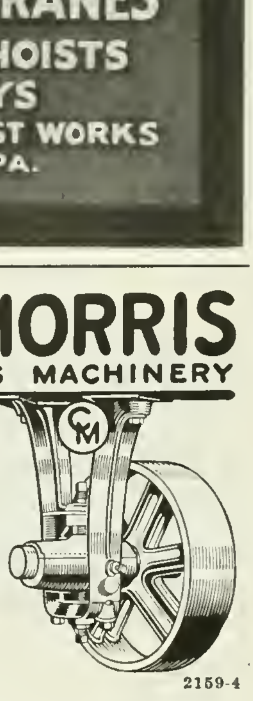
CRESSON-MORRIS

POWER TRANSMITTING MACHINERY



General Power transmitting machinery; Shafting; Rope transmission; Machine moulded and cut iron and steel gears for heavy service; Complete plant equipment; Sugar centrifugals. Engineers; Founders; Machinists.

CRESSON-MORRIS CO.
18th St. and Allegheny Ave.
PHILADELPHIA, PA.

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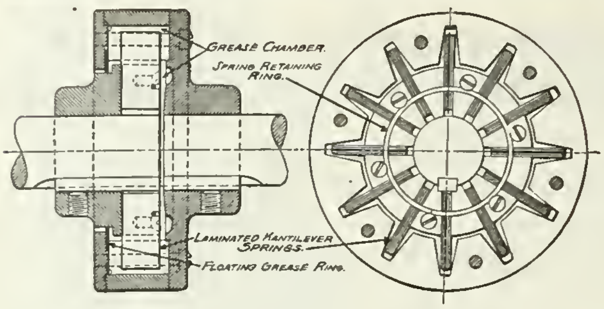
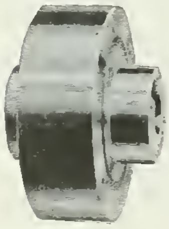
Sixty Years Experience as Engineers • Founders • Machinists

Brown KANTI-LEVER SPRING COUPLINGS



PLENTY OF END PLAY

—and *no end thrust.* Brown Kanti-Lever Spring Couplings correct angular misalignment of shafting and reduce wear on the machinery by reducing the shock due to changes in load, loose bearings, worn gears, etc. They add to the efficiency of the motor drive and are particularly advantageous where herringbone gears are used. End play up to several inches can be had.



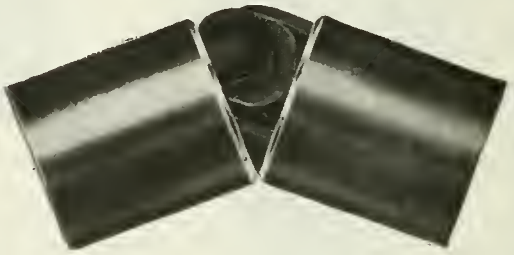
Send for the booklet and more details.

Brown Engineering Co.
133 N Third St — Reading Pa

Speaking of Standardization

G. & P. Universal Joints cover a range of sizes to meet almost every ordinary and many special requirements; many of the well-known large machine tool manufacturers have used them for years in driving mechanisms. G. & P. Joints have casehardened wearing surfaces, a total absence of sharp corners, screws and small parts that collect dirt. Make for long life and good service.

Details and price list on request



Manufactured by

Gray & Prior Machine Co.
38 Suffield Street Hartford, Conn.

NORTHERN CRANES

ELECTRIC HOISTS
AIR HOISTS

Bulletins on Request

NORTHERN ENGINEERING WORKS, DETROIT, MICH.

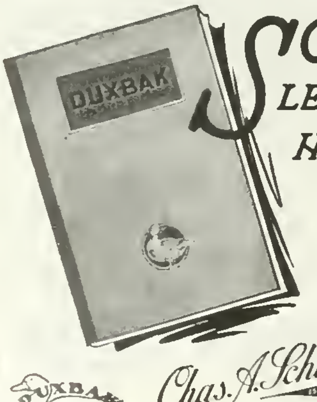
To Speed Up Work on Cutting Machinery, Use Better Oils Made Cheaper by the

TOLHURST
(Reg. U. S Patent Office)
CHIP WRINGER

The Tolhurst Chip Wringer reclaims 48 gallons an hour from four loads of chips or turnings. The saving in oil and the increased production are the convincing performances by Tolhursts in modern plants.

Tolhurst Machine Works
TROY, N. Y.

Write for Complete Information



SCHIEREN'S LEATHER BELTING HANDBOOK

Published in 18 sections, contains the cumulative data of 54 years' experience in the application of belting drives.
If you use belts, don't miss it. Write for binder, released and future sections.

Chas. A. Schieren Company
ESTABLISHED 1868
Tanners Belt Mfgrs.
73 Ferry St.,
NEW YORK, N. Y.

DUXBAK BELTING
TRADE MARK

Branches and Distributors in all leading cities

Curtis Universal Joints

NONE BETTER

Sole Distributors for U. S. A.

BOSTON GEAR WORKS
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Branches at BOSTON NEW YORK CHICAGO CLEVELAND

MORSE DRIVES

SILENT CHAIN

THE MORSE "ROCKER JOINT"

Highest efficiency in power transmission

99% of power transmitted with positive speed ratios, uniform smoothness of operation, and a minimum of upkeep. They require less attention than belt drives, and possess the added feature of greater durability and flexibility of speed.

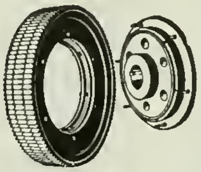
Another distinct advantage of a Morse Silent Chain Drive is the exclusive "Rocker-Joint" which reduces friction and wear and adds years to the life of the drive.

Further, Morse Drives require less motive power; have less vibration; possess greater flexibility, and can run on almost any distance of center-conserving space.

There is a Morse Engineer near you. He is a specialist in the transmission of power. Call upon him without any obligation to you.

MORSE CHAIN CO., ITHACA, N. Y.

There is a Morse Engineer near you



Shear Spin Sprocket

ATLANTA, GA., Candler Bldg., Earl F. Scott & Co.
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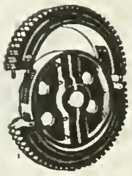

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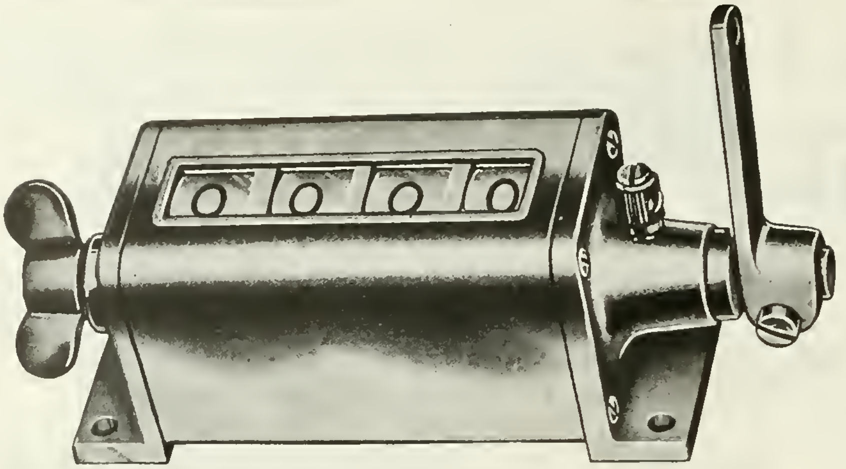

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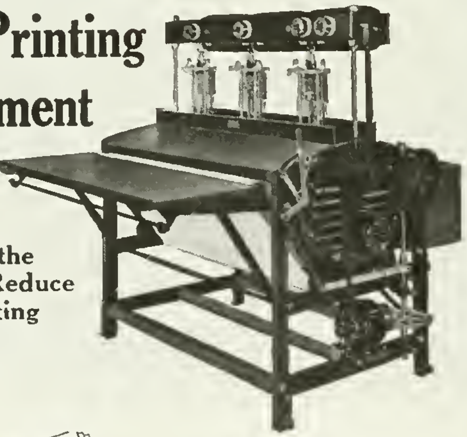

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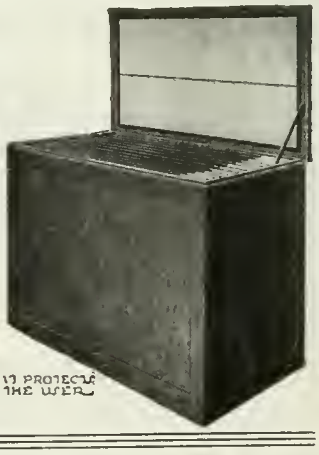

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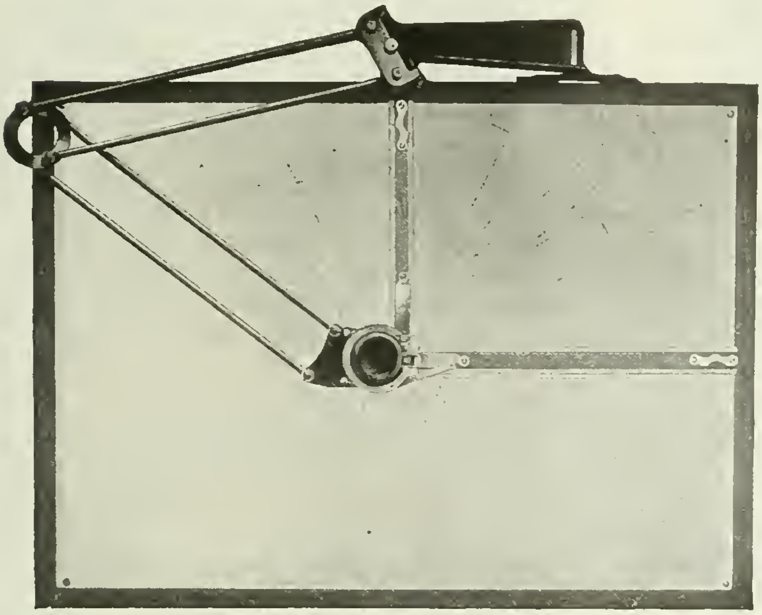

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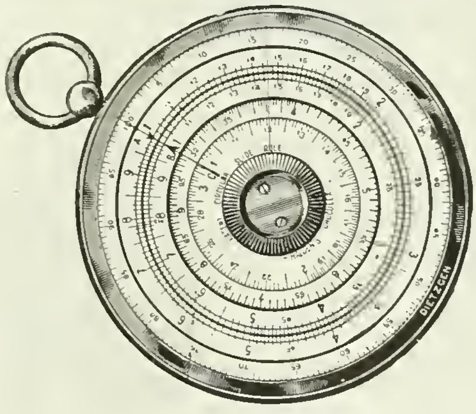

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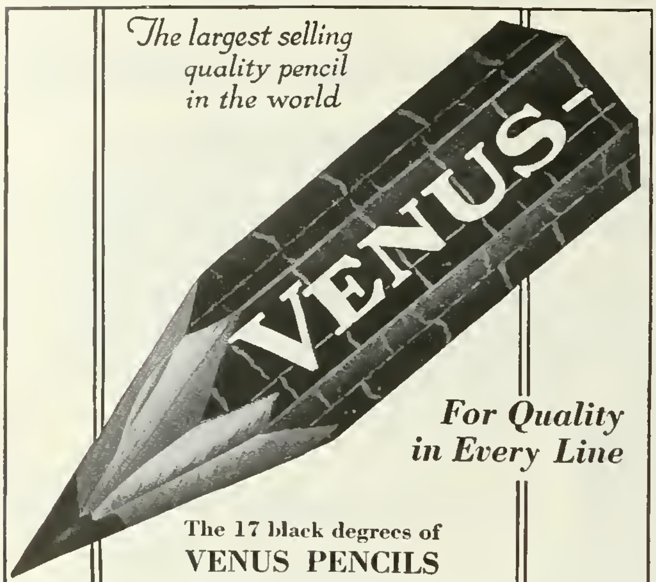

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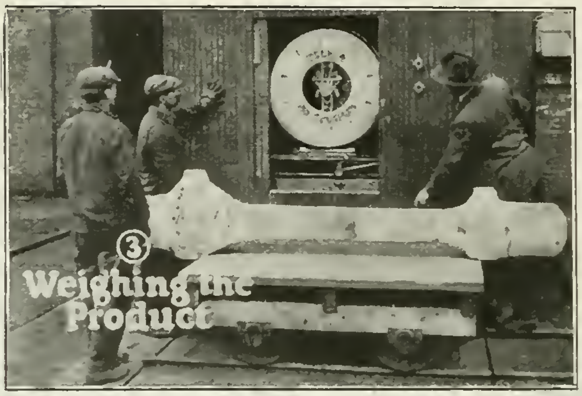

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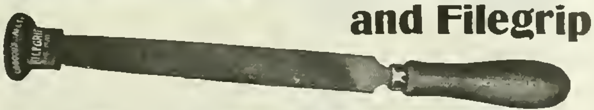

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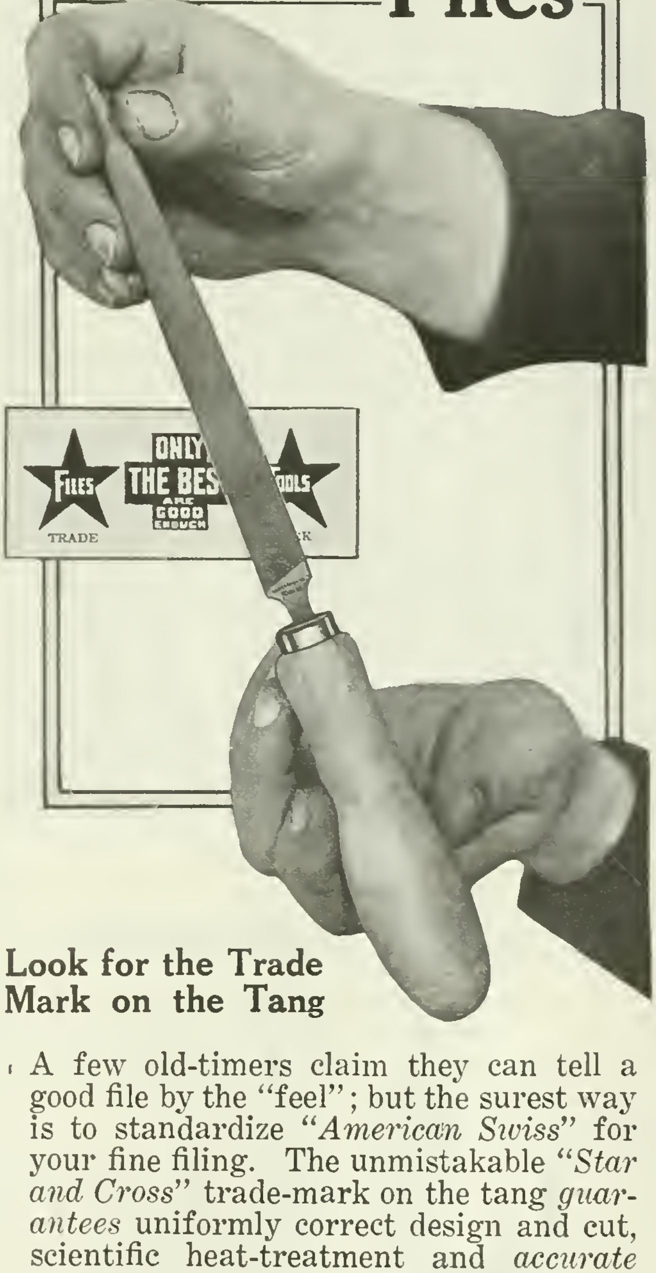

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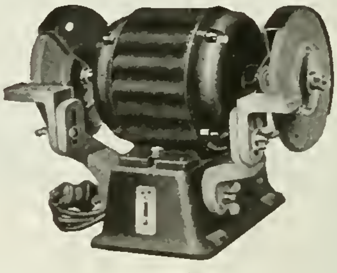

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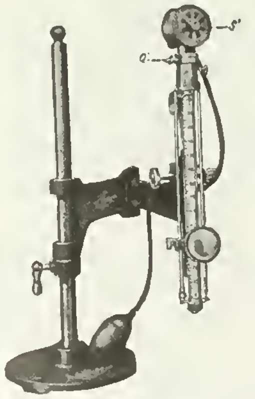

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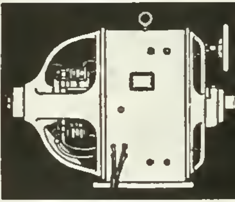

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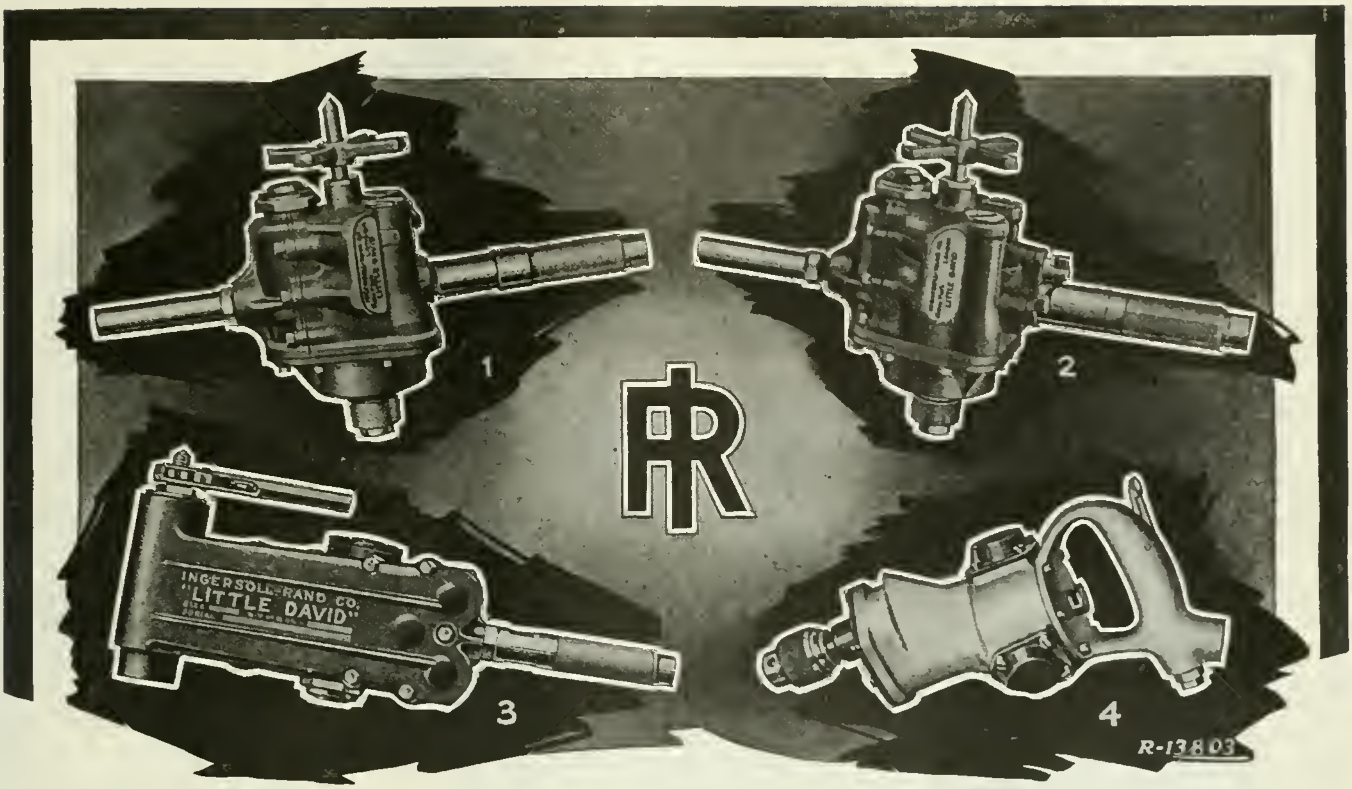

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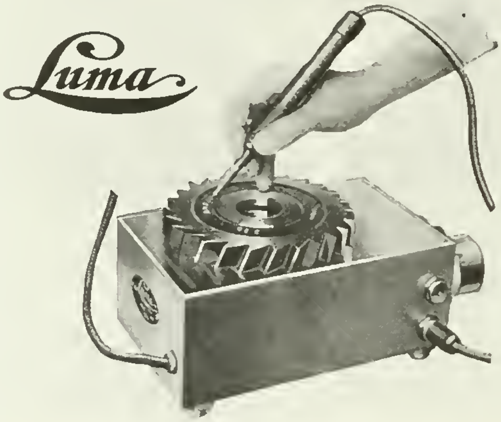

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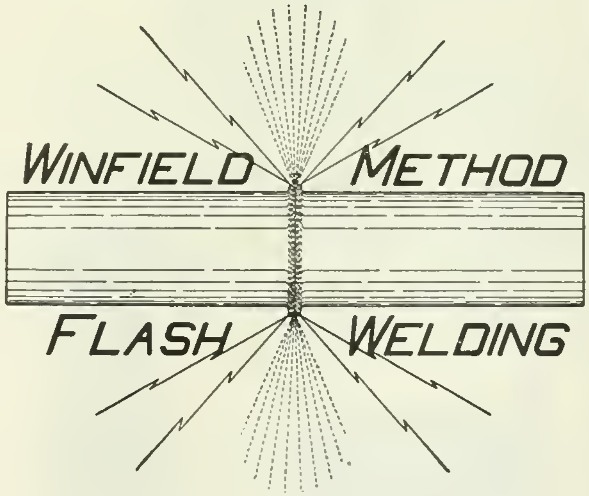

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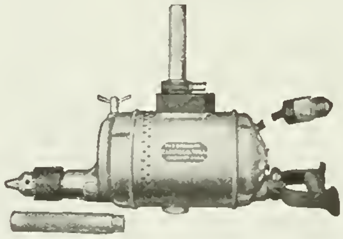

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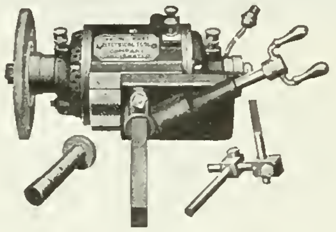

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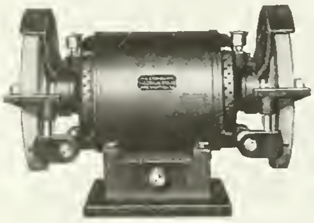

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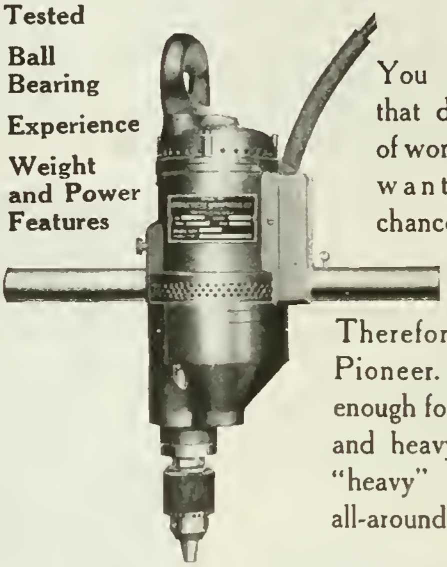

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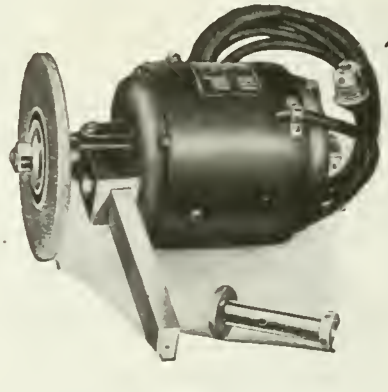


STOW Tool Post Grinder

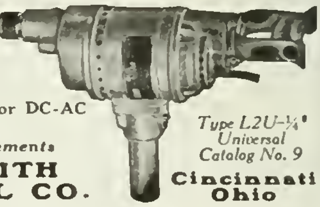
For grinding Centers, Dies, Cutters and other equipment, this grinder is in a class of its own. Handles both Internal and Surface Grinding—hand feed or plain feed. Regular equipment $^3/_8$"x6" wheel, internal grinding attachment, with 10 ft. flexible cord and plug to fit standard lamp socket. Write for details.

STOW MANUFACTURING CO., Inc., Binghamton, N. Y.
London Stock: 85 Queen Victoria Street

PORTABLE ELECTRIC DRILLS and GRINDERS

Complete line of sizes suitable for DC-AC and Universal Current

Tested to U. S. Navy requirements



Type L2U-¼" Universal Catalog No. 9

THE NEIL & SMITH ELECTRIC TOOL CO.
Cincinnati
Ohio

HAND SNAGGING GRINDER

(Electric)

Light Weight	20 pounds
Large Wheel	7" x 2"
High Power	¾ H.P. Max.

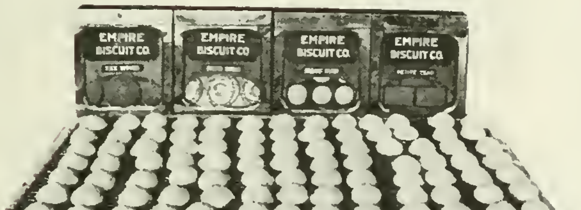
FORBES & MYERS, 178 Union St., Worcester, Mass.

Power King
Portable Electric Drills

Biscuits and Portable Drills!

You're wrong again! They don't use "Power King" to put holes in the biscuits. Empire Biscuit Company uses "Power King" to do the repair work on the batter machines, the ovens and conveyors and all the other apparatus—of which there is a lot in this Brooklyn factory.

"Power King" is the *Adaptable* portable drill—has two speeds, is powerful and rugged, with a big factor of safety and much reserve energy.



Let us send you detailed information about "Power King" and the new drill stand.

Jones, Mac Neal & Camp
INCORPORATED

FACTORY & GENERAL OFFICES
WARSAW, INDIANA.

Why Experiment? Use "Van Dorn"

ELECTRIC DRILLS AND GRINDERS

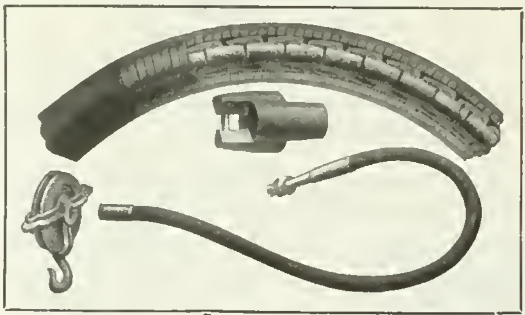
How do you measure Electric Tool worth?

Is it by *Reserve Power—Overload Capacity*—and *Freedom from Troubles* day-in and day-out after months of the hardest continuous service?

If so, then your idea of worth and ours is identical and the "Van Dorn" will just fit your demands.

Have you our catalog? It will interest you.

The Van Dorn Electric Tool Co.
Cleveland Ohio, U. S. A.



THE IDEAL FLEXIBLE SHAFT For Every Purpose

Can be made to meet requirements not possible in other shafts such as running in both directions, delivering the maximum power, and in any length of section up to eight feet.

All parts interchangeable, sections can be coupled together thereby making a shaft of the greatest possible length.

Write us about your flexible shafting requirements

GEM MANUFACTURING COMPANY
N. S., PITTSBURGH, PENNA.

GEM FLEXIBLE SHAFTING

DRILLS GRINDERS US BUFFERS REAMERS

THE difference between a "U. S." and any other portable electric drill is instantly obvious to the mechanic who uses it—and shortly after to the man who employs him, when he sees his work speeded up and his men finishing the day with **far less fatigue.**

Write for catalog 20-E.

The UNITED STATES ELECTRICAL TOOL CO
CINCINNATI, OHIO.

District Sales Offices and Service Stations

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UNITED STATES Portable Electric DRILLS

Complete stocks carried in all service stations.

THE UNITED STATES ELECTRICAL TOOL CO. CINCINNATI, OHIO
The Good Mechanic Knows!

New Home of "Strand" Flexible Shaft Equipments.

Established Nineteen-Five

Strand

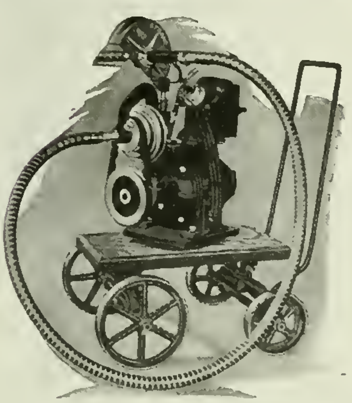
TRADE MARK

We are now located in our new factory

5001-5009 North Lincoln Street Chicago

Eighteen years of clean, honest business methods have placed on our roll of satisfied customers a list of users which if published would require half the pages in this journal. Manufacturers from every part of the world are using the

STRAND Flexible Shaft Equipments



MACHINES BUILT FOR SERVICE

Originators of the Three Speed Motor Countershaft Drive.

Made in several types and sizes.

Manufactured by

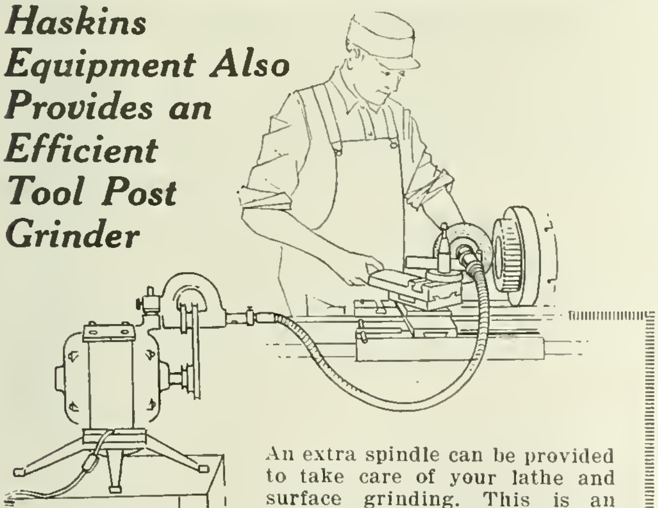
N. A. STRAND & CO.

CHICAGO

Main Office and Factory: 5001-5009 North Lincoln St.

We Believe He Profits Most Who Serves His Customers Best

Haskins Equipment Also Provides an Efficient Tool Post Grinder



An extra spindle can be provided to take care of your lathe and surface grinding. This is an especially valuable feature in shops where there is not enough lathe grinding to warrant an additional equipment. The HASKINS is a good sturdy tool well adapted to this operation.

At other times the machine will be busy grinding castings, cleaning and scraping—occasionally drilling. It can do almost anything and we know you'll keep it busy.

We have a special proposition to make you now. You tell us about the work in your shop—if we can help you we'll say so and back it up with a factory demonstration. There is no obligation. We know that if we can save you money or time you'll keep our machine and pay for it—otherwise we wouldn't let you have it.

R. G. HASKINS COMPANY, 520 West Monroe St. CHICAGO, U. S. A.

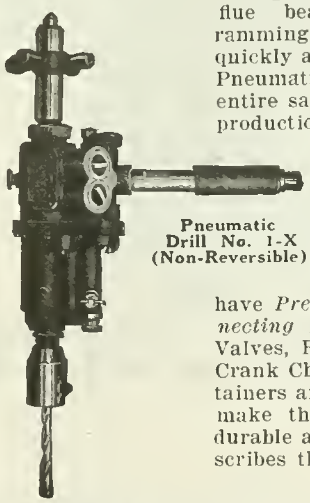
Distributor for Pacific Coast: Mohr Bros. Co., 233 Pacific Bldg., San Francisco, Cal.

Thor

Pneumatic Tools

Light Chipping, Scaling and Cleaning Hammer

Wherever a difficult operation must be performed in close quarters—drilling in wood or metal, driving air-tight rivets, chipping, calking, flue beading, cleaning, scaling, ramming, etc., or lifting heavy loads quickly and safely—you'll find Thor Pneumatic Tools will not only give entire satisfaction but will improve production as well.



Pneumatic Drill No. 1-X (Non-Reversible)

THOR DRILLS

have *Pressed Vanadium Steel Connecting Rods and Pistons,* Corliss Valves, Roller Bearings, removable Crank Chamber Plates, Bearing Retainers and other advantages which make them more than ordinarily durable and convenient. Catalog describes the whole line.

Independent Pneumatic Tool Co.

600 WEST JACKSON BLVD., CHICAGO

NEW YORK PITTSBURGH SAN FRANCISCO
DETROIT CLEVELAND BIRMINGHAM MONTREAL
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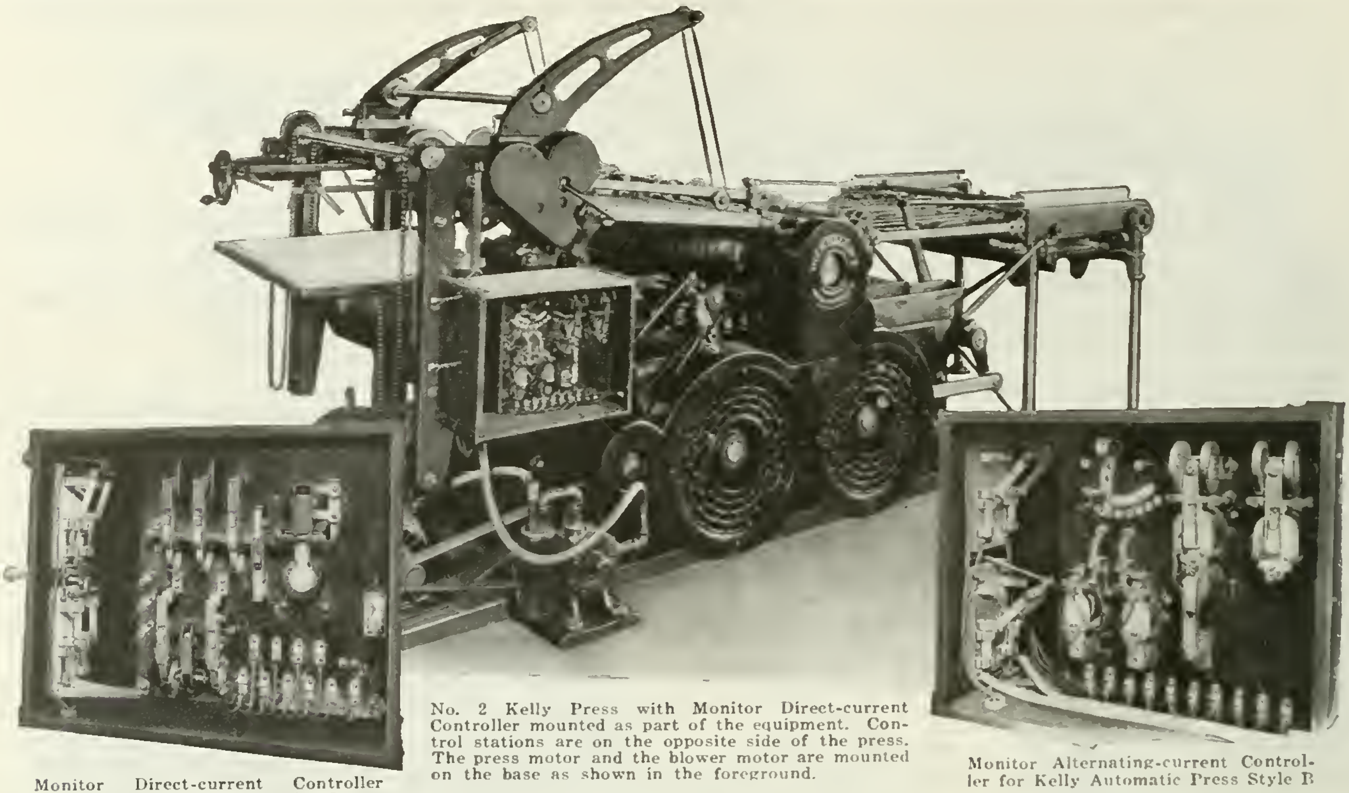


Monitor Direct-current Controller for No. 2 Kelly Automatic Press.

No. 2 Kelly Press with Monitor Direct-current Controller mounted as part of the equipment. Control stations are on the opposite side of the press. The press motor and the blower motor are mounted on the base as shown in the foreground.

Monitor Alternating-current Controller for Kelly Automatic Press Style B

Monitor AC and DC Controllers standard equipment for Kelly Presses

THE remarkable success of the Kelly Automatic Job Press Style B produced a demand for a larger size that has been met with the Kelly No. 2. This press, like the smaller model, was designed especially for high speed commercial and other printing. It provides unique facilities for quick make-ready and adjustment of ink to both press and feeder and is a time-saver on both long and short runs.

The automatic feeding mechanism is fool-proof and does not require attention except when paper stock is exhausted, or when the machine is automatically stopped due to something going wrong with the paper.

The controllers for the No. 2 press were specially designed by the Monitor Controller Company, and are standard equipment on all Kelly presses. They provide for push-button start and stop, and automatic stop in case of necessity.

Electric brake, automatically applied by the controller, acts so quickly that the cylinder will stop from full speed within one revolution.

There are three control stations on the press—an automatic trip station to stop the press and the blower; a three-button main control station mounted near the cylinder, one button providing start for the blower motor, one for the press motor and one to stop both motors simultaneously, and a stop station mounted at the delivery end of the press, which also stops both blower and press motors.

For direct-current operation the press is driven by a 3-hp. motor and the blower by a ½-hp. motor. For alternating-current operation the press is driven by a 4-hp. Polyphase Slip-ring Induction Motor and the blower by a ½-hp. Induction Motor.

The Monitor Controller Company is equipped to design and build controllers for any type of motor service, either direct-current or alternating-current and to meet any requirements of speed adjustment or variation.

MonitorControllerCompany

BOSTON BUFFALO CHICAGO CLEVELAND DETROIT NEW YORK PHILADELPHIA PITTSBURGH ST. LOUIS
NEW ORLEANS BIRMINGHAM

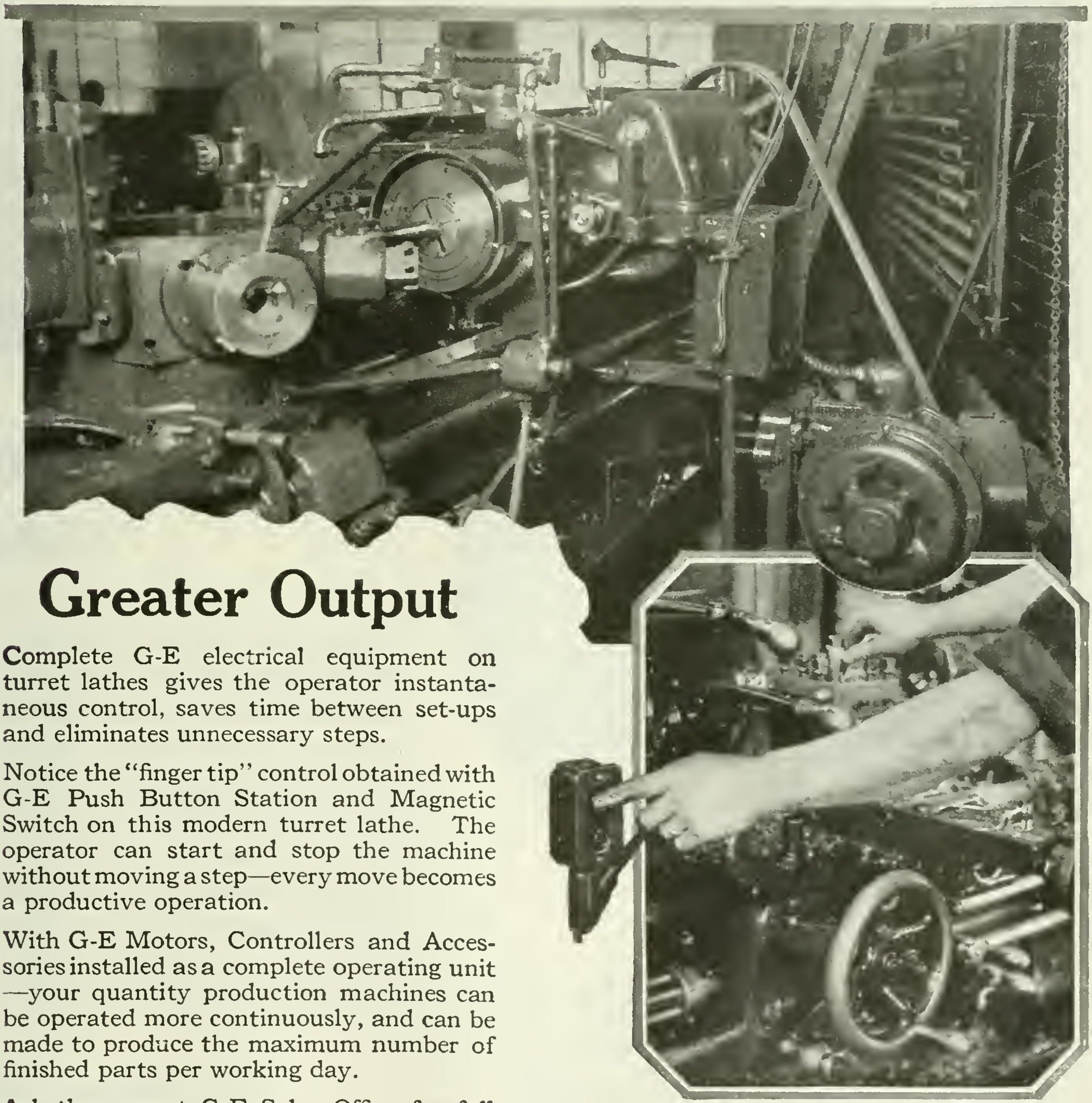
BALTIMORE - MARYLAND

Bulletin 1006 describes and illustrates Monitor Control for machine tools. Ask for it.

The Original "Just Press a Button" System

82-3520

In the Machine Shop



Greater Output

Complete G-E electrical equipment on turret lathes gives the operator instantaneous control, saves time between set-ups and eliminates unnecessary steps.

Notice the "finger tip" control obtained with G-E Push Button Station and Magnetic Switch on this modern turret lathe. The operator can start and stop the machine without moving a step—every move becomes a productive operation.

With G-E Motors, Controllers and Accessories installed as a complete operating unit—your quantity production machines can be operated more continuously, and can be made to produce the maximum number of finished parts per working day.

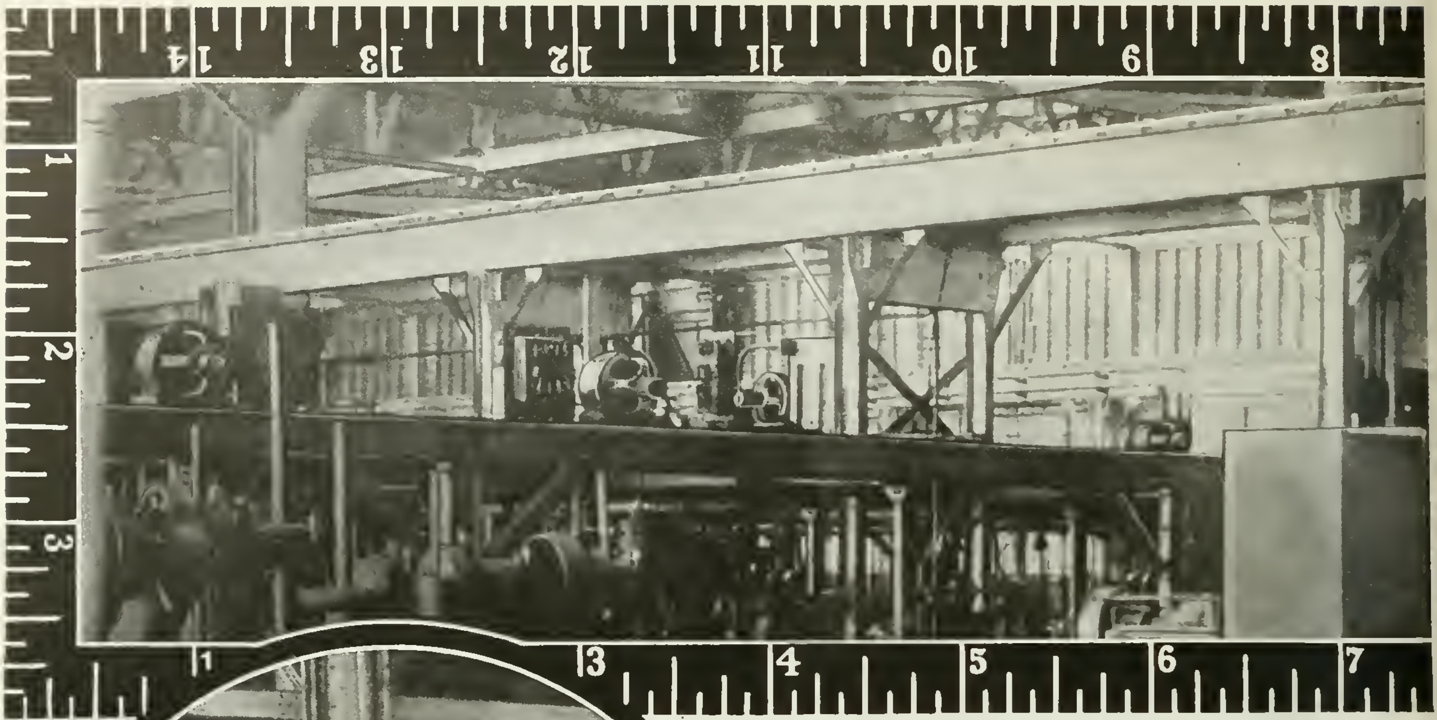
Ask the nearest G-E Sales Office for full information.

Complete G E Equipment on Turret Lathe.

General Electric Company
Schenectady, N. Y.
Sales Offices in all large cities.

GENERAL ELECTRIC

43B-783



The first of a battery of sixteen Westinghouse motors driving sixteen spindle multiple drills.

WESTINGHOUSE ELECTRIC

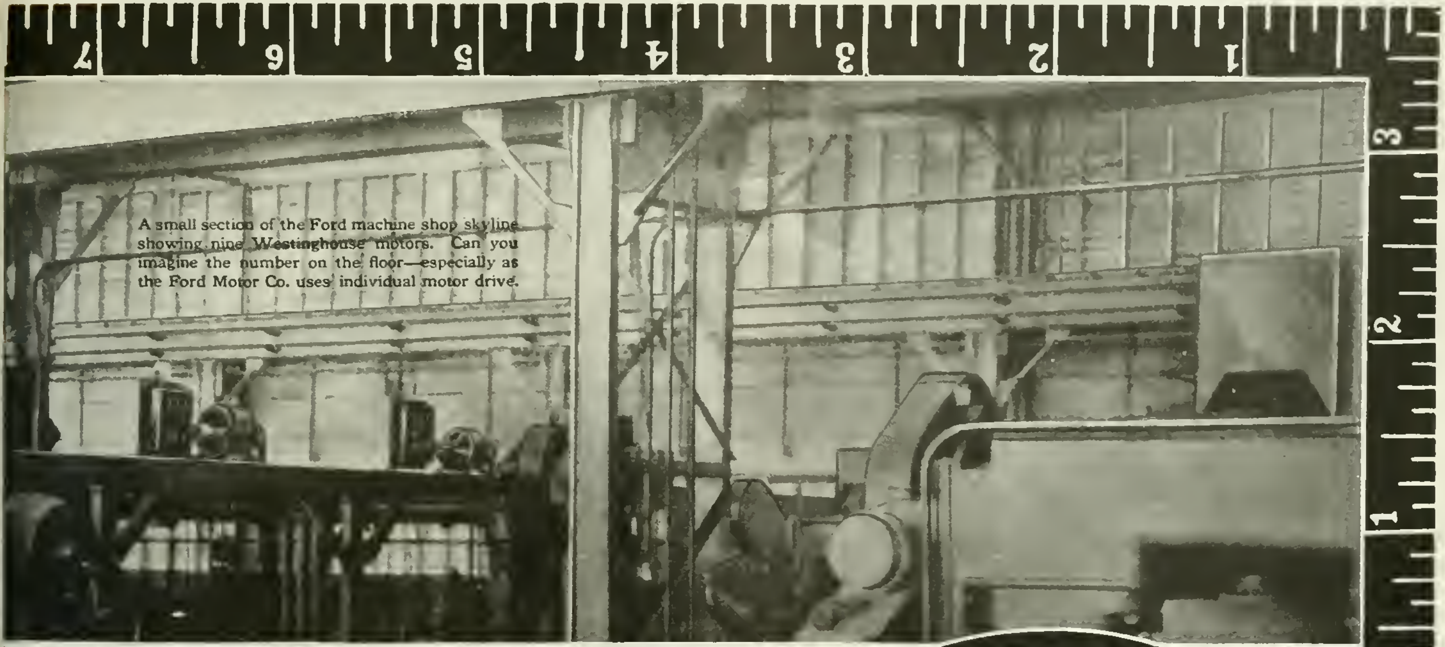
Every inch tool

Westinghouse Type SK direct-current commutating-pole motors represent the most advanced design in direct-current machines for general, constant and adjustable-speed power purposes. They are especially suitable for driving machine tools where the load is frequently started, stopped and reversed. The large number of SK motor-driven machine

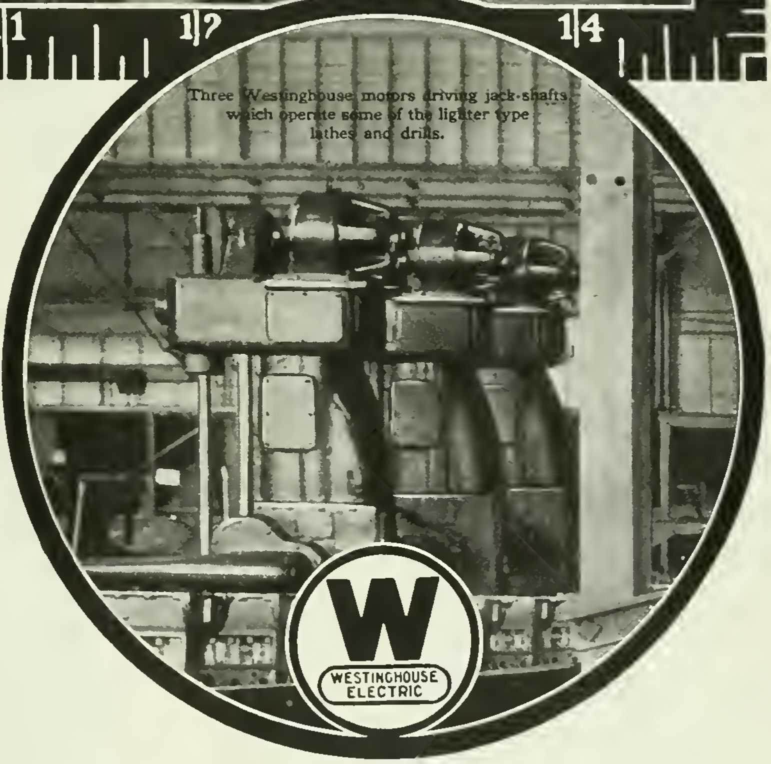
The machine shop at the River Rouge Plant of the Ford Motor Company, represents the latest Ford practice in quantity production. Complete castings for five hundred Fordson tractors are machined in this department every day. This output, however, represents only a fraction of the work handled, for all of the T-400 (Ford car cylinders) are completely machined here and shipped to Highland Park, Mich., for assembly. There are five thousand of these cylinders machined at River Rouge every twenty-four hours.

Westinghouse Electric
East Pittsburgh,

Westinghouse



A small section of the Ford machine shop skyline showing nine Westinghouse motors. Can you imagine the number on the floor—especially as the Ford Motor Co. uses individual motor drive.



Three Westinghouse motors driving jack-shafts which operate some of the lighter type lathes and drills.

a machine motor

tools throughout the country is a tribute to this type of motor. It is proof of the correctness of its design.

Some of the special features of the Westinghouse Type SK Motors are: Great mechanical strength, excellent commutation, dustproof bearings, high operating efficiency and absolute reliability at all times.

& Manufacturing Company
Pennsylvania

The huge output at Highland Park depends entirely upon the continued and uninterrupted operation of the River Rouge machine department. Hence, nothing has been left undone to provide the most efficient and reliable apparatus for performing the work. Westinghouse motors overwhelmingly predominate and are to be seen by the hundreds. These photographs indicate somewhat how thoroughly Ford output depends on Westinghouse performance.

Westinghouse

Write for Details

Three Minutes to Dry 200 Pounds

The GLOBE Tumbling Barrel, used for drying small parts at the Kelsey Wheel Company, Detroit, Mich., saves time and money on a necessary operation; it would take much longer and cost a lot more to get the same result by any other method. The ring clamps shown are loaded in lots of 200 pounds after zinc plating and three minutes' tumbling with sawdust dries them thoroughly.

Four years' service has shown GLOBE Tumbling to be convenient, efficient and profitable; the barrel is always ready for work and has never been out of order.

Polishing, Plating, Drying, Cleaning—there's a GLOBE Tumbling Barrel to get profitable results on every operation

THE GLOBE MACHINE & STAMPING COMPANY

1250 West 76th Street CLEVELAND, OHIO

Manufacturers of Metal Stampings of Quality

FOREIGN REPRESENTATIVES: J. Horstmann, 81-83 Rue Saint Maur, Paris France; 46 Rue Juliette-Recamier, Lyons, France

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Industrial
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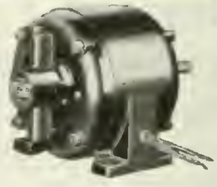
A type for every service. Bulletins on request.

THE GOULDS MANUFACTURING CO.
SENECA FALLS, N. Y.
Branches or agencies in all principal cities.

GOULDS

Interchangeable Frames



Master Motors Must Make Good

If there is one thing more than any other that has largely contributed to the general acceptance of Master Motors, it is that they are built with the viewpoint of the appliance manufacturer always in the foreground.

The interchangeability of Master frames is an example of how carefully every point has been considered. Master frames are interchangeable and the base dimensions are uniform for D. C. and A. C. of the same horsepower ratings. Many parts are also interchangeable.

If you buy motors or design electrically driven products, you will find our Data Book full to the brim with helpful suggestions. Write for it and other literature today.

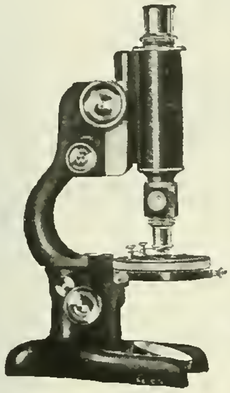
THE MASTER ELECTRIC CO., 448-1st St., Dayton, O.

MASTER

40° GUARANTEED MOTORS 40°

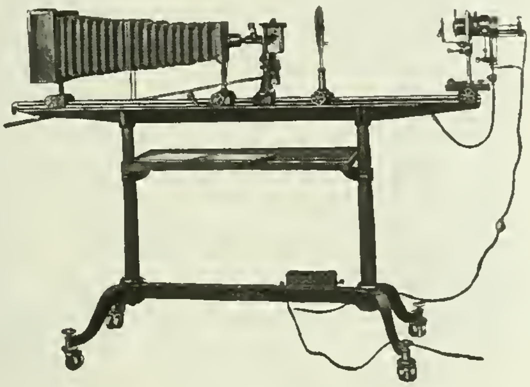
Repulsion-Induction 1/8 to 1½ H.P. *Polyphase Direct Current*

Bausch & Lomb Optical Apparatus for Inspection

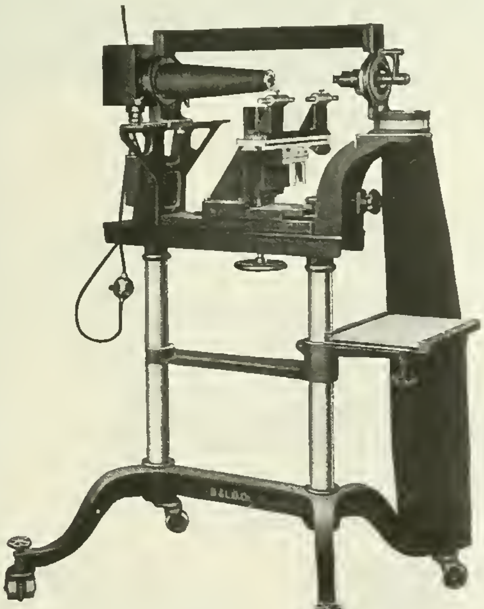


Metallurgical Microscope

Binocular Microscope



Photomicrographic Apparatus



Contour Measuring Projector

BAUSCH & LOMB OPTICAL CO.
Rochester, N. Y.
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Optics in Industry

IN the development of modern industry, the inspection and test of materials used in manufacture—and of the finished product—have assumed great importance. For finality of conclusion and accuracy of result, optical tests are certainly the most satisfactory.

Chemical tests may show the correct proportion of the ingredients, in iron or steel for instance, but the only way in which the condition or physical structure can be determined is by an optical examination. This is true with many other materials, also.

THE MICROSCOPE—Revealing defects and imperfections visible only in a greatly magnified image.

PHOTOMICROGRAPHIC APPARATUS—For making permanent photographic records of the findings of the microscope; called Metallographic Apparatus when designed for photography of metals.

CONTOUR MEASURING PROJECTOR—Invaluable for the visual inspection or check of the contours of screw threads, gears, cutting tools, and the like.

Our Scientific and Technical Bureaus will be glad to suggest ways in which you can better your inspections by the application of optical instruments.

Makers of Microscopes, Photomicrographic Apparatus, Projection Apparatus, Binoculars, Telescopes, Ophthalmic Lenses, and Other High-grade Optical Products.

AIRCO

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ANYTHING AND EVERYTHING
FOR OXYACETYLENE WELDING AND CUTTING

SERVICE

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Public faith in a product is a reflection of faithful performance. Thus, consistently, have Airco Oxygen and Airco Acetylene built up good-will.

Write for Airco booklet:
"Anything and Everything for Oxyacetylene Welding and Cutting"

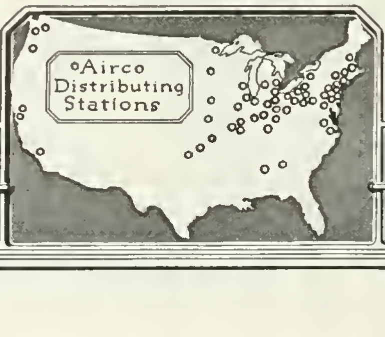
AIR REDUCTION SALES COMPANY

Manufacturer of Airco Oxygen — Airco Acetylene — Airco-Davis-Bournonville Welding and Cutting Apparatus and Supplies, Acetylene Generators, and Specially Designed Machines for Automatic Welding and Cutting— Nitrogen, Argon and other Airco Atmospheric Gas Products

Controls the manufacture and sale of National Carbide

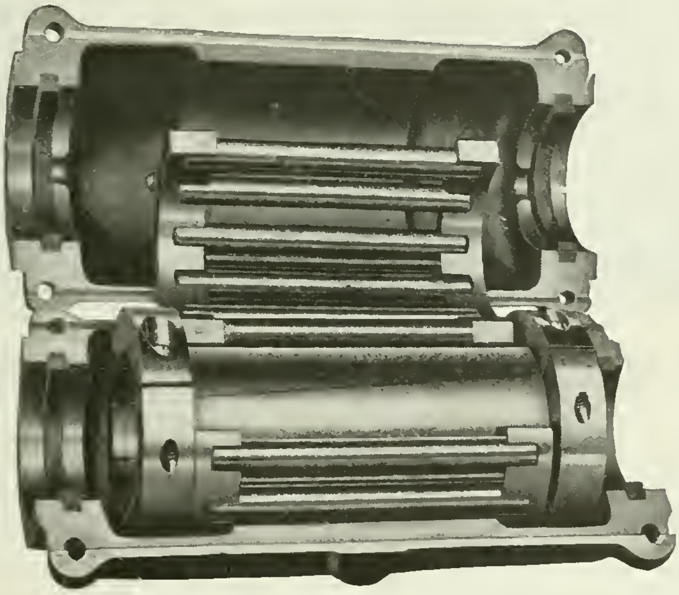
Home Office: 342 Madison Avenue, New York, N.Y.

Airco District Offices, Plants and Distributing Stations conveniently located throughout the Country.



"Airco Oxygen and Acetylene Service is Good Service"

7,000
Sells Bearings in the Dodge Plant



American Agricultural Chemical Company has installed Sells Bearings in its 25 plants.

United Shoe Machinery Company uses Sells Roller Bearings

So do

French, Shriner & Urner and the Borden Condensed Milk Company

also

The American Car and Foundry Company

and

Aunt Jemima Mills Company and the Gillette Safety Razor Company.

We could continue this list until we had mentioned thousands of concerns

—all using
Sells Roller Bearings.

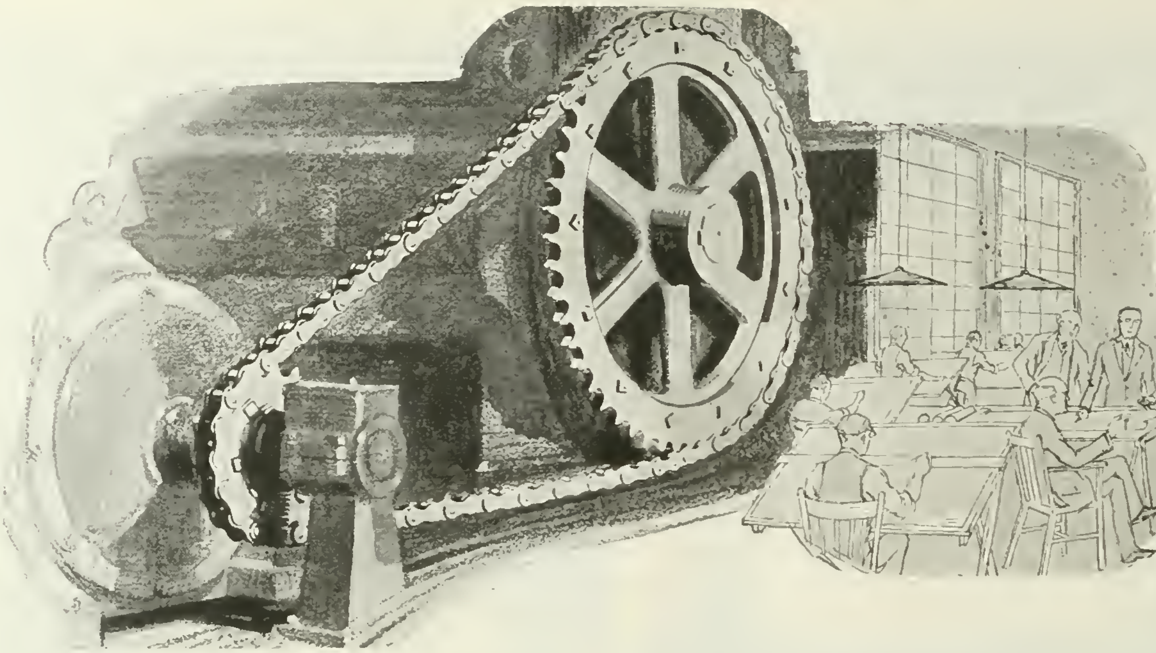
If you, too, are ready to begin saving coal or power we'll be glad to tell you how little it will cost to install Sells Roller Bearings with the patented sleeve in your plant.

Shall we send our booklet "Anti-Friction Power Transmission"?

Royersford Foundry & Machine Company
54 N. 5th Street
PHILADELPHIA

SELLS *Roller Bearings*

And see that you get the Sells; it's marked. The bearing that is past any experimentation.



Baldwin Chain Drives and Sprockets Turn the Wheels of Industry

Steel Roller Chain.

Steel Block Chain.

Malleable Detachable Chain.

New Steel Replacement Series.

Sprockets both Cut and Cast.

Baldwin Transmission Engineers will help you select the standard system best suited to your needs or will develop special drives to meet them.

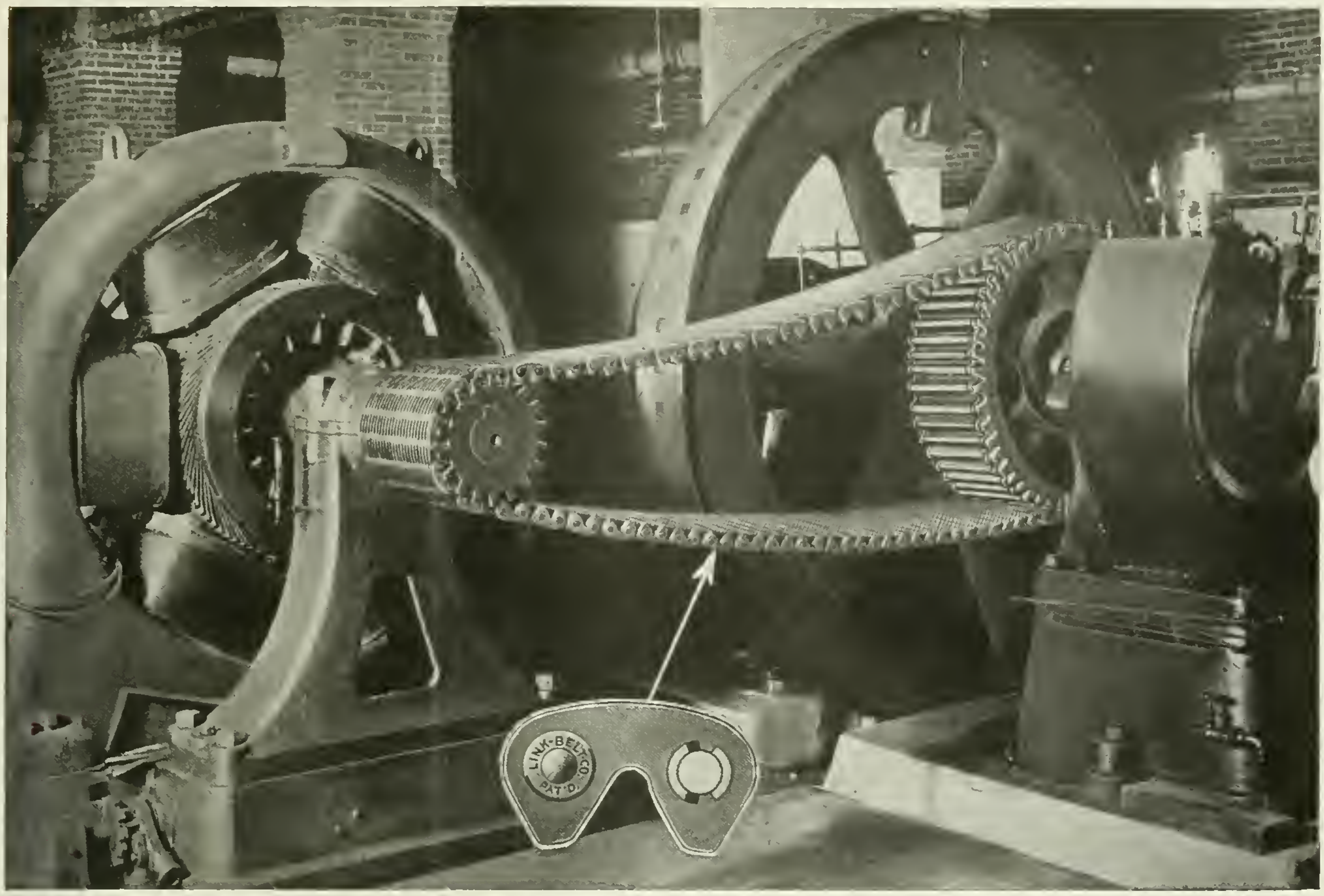
Baldwin Roller Chains and Sprockets solve transmission and conveying problems in practically every major industry. Experience has shown that special chains must be furnished to meet unusual conditions. We study each problem separately, carefully taking into consideration all varying conditions of loads, shocks, distances between centers, etc. Lumber, steel, paper, cement, textile mills, etc., secure continuous production with minimum power waste by using the *right* Baldwin Drive.

Dependable service cuts production costs, long wearing qualities reduce replacement charges to almost nothing.

BALDWIN CHAIN & MFG. COMPANY

WORCESTER, MASS.

H. V. GREENWOOD, General Western Representative
Peoples Gas Building, Chicago, Ill.



Since 1903—20 years ago—

this Link-Belt Silent Chain Drive has been operating an air compressor at the La Salle St. Station, Chicago.

This drive has required less than $5.00 repair per year.

It is still good for many years economical service—even though an air compressor is a comparatively difficult thing to drive. Such is the service rendered by Link-Belt Silent Chain Drives.

Learn more about this effective, quiet, drive for all kinds of machinery and lineshafting. Send for our 144-page price-list data book No. 125. It is a handbook of silent chain practice. Return the coupon.

LINK-BELT COMPANY

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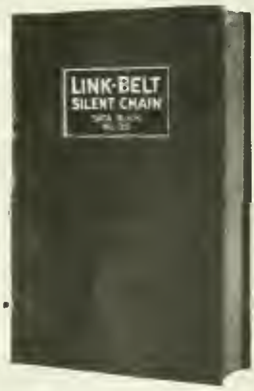
H. W CALDWELL & SON CO., CHICAGO NEW YORK, Woolworth Bldg. DALLAS, TEXAS, 709 Main St.



LINK-BELT COMPANY
910 S. MICHIGAN AVENUE. CHICAGO

Please send postpaid—Link-Belt Silent Chain Data Book No. 125.

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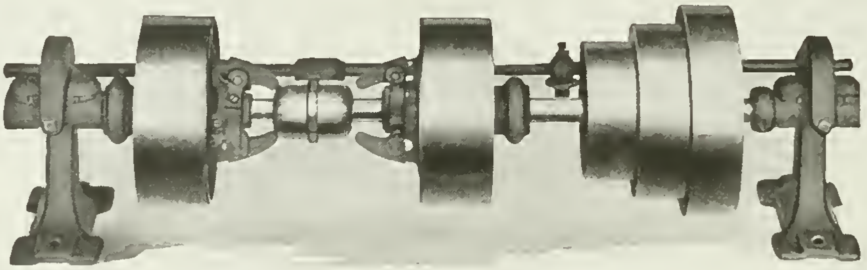
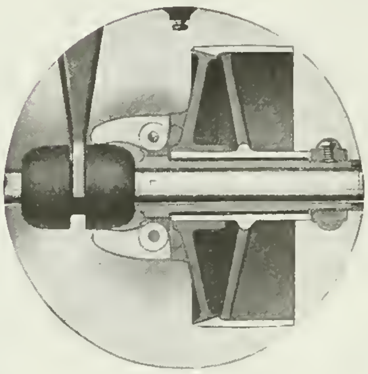
Machinery, N. Y.—1259

LINK-BELT
SILENT CHAIN DRIVES

Bardons & Oliver Friction Countershafts

Endorsed by 20 Years' Successful Performances





Seven Sizes—Two and Three Speeds

Are your countershafts all doing their full duty? If not, look up the countershafts in the B & O section and check up their records as compared with the rest. If you haven't any in your factory drop in on one of your neighbors who has. Get his opinion and size them up for yourself.

We're satisfied to have B & O Countershafts judged by their performances—they've been making good for 20 years.

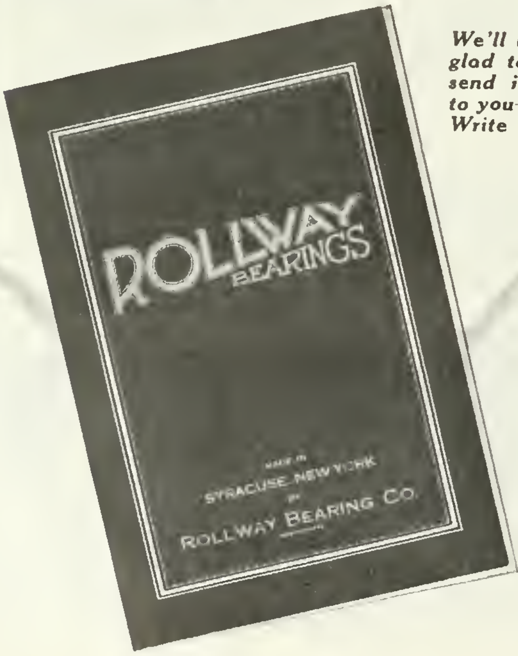
Circular outlines their main features of superiority and describes the seven sizes—7″ to 18″—sold complete or in parts. Write for it today.

BARDONS & OLIVER
of **Cleveland, Ohio**

All About
ROLLWAY
Maximum Type
Bearings
in this
New Catalog

A bigger, more complete catalog—you'll want a copy if you use anti-friction bearings or if you need bearings for particularly severe duty. Contains many facts and figures for designers and engineers.

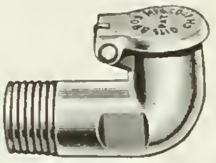
ROLLWAY BEARING COMPANY, INC., Syracuse, New York



ROLLWAY BEARINGS

MADE IN SYRACUSE NEW YORK BY ROLLWAY BEARING CO.

We'll be glad to send it to you—Write

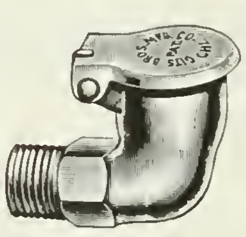


Style "L"

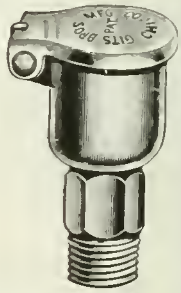
Style "Q"

Style "B"

Style "G"



Style "U"



Style "A"

GITS OIL CUPS

Give perfect satisfaction where others fail. State style and size in which you are interested, and we will send free sample and catalog.

Gits Bros. Manufacturing Company
1901 S. Kilbourne Avenue CHICAGO, ILLINOIS

THE TEXACO LINE

Texaco Lubricants are carefully prepared to meet practical conditions and each lubricant is carefully tested in many plants before it is marketed for the purpose intended.

TEXACO MACHINE OILS
TEXACO CUTTING OILS
TEXACO SOLUBLE OILS
TEXACO THUBAN COMPOUND
For light fast-running enclosed gears

TEXACO CRATER COMPOUND
A heavy mineral lubricant for lubricating heavy gears, wire rope, chains, etc.

TEXACO CUP GREASES
TEXACO MOTOR AND GENERATOR LUBRICANTS
TEXACO TURBINE OILS
TEXACO ENGINE OILS
TEXACO CYLINDER OILS
A grade for every condition of heat, pressure, character of water, speed, etc.

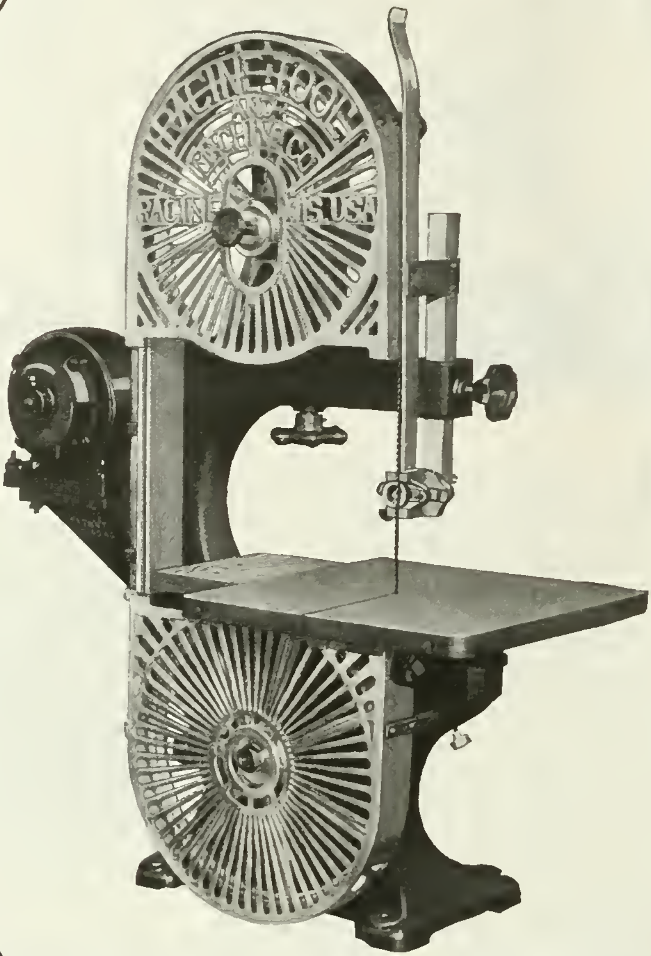
In short, we can furnish you with a scientifically correct lubricant that will increase the operating efficiency of any of your machines or power units.

These lubricants are in use in numbers of the most carefully operated machine shops and power plants not only in this country, but throughout the world.

We shall be glad, at all times, to answer any question relating to the use or application of lubricants, and we would thank you to address inquiries to our nearest district office.

THE TEXAS COMPANY, U. S. A.
Texaco Petroleum Products
Dept. F, 17 Battery Place, New York City

Atlanta
Boston
Billings
Chicago
Dallas
Denver
El Paso
Houston
Jacksonville
New Orleans
New York
Norfolk
Oklahoma City
Philadelphia
Pittsburgh



A Two and One-half Mile Cut Through Brass with ONE Saw Blade —and the Blade is Still Running

More than 40,000 pieces of 1¼″ brass tubing have been cut with one saw blade and the blade is still good—a wonderful testimony to the smooth, vibrationless operation of the

RACINE DUPLEX BAND SAW

The Racine Duplex Band Saw is an accurate, rugged, practical machine tool designed by experts in metal cutting machinery. Ball-bearing mounted wheels, spring tension, and convenient adjustment for truing wheels add to the life of the blades and assure better production. Speed changes and special design fit it to handle wood, soft metals or steel. Compactly built with individual motor drive —can be located at the point most convenient to the work.

Use "Racine" H. S. Wood and Metal Band Saw Blades.

Bulletin giving complete details on request.

Racine Tool & Machine Co.
250 15th Street Racine, Wis., U.S.A.
"STANDARD THE WORLD OVER"

"RACINE" High Speed Metal Cutting Machines

Make Blade Last Ten Times Longer

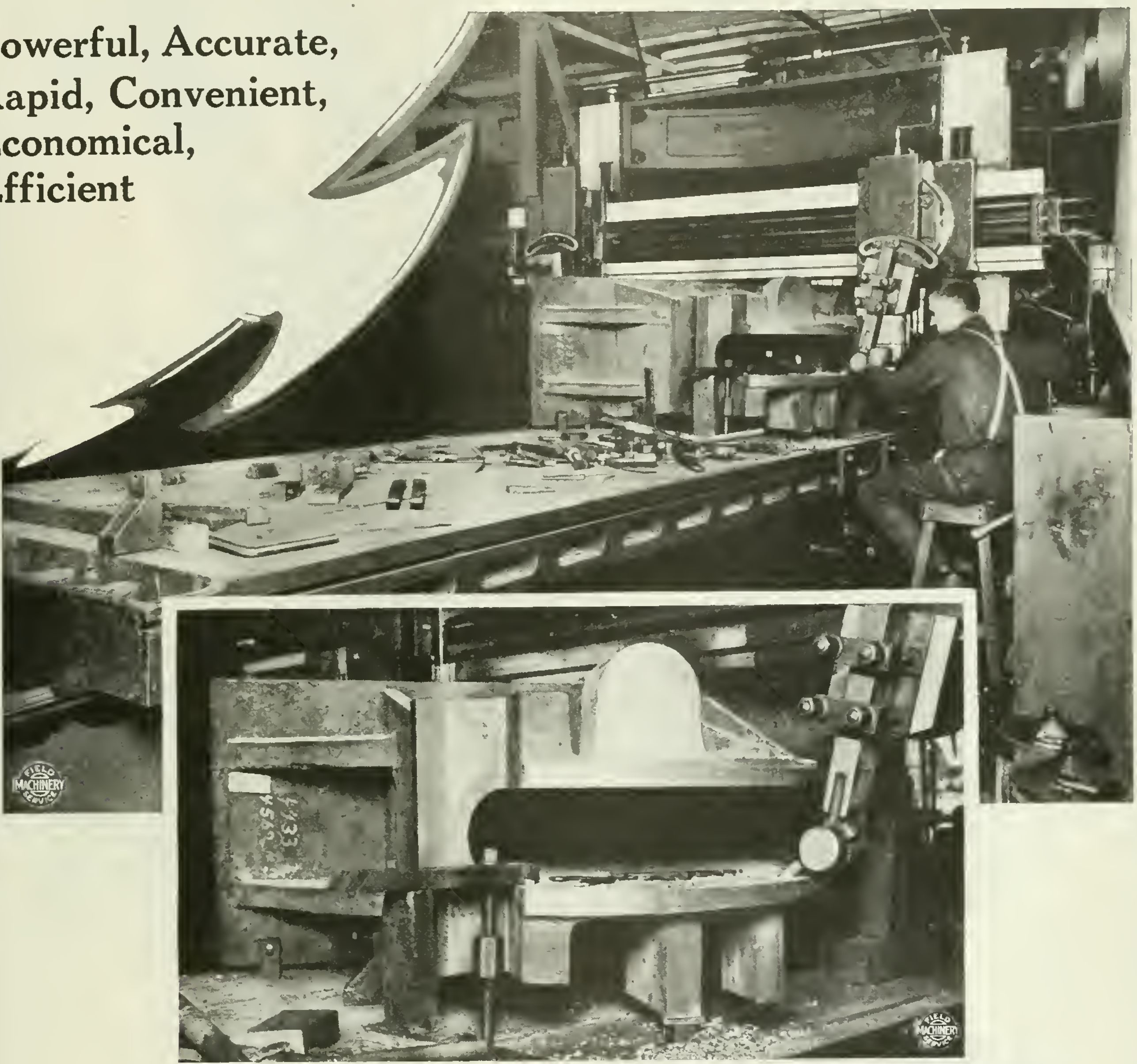
—saw lifts positively on every return stroke —cuts on draw stroke only. Blades last ten times longer, work is smoother and more accurate.

Send for complete bulletin and sample, cut from 5½″ bar that shows quality of work.

Use "Racine" H. S. Tungsten Power and Hand Hack Saw Blades.

ROCKFORD PLANERS

**Powerful, Accurate,
Rapid, Convenient,
Economical,
Efficient**



In the Toledo, Ohio, plant of the City Machine & Tool Company this Rockford Planer, 72″ x 48″ x 18′, is rendering a high degree of service machining large tool work. It takes heavy cuts, accurately. In the picture the Rockford is shown finishing the inside portion of a steel combination blank holder and heading die for producing automobile fenders.

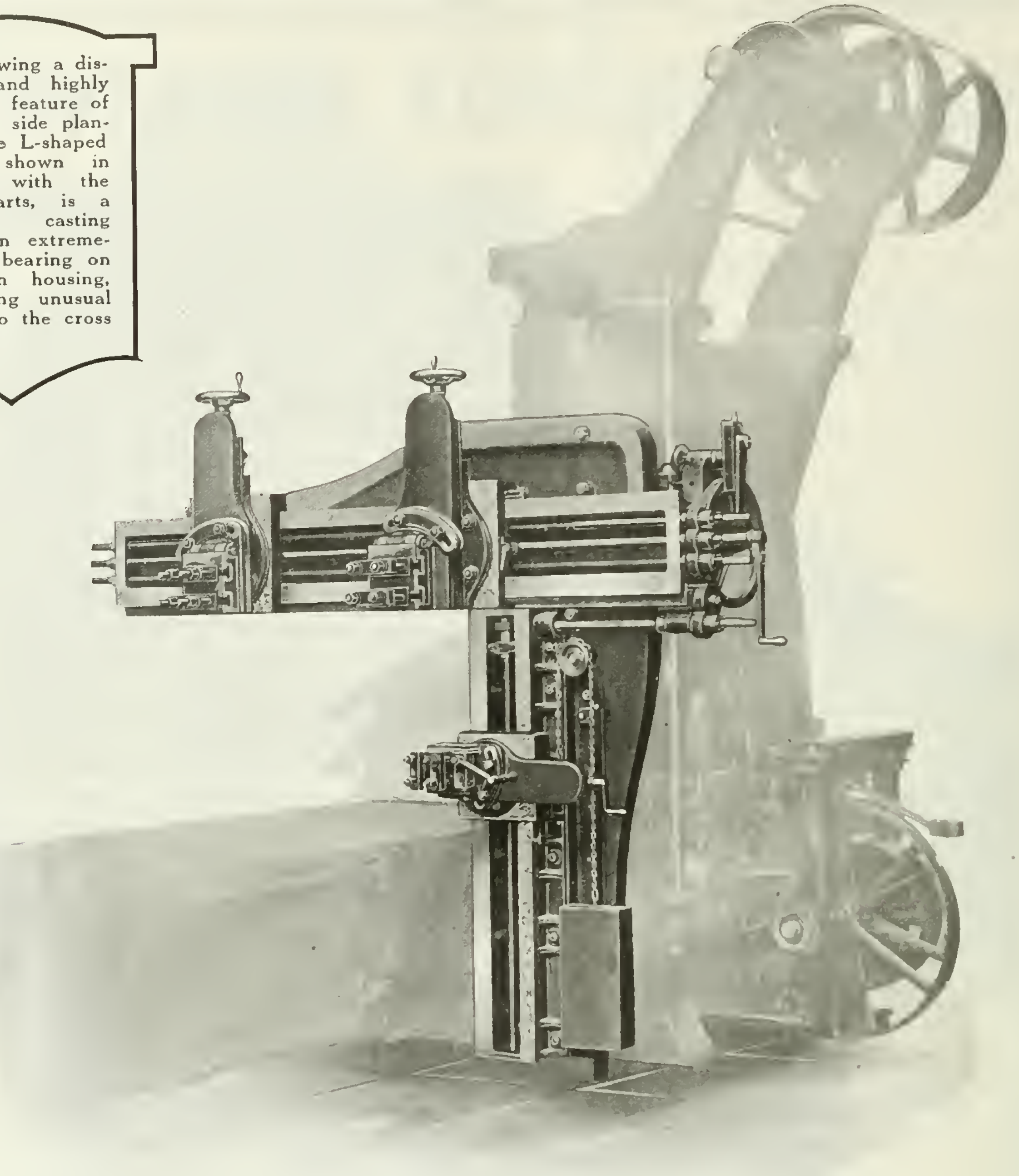
Rockford Planers are built in sizes from 24″ to 54″, any length and any desired head equipment. It will be well worth your while to get posted on Rockford Planers and the work they do.

Send for the Catalog

ROCKFORD MACHINE TOOL COMPANY

Kishwaukee Road **ROCKFORD, ILL., U. S. A.**

SHAPERS—PLANERS—DRILLS



View showing a distinctive and highly important feature of our open side planers. The L-shaped casting, shown in contrast with the other parts, is a one-piece casting having an extremely large bearing on the main housing, and giving unusual rigidity to the cross rail.

An Important Feature in Detrick & Harvey Open Side Planers

BETHLEHEM Detrick & Harvey Open Side Planers are noted for a feature in design that is of greatest importance in giving satisfactory service over long periods.

A fundamental requirement of planer construction is rigidity in the cross rail and "squareness" with housing and table. This is particularly so in the open side type of planer in which the outer end of cross rail has no housing bearing, and depends for stiffness on cross rail strength and bearing of inner end on housing.

With cross rails having limited or small bearing area on housing, wear occurs, with consequent chattering while working and loss of alignment with bed and table.

How the distinctive Bethlehem Detrick & Harvey feature overcomes these difficulties is explained in our Catalog P-1.

Examples of Bethlehem Detrick & Harvey Open Side Planers that have been in use over thirty years and are still giving excellent service is indisputable evidence that this design is superior.

BETHLEHEM STEEL COMPANY
General Offices: BETHLEHEM, PA.

BETHLEHEM

"WHITNEY"

HAND MILLING MACHINE

THOUSANDS IN USE

Note that the

"WHITNEY"

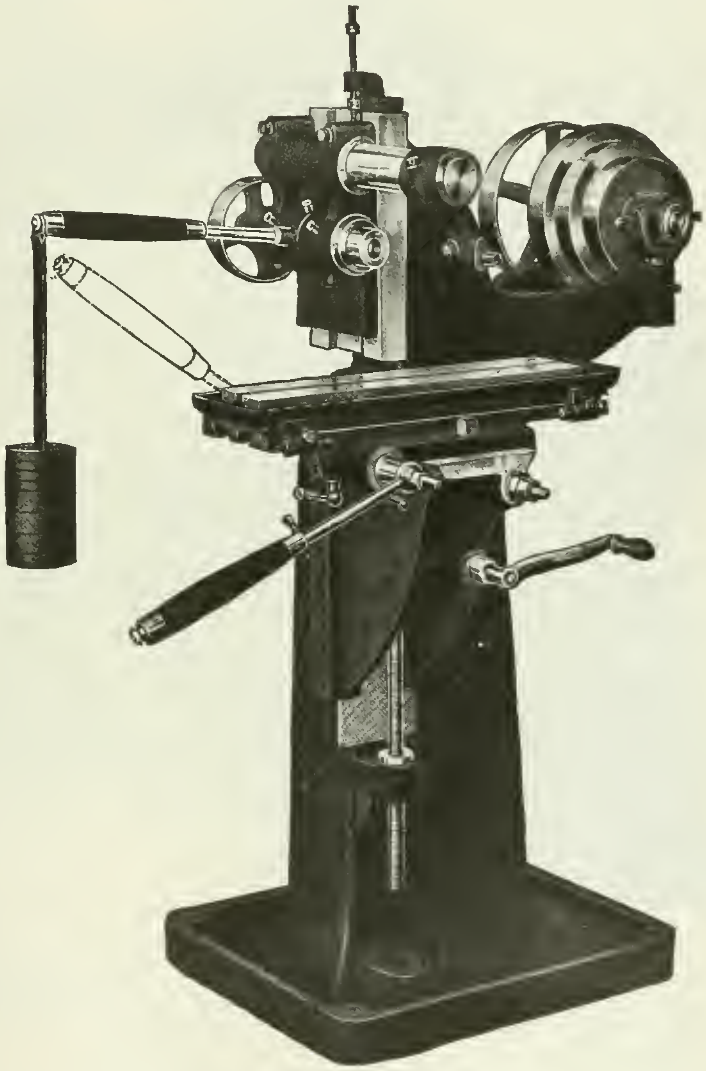
is different from the usual type of Hand Milling Machine.

The

Sliding Head

is its distinctive feature, giving advantages possessed by no other type of Hand Miller.

The spindle is driven by interchangeable side pulleys, giving six spindle speeds with three grade cone and four with two grade cone.



PROMPT DELIVERIES

THE WHITNEY MFG. COMPANY

HARTFORD, CONNECTICUT

CHAINS KEYS AND CUTTERS HAND MILLING MACHINES

NEW YORK
L. C. Biglow & Co., Inc.
243 W. 55th St.

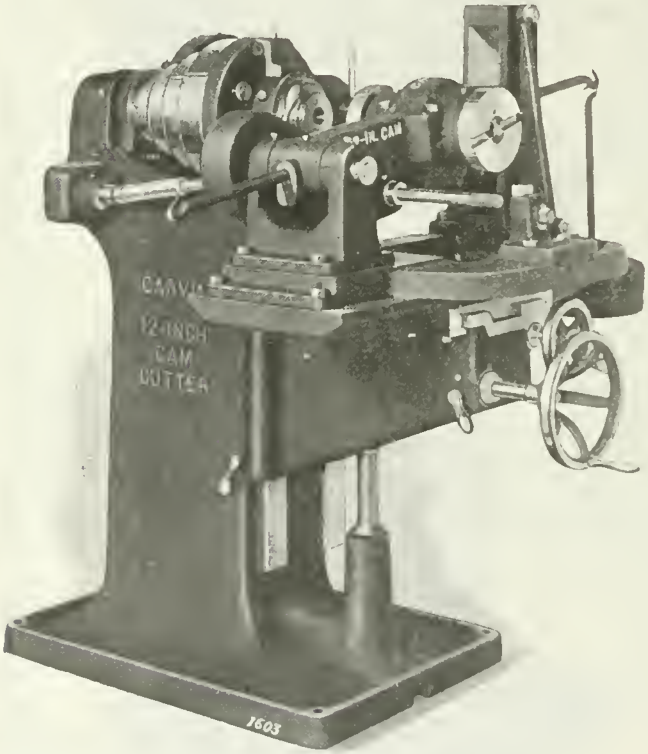
LONDON, ENG.
Burton, Griffiths & Co., Ltd.
64 Vauxhall Bridge Road

PARIS, FRANCE
Fenwick Freres & Co.
8 Rue de Rocroy

For Production

The one sure way to profits today is via the route of lowered costs. Which means just this—real production at every turn and corner.

GARVIN
Cam Cutting Machines



12" Cam Cutting Machine
Arranged for cutting face cams

Simple and Convenient to operate

It is not necessary to purchase a complicated machine to take care of your cam or form milling as GARVIN manufactures a line of Cam Cutting Machines that will meet your requirements.

Easily changed for cutting either Face or Barrel cams, and will also take care of large variety of form milling.

We will be glad to go into details with you.

THE GARVIN MACHINE COMPANY, Spring and Varick Sts. NEW YORK

Duplex Drills and Mills, Bright Internal Grinders, Tappers, Screw Machines, Screw and Die Slotters, Hand and Index Millers.

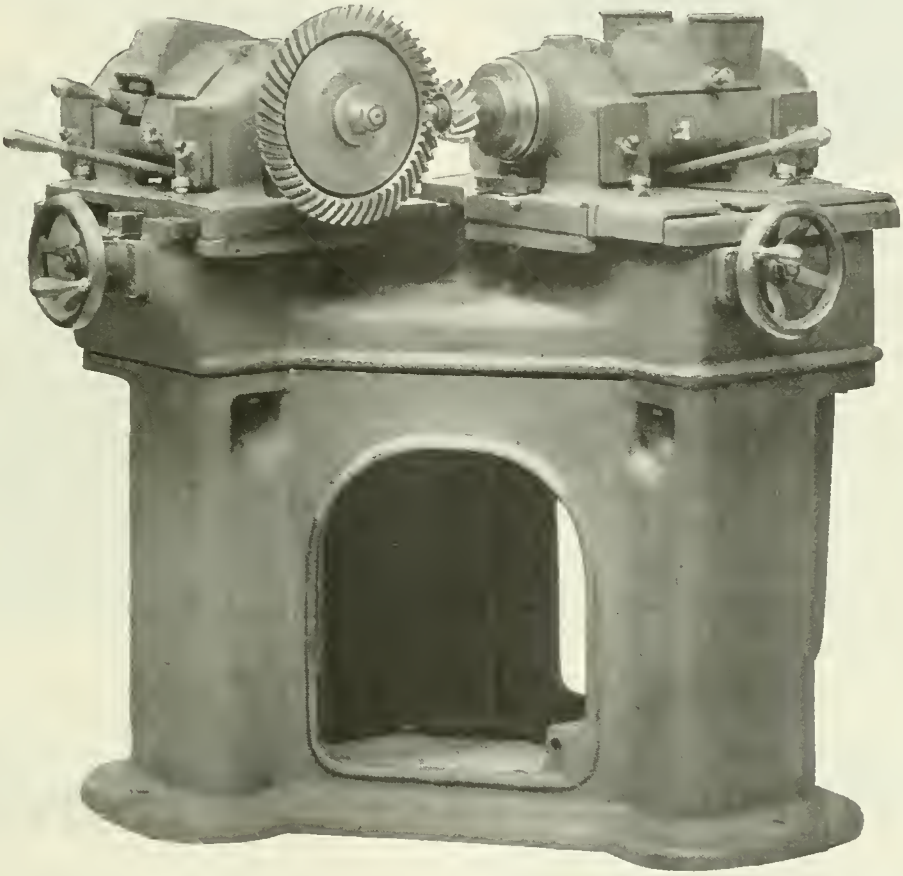
GARVIN

Spring Coilers, Production, Universal, Plain, Vertical and Slot Millers, Profilers, Cam Cutters, Bench Cutter and Surface Grinders.

GLEASON

BEVEL GEAR TESTING MACHINE

NEW DESIGN



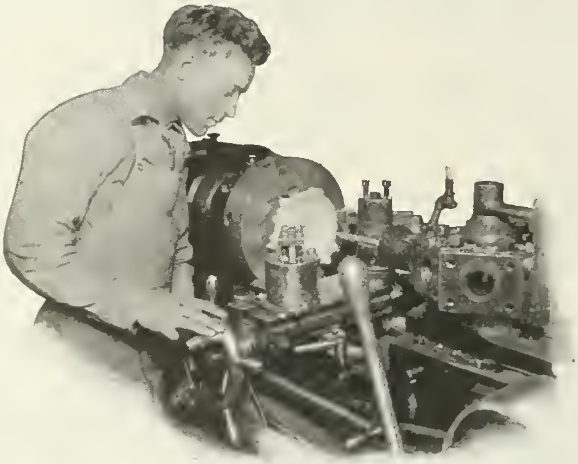
18" Bevel Gear Testing Machine

The machine used for testing the running qualities of Bevel or Spiral Bevel Gears must be rigid, unchanging in alignment, and convenient to operate.

This New Design 18-inch Bevel Gear Testing Machine is built with hardened and ground spindles running in adjustable taper bronze bearings lubricated by continuous flow of oil. The compensating locking lever brings both binder bolts to equal tension with one motion of hand lever.

GLEASON WORKS, Rochester, N.Y.

MACHINISTS OR WRESTLERS?



Are your Turret Lathe operators devoting their entire time to the production of finished pieces or are they wasting precious moments wrestling with machines that are difficult to operate?

Motions wasted are moments lost!

Wasted labor means lost production. It means a higher cost for getting things done.

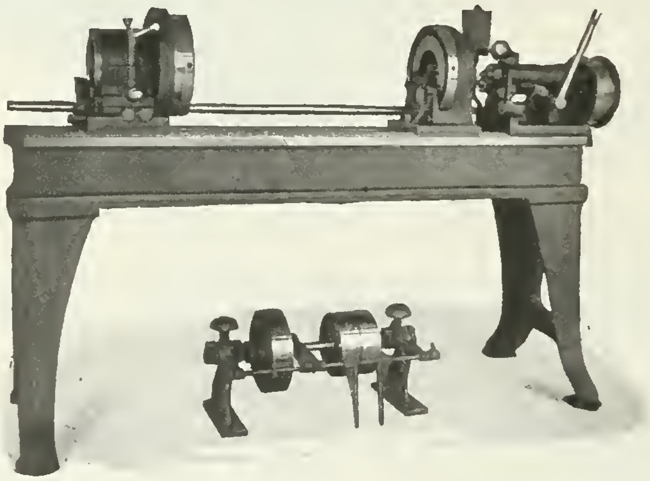
Millholland Turret Lathes Are Notably Easy to Operate!

TURRET
MILLHOLLAND
LATHES

MILLHOLLAND MACHINE CO.

1102 West 23rd Street, Indianapolis, Ind.
New York Office: 2 Rector St., Room 433

THE WHITON
Revolving Centering Machine



For Accurately Centering Finished Shafts

The cut shows new *Revolving Centering Machine*—a large size of the well-known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machines and embodies all the special features.

Circulars and prices sent upon application.

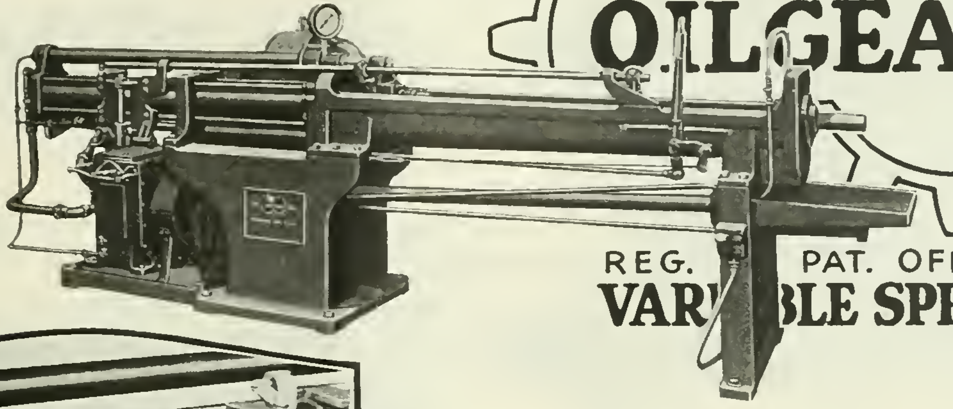
THE D. E. WHITON MACHINE COMPANY

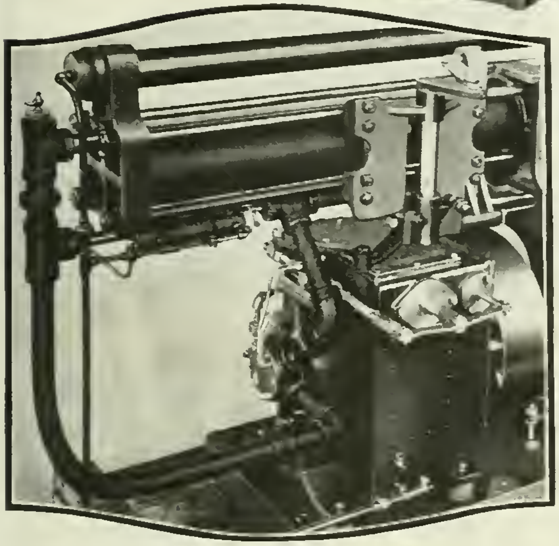
NEW LONDON, CONNECTICUT, U. S. A.

OILGEAR

REG. PAT. OFFICE

VAR BLE SPEED





Broaching vs. Reaming

Broaching round holes has heretofore never been considered feasible because of the excessive upkeep cost of the broaches. Reaming has been the only alternative. With the Oilgear High Speed Broaching Machine, manufacturers are now demonstrating to their complete satisfaction that broaching round holes is entirely practicable.

One manufacturer, a builder of a nationally advertised motor car, has been getting on his Oilgear Broaching Machine (in steel) an average of

3600 Draws Before Regrinding

as against 400 draws on screw-driven machines.

The success of the Oilgear High Speed Broaching Machine is due to the following facts:—

1—High cutting speed—30 feet per minute maximum.

2—Safety control prevents breakage of broaches (Oilgear control can be set to stop the machine when pull is excessive—no overrunning.)

3—Entire absence of mechanical shock to broaches.

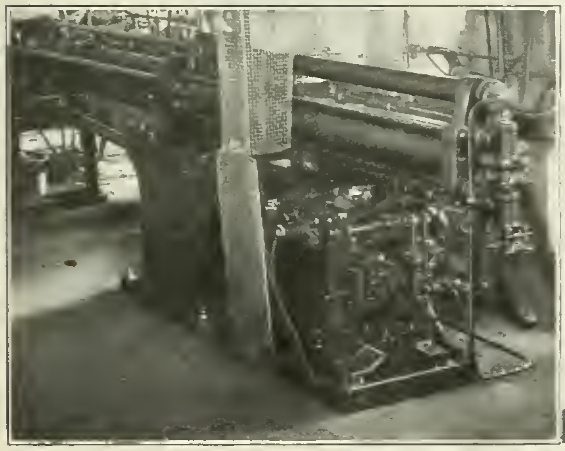
4—No twisting of broaches possible.

We'll be glad to demonstrate just what an Oilgear High Speed Broaching Machine will do on your work. Drop us a line if you are interested and we'll do the rest.

The Oilgear Pump

on the Oilgear High Speed Broaching Machine is fool-proof. It has no valves and no packing—nothing to get out of order. The only upkeep required for year-in and year-out service consists in checking the oil supply once every three months.

The illustration below shows an Oilgear High Speed Broaching Machine that is being used for broaching 5/8-inch round holes. The manufacturer finds that he gets a better job than he formerly obtained by reaming, that the broach cost is less than the reamer cost, and that the production is just as great.

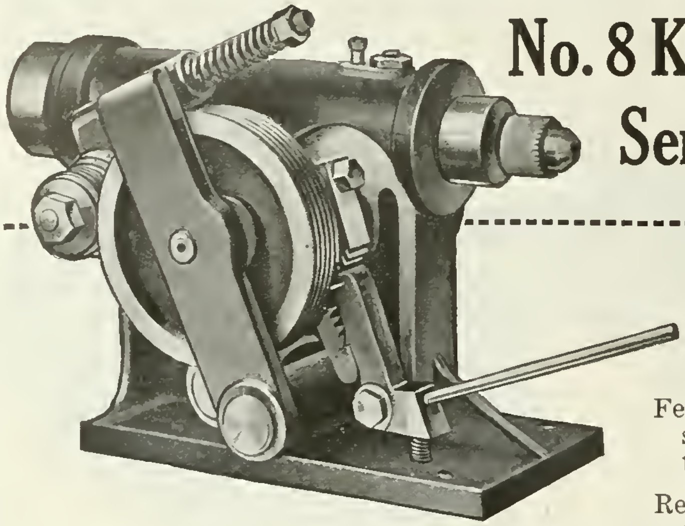


THE OILGEAR COMPANY

Manufacturers of Broaching Machines, Hydraulic Presses, Variable Delivery Pumps, and Variable Speed Drives.

64—27th Street, MILWAUKEE, WISCONSIN

BUFFALO: Buffalo Machinery Sales Corporation, 833 Ellicott Square. CHICAGO: Federal Machinery Sales Co., 12 N. Jefferson St. CLEVELAND: Cleveland Duplex Machinery Co., Inc., 1224 W. 6th St. DETROIT: Donald Clute, 428 East Jefferson Ave. INDIANAPOLIS: F. C. Litchfield, 1024 Hume-Mansur Bldg. PITTSBURGH: Laughlin-Barney Machinery Co., Union Trust Bldg. NEW YORK: Russell, Holbrook & Henderson, Inc., 30 Church St. ST. LOUIS: Elliott & Stephens Machinery Co., 721 Olive St.



Patented May 31, 1921

No. 8 Kingsbury Automatic Sensitive Drill Head

High Speed—
Uniform Pressure Feed
Automatic Spindle Control

Feed varied from .011″ to 0 depending on resistance encountered by drill, consequently the machine operates at high efficiency.

Relieving cams can be furnished to duplicate the motions of a skilled operator, on difficult drilling jobs.

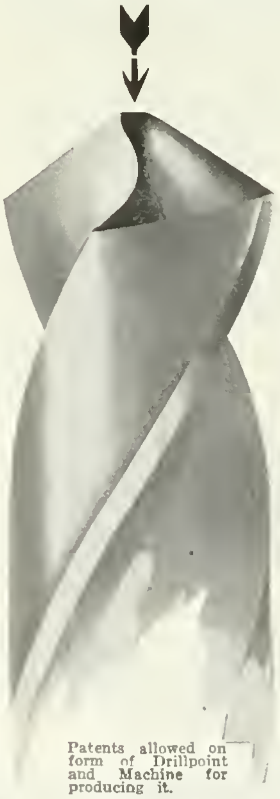
This drill head serves as a nucleous in the design of semi and full automatic universal and single purpose drilling machines that meet the demands of modern production.

We are prepared to furnish hopper feeds, indexing fixtures, for from 1 to 5 spindles, automatic clamping fixtures, etc. We also carry in stock various stands for vertical and horizontal mounting of the drill heads. Let us figure on suitable equipment for your work.

KINGSBURY MFG. COMPANY, Keene, New Hampshire

Represented by: Neff, Kohlbusch & Bissell, Inc., Chicago. Russell, Holbrook & Henderson, Inc., New York. Purinton & Smith, Hartford, Conn.

"Theoretically Correct" Drillpoints Automatically Produced on the Oliver Drillpointer



Patents allowed on form of Drillpoint and Machine for producing it.

They increase production by greatly increasing the number of holes per grind.

Drill close to size.

Double the life of your drills.

Reduce thrust nearly 50%, cutting down power bills and eliminating drill press repairs.

Save price of machine in short time.

Send us some drills to grind and let us prove it.

AN OLIVER OF ADRIAN PRODUCT

Oliver Instrument Company

1410 East Maumee Street
ADRIAN, MICHIGAN

New York Branch:
139 Lafayette St.,
Tel., Canal 3982
C. D. PROCTOR
District Sales Representative

SOCIETE GENEVOISE

Circular Dividing Machines

(Made in Switzerland)

Supplied in the following capacities and accuracies.

Cat. No.	Max. Diam. of Work Inches	Guaranteed Accuracy Seconds of Arc
0066	9⅜	±15 to 20
0067	22½	± 6
0082	26	± 6
0083	26	± 2
0062	38½	± 4
0064	38½	± 2
0064A	38½	± 1
0090	78	±15
0091	264	—

Write for Prices

THE R. Y. FERNER COMPANY

U. S. Representatives

1410 H. St., N. W. Washington, D. C.

Bruno Slotting Attachment

$25.00

Converts Your Shaper into a $1000.00 Slotter

Standard Cutting Tools $1.50 Each

H. A. MOORE CO.
ROCHESTER N. Y., U. S. A.

ANDERSON Balancing Ways

Always Level,

Always Ready

They are made in the following sizes

Swing	Greatest Distance Between Standards	Capacity in Lbs
20 in.	20 in.	1,000
40 "	30 "	2,000
60 "	30 "	2,000
72 "	66 "	5,000
96 "	88 "	10,000

Ball bearing construction; chilled iron disks ground true and accurately balanced. Write for prices.

Manufactured by
ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET
ROCKFORD ILLINOIS

Snyder "G & A" Stud Driver

This tool drives the stud as tight as specifications require. The slightest back turn and the grip on the threads is released instantly. Made of high grade alloy steel, assuring service and durability. Either hand type, taper, square or hexagon shanks.

SNYDER MANUFACTURING COMPANY
850 Lafayette Blvd. W., DETROIT, MICH.

Buhr PATENT

Multiple Drill Heads

Increase the range and productivity of your single spindle drilling machines without increasing operating costs. 3 to 12 spindles. Write us for details.

NELSON-BLANCK MFG. CO., Detroit, Mich.

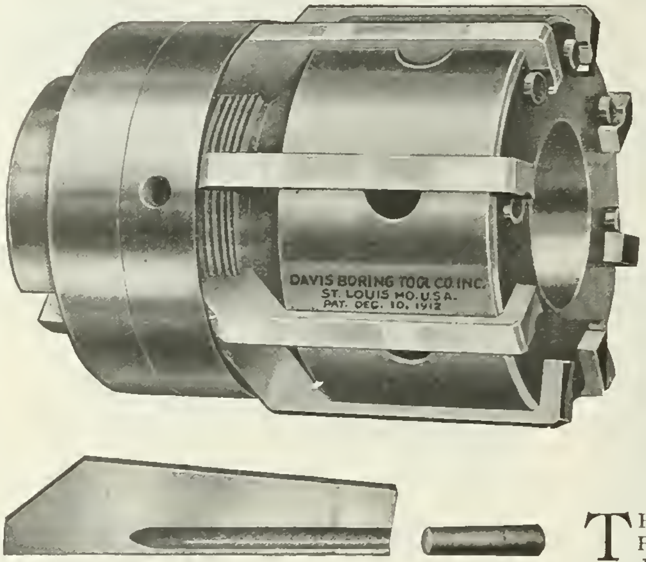
Chesterfield Cutting Metal is a new alloy of rare promise. It is non-corrosive, non-magnetic, extremely hard and retains its cutting edge when red hot—a cutting metal of unparalleled superiority.

Chesterfield Metal is a strictly metallic alloy—an ideal cutting metal for high speed work in cast iron and soft steel. It has hardness combined with toughness that enables it to hold the finest edge even under the most severe conditions.

Chesterfield Metal comes ready for use, cast to shape, which eliminates annealing and tempering; it merely requires grinding to be ready for the machine. It can be ground on either a dry or flooded wheel.

If you are interested in lowering cutting costs write for more information to the Chesterfield Metal Company, 261 St. Aubin Avenue, Detroit, Michigan.

WE SUPPLY THE WORLD WITH EXPANSION BORING TOOLS AND EXPANSION REAMERS



Davis Expansion Reamers

PATENTED 1912

This reamer is primarily intended for those plants where a moderate-priced tool is required to maintain a uniformly high production.

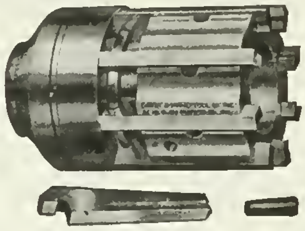
SHELL TYPE
GROUP II—No. 550

THE unlimited possibilities that Davis Expansion Reamers offer for increasing and improving production should interest those who endeavor to maintain maximum efficiency in their reaming production.

Davis Expansion Reamers rank supreme—they have no equal for efficiency, economy or production. They are designed on correct engineering principles that provide for greater range of expansion, full blade utility and quick, accurate adjustment. Their simple construction and ease of operation make them popular with the men who use them, and their low cost, economy and ability to produce, appeals to executives and owners who are anxious to obtain best results.

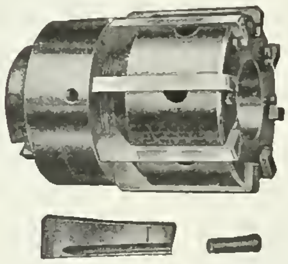
Expansion of blades is uniformly forward and outward on taper—thus eliminating circular grinding entirely when adjusting; while the ends of the blades always project and cut in advance of reamer body. Blades are held securely in reamer with hardened and ground taper pins that have 100 times the holding power of troublesome blade screws.

Do not experiment in your reaming production—adopt the Davis Reamer and be assured of best results at all times.



GROUP I—No. 540

A high class production reamer unequalled for maximum efficiency. Has graduated dial that controls blade movement, either forward or backward, within accurate limits of .00025 in.



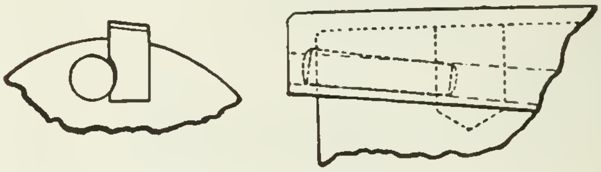
GROUP III—No. 560

A good, substantial, low-priced reamer designed for those shops where requirements are more or less limited.

Send for Descriptive Reamer Circular No. 522—Now

Davis Boring Tool Company
Incorporated
3706-22 Forest Park Boulevard
St. Louis, Missouri
Established 1903

Patented Method of Holding Blades



Blades are held in reamer with hardened and ground taper pins that are fitted, almost entirely, in reamer body at special angles that produce perfect line bearing in blade groove, for entire length of taper pin. The constant downward and lateral pressure along line of contact holds the blade rigidly, yet permits free movement of blades, backward or forward, in adjusting to required diameter.

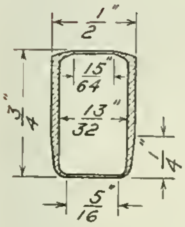
LARGEST EXCLUSIVE MANUFACTURERS OF EXPANSION BORING TOOLS AND EXPANSION REAMERS

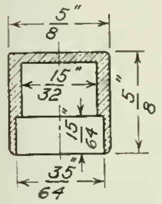
"Ledrite"

TRADE MARK

Brass Rod

It's Tested





"Bridgeport" TRADE MARK
BRASS CO. U.S.A.

Mr. Oil Cup Manufacturer Is Perfectly Satisfied

He had not always been. For years he had bought Brass Rod but always there had been some source of trouble of one kind or another. Sometimes these troubles were of a very minor character, but annoying. Sometimes he paid a premium on his rod in slowed-up machines and greater percentage of rejections.

Then he heard of Ledrite and sent a trial order. He got free-cutting brass rod which did not heat up the tools; his automatics could be run at highest efficiency; work produced was accurate. Because the rod wasn't brittle second operations were equally fast and accurate. Ledrite Brass Rod was just what this manufacturer needed, what he *knew* he needed—and his troubles are over.

Ledrite is just what its name indicates—contains exactly the right quantity of lead—is uniform—is obtainable in any quantity.

Specify Ledrite on your next order. Send for our book on Brass Rod M823.

Pershing Square Building
NEW YORK
General Motors Building
DETROIT

Bridgeport Brass Company
Bridgeport Connecticut

North American Building
PHILADELPHIA
Wrigley Building
CHICAGO

Colton-Detroit Twist Drills

It's Safe to Drive Them Hard

Drive them hard—it brings out their superior qualities. Colton-Detroit Drills are high speed—in composition and performance. They finish more holes, require fewer grindings, and give longer service than most drills. Their wide grooves prevent clogging. They're more economical—and you can prove it.

Oversize shanks furnished without extra charge if you want them

Write for prices

ARTHUR COLTON COMPANY, Detroit, Mich.
2618 Jefferson Avenue, East

REPRESENTATIVES: **Buffalo:** W. V. Houck, 730 Marine Bank Bldg. **Chicago:** H. E. Barton Tool Co., 106 South Jefferson St. **Milwaukee:** General Sales Agency, 3205 Vine Street. **New York City:** F. A. Brady, Inc., 30 Church Street. **Pittsburgh:** W. E. Nagle & Son, Jenkins Arcade Bldg. **Philadelphia:** Wenson Tool Co., 745 No. Sixty-third Street. **San Francisco:** L. G. Henes, 75 Fremont Street. **Los Angeles:** L. G. Henes, 218 East Third St. **Cincinnati:** Advance Tool Co., Canal and Jackson Streets.

"HUNTER"

PNEUMATIC HAMMER
VANADIUM STEEL

RIVET SETS

—AND—

CHISEL BLANKS

The shanks of our Rivet Sets are faced to a slight radius. This insures the piston coming in contact in line with the axis of set, increasing the effect of piston stroke on rivets, a particular advantage when hammer cylinders are worn, with a marked reduction in shank breakage. Standard chisel blanks are made from 3/4" x 9" or 7/8" x 8" octagon stock.

A full line carried in stock.

Hunter specialties include—Hot Saws, Friction Discs, Solid Blades made of Vanadium, Tungsten and Chrome Alloy Steel. Saw Sharpening Machines. Inserted Tooth Grinders. Hardened Steel Specialties. Catalog on request.

Hunter Saw & Machine Company
Pittsburgh, Pa.

"Eight years without adjustment"

" —and this Starrett 'mike' is just as accurate as the day I bought it eight years ago."

"Why shouldn't I be a Starrett booster?"

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

STARRETT TOOLS
STARRETT HACK SAWS CUT QUICKER LAST LONGER

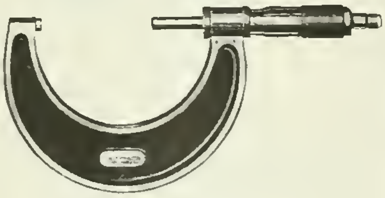
Starrett Micrometer Calipers
No. 226

Accurate gages at popular prices. Well adapted for general use as they can be set quickly for the different measurements and are easily read.

Graduated by thousandths, furnished with lock nut and supplied with or without ratchet stop as desired. Frames are drop forged from bar steel and nicely finished.

See page 172 of our Catalog No. 22D for description of No. 226 Sets. Write for copy if hardware dealer can't supply you.

Use Starrett Micrometers

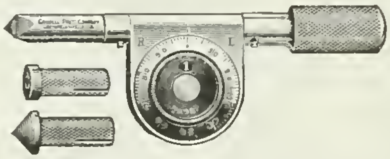


GOODELL-PRATT

1500 GOOD TOOLS

Speed Indicators

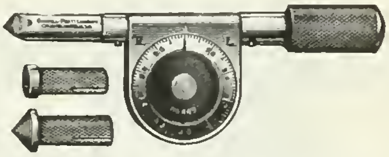
Let's look at the features that make Goodell-Pratt Speed Indicators the most desirable instruments of their kind.



No. 387 Double Dial registers to 1000 R.P.M. Price, each, $2.60.

We'll go right to the heart of the tool first and look at the gears that operate the dials. The driving gear is an accurately generated worm on the hardened steel spindle. This meshes with, and drives the hard brass gear to which the dial is attached.

The dials are plainly graduated in one direction only. This desirable improvement is made possible by the double end spindle and reversible handle.



No. 449 Double Dial registers to 100 R.P.M. Price, each, $2.20.

The cuts show the Indicators reading direct for a right hand shaft. To get the speed of a left hand shaft simply remove the handle and lock it into the other side of the neat die-cast frame.

In spite of these improvements the instrument is more compact, and the nicely knurled handle and bright nickel finish make it far pleasanter to handle.

Insist on getting Goodell-Pratt Speed Indicators.

Goodell-Pratt Company

Toolsmiths

GREENFIELD, MASS., U. S. A.

"Yes, Ford Talking— George Ford"

"You want to know how I used up those Taper Shank Drills with the tangs broken off?"

"Why, don't you know about the Wahlstrom Quick Change Chuck made for this very purpose? You change drills without stopping machine, and using up two or three drills with broken tangs pays for the chuck."

"Ask Wahlstrom to send you one on 10 days' trial. They'll do it."

Wahlstrom Tool Co.
5520 Second Avenue
BROOKLYN N. Y.

Your Tapping Costs

"Drives by the Square"

"Centers by the Shank"

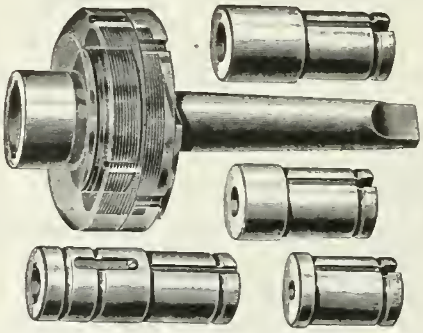
Largely depend upon the style of Tap Drive you use. "WEAR-EVER" TAP CHUCKS are distinctive for simplicity and effectiveness in reducing tap breakage and operation costs.

Why not apply this saving in your plant?

SCULLY-JONES & CO.
Tool Division
13th and Robey Sts.
CHICAGO, ILL.

Speed Up Your Tapping

With B. & S. Safety Holder



You can drive taps at full speed to the bottoms of holes without fear of breakage. Tap driver stops instantly under excess torsion.

There's no lost motion—tool changes can be made without stopping spindle.

Five sizes. Taps to 2½" diameter.

Try one.

The Beaman & Smith Co., PROVIDENCE Rhode Island

"THE SIMPLEST DIE THAT OPENS"

The Only Die that Opens and Closes while Rotating

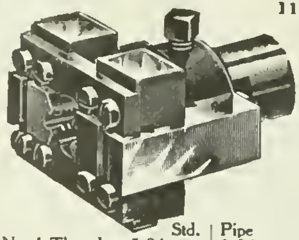
CUTS PARALLEL THREAD TO SHOULDER

SKELETON FRAME
CHIP-PROOF AND FOOL-PROOF

The Only Universally Automatic Die; can be closed While Rotating; opens automatically either by Center-Stop, Shoulder-Stop, or Stop on Machine for any Exact Length of work.

Can be used on Drill Press, Speed Lathe, Engine Lathe, Turret Lathe.

SAVES TIME, CUTS COSTS, AND DOES BETTER WORK



	Std.	Pipe
No. 1	Threads to 5-8 in.	3-8 in.
No. 2	" " 1 in.	3-4 in.
No. 3	" " 1 1-2 in.	1 in.
No. 4	" " 2 in.	1 1-2 in.
No. 5	" " 2½ in.	2 in.

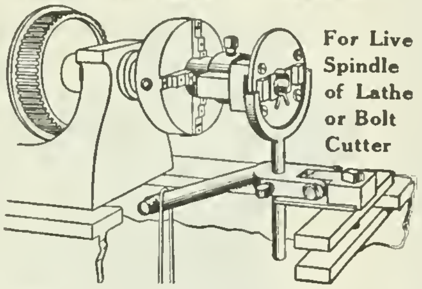
ERRINGTON

Main Office: Broadway and John St., N. Y.
Phone Cortlandt 3149

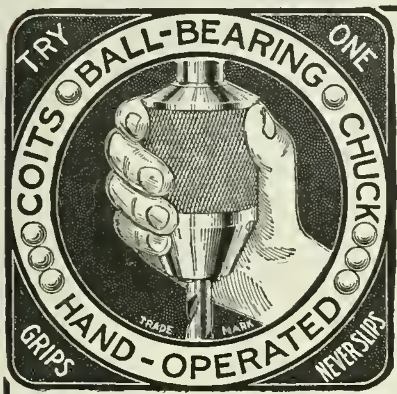
Chicago Office:
113 N. Desplaines Street

Boston Office:
830 Old South Building

Catalog Francais; Edgar Bloxham, Paris, 12 Rue de Delta



For Live Spindle of Lathe or Bolt Cutter



The Chuck That Never Slips.

The More You Crowd It,

The Tighter It Grips.

NARRAGANSETT MACHINE CO.
PROVIDENCE, R. I., U. S. A.

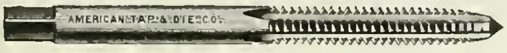
Almond PRODUCTS

Geared Drill Chucks	Right Angle Transmission
Standard Drill Chucks	Flexible Arms
Independent Lathe Chucks	Flexible Tubing
Geared Scroll Lathe Chucks	Micrometers
Combination Lathe Chucks	Fine Mechanical Tools

Illustrative Descriptive Bulletins Mailed upon Request

T. R. ALMOND MFG. CO., Ashburnham, Mass.

AMERICAN



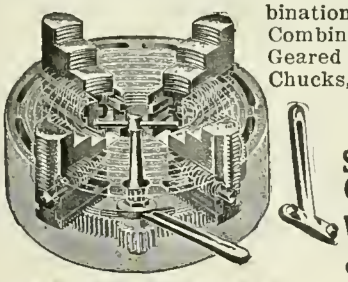
TAPS—DIES—SCREW PLATES—REAMERS

Let us quote on your next order.

American Tap & Die Co., Greenfield, Mass.

If you want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting - off Chucks.



Spur Geared Scroll Combination Lathe Chuck

Strongest Grip, Greatest Capacity
Great Durability and Accuracy

WESTCOTT CHUCK CO.
ONEIDA, N. Y., U. S. A.
Ask for Catalogue

For Multiple Drilling on Close Centers

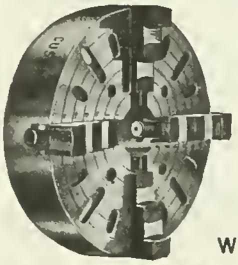
Trump Drill Chucks are time and labor saving conveniences for multiple spindle machines. They drill holes up to 3/8″ diameter and on centers down to 5/8″.

Have only three parts, are hardened, finely finished and low in price. Can be used with all standard quick change drill chucks. Sizes No. 1, 0″ to 1/8″; No. 2, 0″ to 1/4″; No. 3, 0″ to 3/8″.

Shipments made from stock.
Send for trial order.

Trump Brothers Machine Co.
Wilmington Delaware, U. S. A.

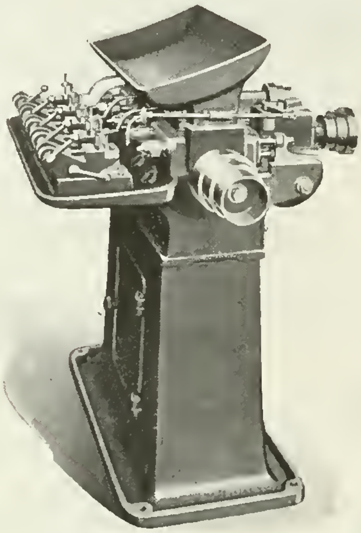
CUSHMAN CHUCKS



4 Jaw Independent Type
"*The Incomparable*"
also
Self-Centering (Geared Scroll Type)
2 Jaw Lathe Chucks
"The Hartford" Drill Chucks

WRITE US FOR BOOKLET "*The Incomparable*"

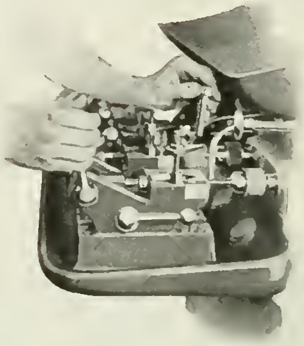
THE CUSHMAN CHUCK CO. HARTFORD, CONN., U.S.A.



DETROIT
Semi-Automatic Five Spindle Drilling Machines

A machine designed for the definite purpose of drilling small holes in small work as accurately and speedily as possible; a drill that takes a considerable range of work within certain limits and that fully meets the needs of modern manufacturing conditions.

The circular says, "The workmanship in the Detroit Semi-Automatic Drilling Machine is of the very best" and that includes, of course, the accessories with which it is equipped.



DETROIT MACHINE TOOL COMPANY
TIME FLIES
USE IT RIGHT
HIGH PRODUCTION MACHINERY

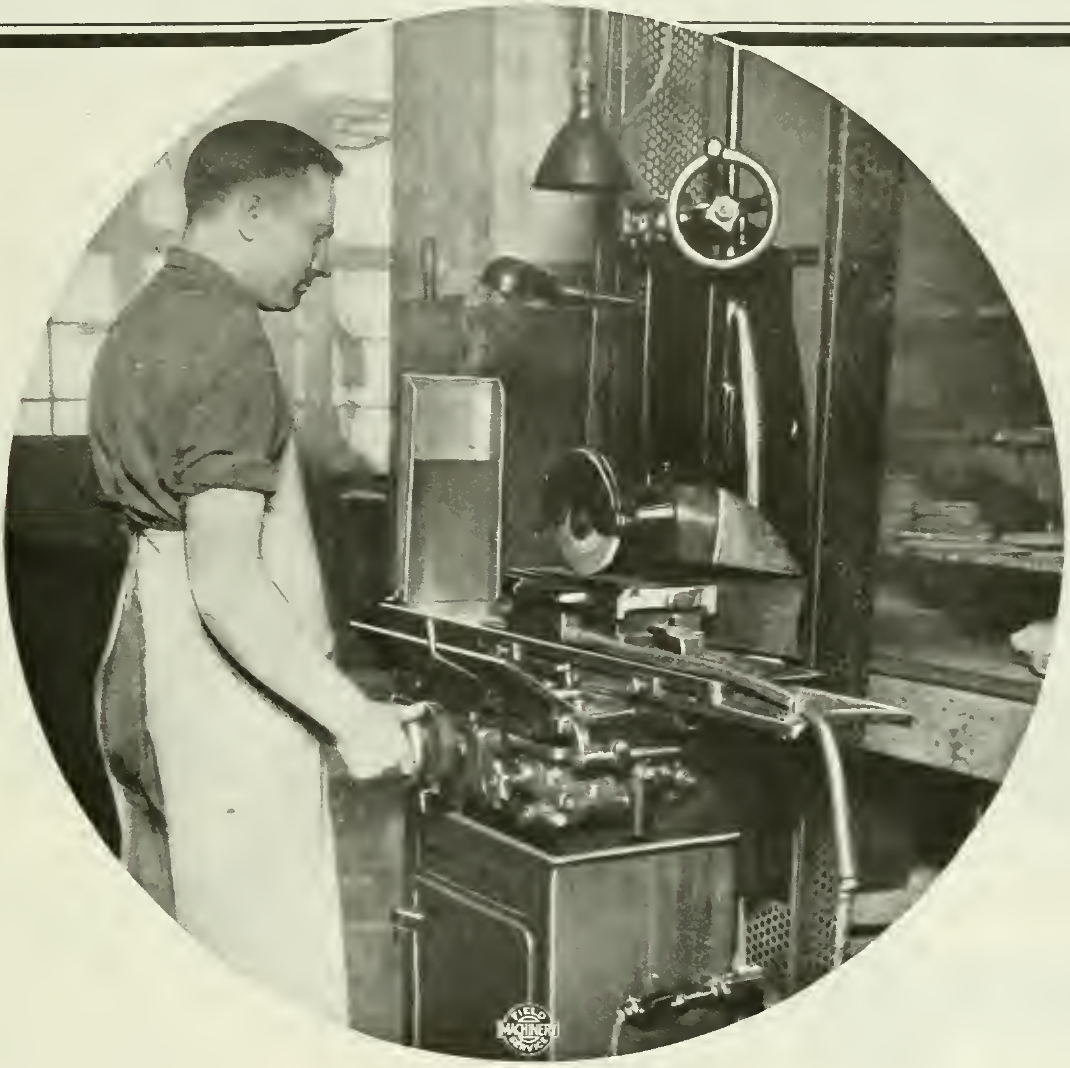
Detroit Semi-Automatic Five Spindle Drilling Machines are Regularly Equipped with

Jacobs Chucks

Good Mechanics Work Better With Good Tools

This advertisement is published in the interests of good Drilling Equipment by the makers of the Jacobs Chuck

WALKER MAGNETIC CHUCKS



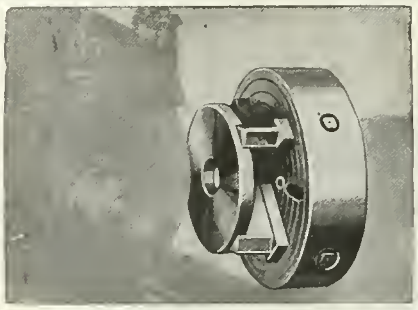
Fine Finishing on a Production Basis

The limits are so close on these mold blades for type casting machines, that the work is inspected on a comparator measuring to ten thousandths (no perceptible variation is passed) and the corners are inspected for sharpness with a magnifying glass. That the work is on a profitable production basis in spite of this is due to the Walker Magnetic Chuck; the parts are loaded 14 at a time and .0035″ of metal is removed in seven grinds.

How else would you hold such parts without strain or distortion; how else could you chuck them *quickly* and *easily* as well as accurately?

Old users say, "Walker Magnetic Chucks are the best way to chuck most work, the *only* way to chuck some of it." Let us tell you all about them.

O. S. WALKER CO., Inc., Worcester, Mass., U.S.A.



T. M.

GRINDING MACHINE CHUCKS

This type of chuck was designed and perfected for use on grinding machines. The slots in the face are less exposed than usual; hence, the operating screws that move the jaws are well protected from emery dust.

The patented two-piece reversible jaws can easily be reversed without removing the jaw body. Strong, dependable, accurate.

Illustrated literature and catalogue upon request.

THE SKINNER CHUCK COMPANY

NEW BRITIAN, CONN. U. S. A.
ESTABLISHED 1887

New York Office:
94 Reade St.

Chicago Office:
552 West Washington Blvd.

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915 Broadway

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London Office:
139 Queen Victoria St., E. C. 4

SWEETLAND CHUCKS

If Limited to One Chuck—

Style No. 40 would serve your needs, 4-Jaw combination: hardened steel jaws, interchangeable and reversible; easy to operate; sizes 6" to 24" in 3" steps; to 42" in 6" steps.

Catalog 13-C tells about it. Write for a copy.

THE HOGGSON & PETTIS MFG. CO.
New Haven Connecticut, U. S. A.

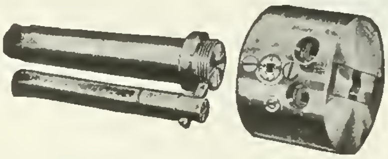
"LOGAN"

Air-Operated Chucks and Labor-Saving Devices

Increase Operating Efficiency, and Production Capacity. "LOGAN" Complete Equipment to meet every Chucking or Holding requirement. Try one for thirty days at our expense. Send for Catalog R-15.

THE LOGANSPORT MACHINE CO.
529 Market Street Logansport, Indiana, U. S. A.

For Economy in Precision Boring



Flynn Micrometer Off-Set Boring Heads

Think of the convenience and the time you can save on jig, fixture and experimental work by having a boring tool so fixed that you can advance it by thousandths, plainly indicated on an easily read dial, with the same wrench which turns the screws which open and lock the jaws.

Heads run concentric with minimum overhang and no projections to interfere in close quarters.

Let us tell you more about it.

J. M. WATERSTON, 425 Woodward Ave.
DETROIT, MICH.

Lavoie Air Chucks

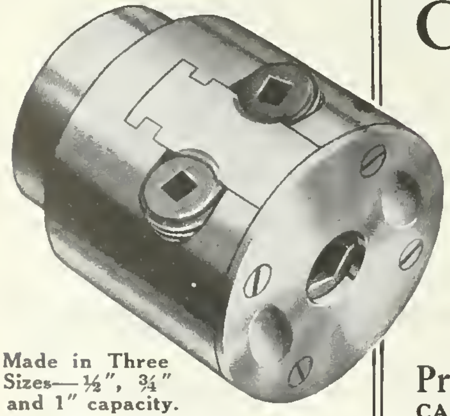
See them in operation; note the small number of parts, the simplicity of operation. No objectionable cylinder at rear of spindle; only a single line of piping required.

The Frontier Chuck and Tool Co., Inc.
30 Letchworth St. BUFFALO, N. Y.

TITAN QUICK CHANGE DRILL CHUCKS AND COLLETS

TITAN TOOL CO. Erie, Pa., U. S. A.

Detroit, Mich.: E. H. Welker Company, 222 West Larned Street. Chicago, Ill.: Rickert-Shafer Co., 117 N. Jefferson St. Cincinnati, Ohio: C. M. Bigger & Co., 414 Elm St. Cleveland, Ohio: Rickert-Shafer Co., 380 Rockefeller Bldg. Indianapolis, Ind.: Indiana Tool Service Co., 321 Occidental Bldg. New York: Rickert-Shafer Co., 50 Church St. Boston: Rickert-Shafer Co., 755 Boylston St. Philadelphia: Normoyle & Lapp, 514 Liberty Bldg.



Made in Three Sizes—½", ¾" and 1" capacity.

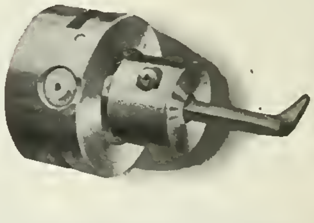
CASLER TOOLS

The surest way to determine exactly how much time and trouble Casler Twin Screw Drill Chucks and Off-Set Boring Heads will save in your plant and to what extent they will improve your output is to try them—preferably on your most expensive jobs.

Write for details and 30 days' free trial offer.

Production Engineering Corporation
CANASTOTA NEW YORK

The CASLER Off-Set Adjustable Boring Head.



Micrometer Adjustment to thousandths. Five sizes—½" to 1½" capacity—3/16" to ⅝" offset.

Developed and Manufactured by Thomas Elevator Co.

BARKER WRENCHLESS CHUCK

Turn Unproductive Minutes into Productive Hours—

Your machine tools—turret lathes, automatics, semi-automatics.

Only when they are *busy* do you make money. But when they stand idle—you lose.

Every machine loses a certain percentage of the day in adjustments of some kind or other. And if you could *reduce* that lost percentage—if you could gather up those minutes wasted in adjusting (chucking and changing the work), mold it into hours, then use it as *productive time*—it is not possible to reckon the days, the *weeks* you would save.

The Barker Wrenchless Chuck offers you a solution to this problem.

THOMAS ELEVATOR CO.
24 South Hoyne Ave. CHICAGO

HANNIFIN Production Tools—

Air Operated Chucks—Adjustable Boring Bars

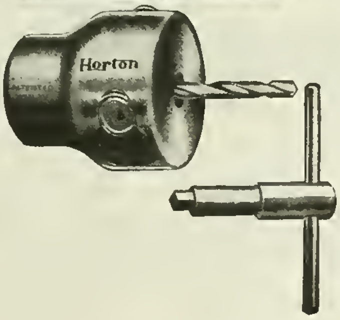
Air operated Arbor Presses, Chucks, etc.; Countershafts, Vises, Mandrels and Clamping Devices, Adjustable Boring Tools, Multiple Boring and Reaming Tools, Adjustable Reamers, Line Boring and Reaming Bars, and Cylinder Boring and Reaming Tools, Car Wheel Boring Bars.

Catalogues on Request.

Hannifin Manufacturing Co.
Lexington and Kolmar Aves. Chicago

Horton

Two-Jaw Drill Chucks

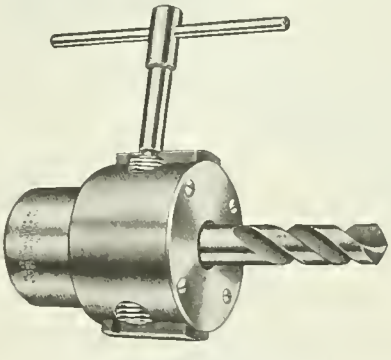


Simple—compact, two jaws, single screw, solid body. Made for hard work and severe use. Seven sizes from 0-1/4″ to 0-2″.

The E. Horton & Son Co., Windsor Locks, Conn., U. S. A.

Begin with Practical Chucks

Union Chucks are designed to economize time and are made in sizes and styles to meet every requirement. Every chuck fully guaranteed. A feature of this Positive Friction Drill Chuck is the Transverse Slot which provides for using drills with tenons. Seven sizes—0 to 2″.



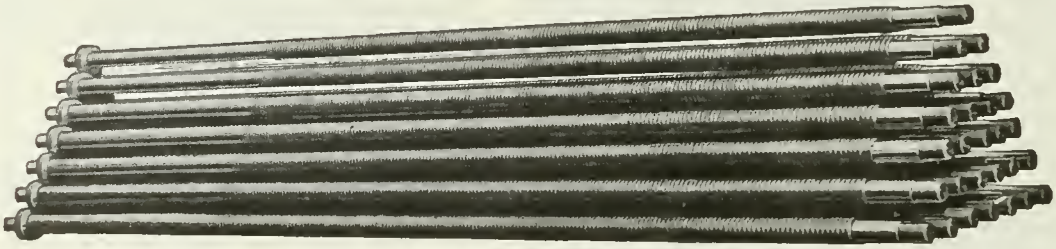
Complete line described in catalog which we will be glad to send on request

Union Manufacturing Company
New York Office
26 Cortlandt Street
New Britain, Conn., U. S. A.

Makers of a Complete Line of Chucks

Hindley Screws

To use them once is to become a Hindley customer. Hindley Screws are accurate; possess unusual strength and wearing qualities. They're guaranteed. Lead, Feed and Power.



Let us quote.

HINDLEY GEAR COMPANY
1105 Frankford Ave.
PHILADELPHIA, PA.

WHEREVER NUTS ARE TURNED TIME CAN BE SAVED BY USING THE

FAVORITE
REVERSIBLE RATCHET
WRENCH

PATENTED - GREENE TWEED & CO. N.Y.

The FAVORITE wrench does not have to be removed from the nut at every quarter turn, as required with open end wrenches, but stays on the nut until operation is completed. Its ratchet movement is quick, straight forward and positive.

BUILT STRONG FOR ROUGH USAGE

Write us for full particulars

Greene, Tweed & Co.
Sole Manufacturers
109 Duane St.
New York
Tool Department

Why H & G Die-heads Always Produce

1. Chasers are hobbed. Hobbed chasers fit the screw as a nut fits the lead screw. This is the only correct method by which accurate results can be secured.
2. H & G chasers are hobbed with Hanson Hobs. Hanson Hobs are finished after hardening, accurate in lead and thread form and perfect in finish—all of which is reproduced in the threads cut by H & G chasers.
3. The chasers are supported in the die-head by cams directly over the cutting point and cannot give under the strain of cutting.
4. The entire body and all parts of H & G Die-heads are hardened and accurately ground. Chaser slots are tested with go and no-go gauges having less than one-thousandth difference.

New 96-page Catalog

This new miniature catalog contains much valuable information relative to thread cutting in addition to a complete description of H & G Die-heads which are adaptable to all machines.

The Eastern Machine Screw Corporation
23-43 Barclay Street, New Haven, Conn.
Die-heads that Revolutionize Threading

H&G

VULCANIZED FIBRE

BE SURE AND SPECIFY

"WILMINGTON FIBRE"
SHEETS
RODS
TUBES
WASHERS, Etc.
SPECIALTIES

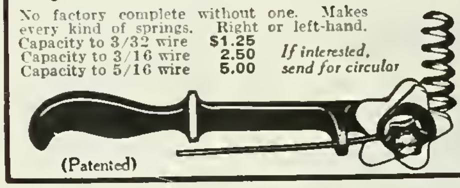
WILMINGTON FIBRE SPECIALTY CO., Wilmington, Del.
BRANCH OFFICES "EVERYWHERE"

Hjorth Perfection Spring Winder

No factory complete without one. Makes every kind of springs. Right or left-hand.

Capacity to 3/32 wire	$1.25
Capacity to 3/16 wire	2.50
Capacity to 5/16 wire	5.00

If interested, send for circular



(Patented)

Hjorth Lathe & Tool Company
10 Tremont St., Boston, Mass.
Works: Woburn, Mass.

STEEL Lupton SHELVING
In stock at INVESTMENT VALUE warehouse
PHILADELPHIA
David Lupton's Sons Co., Phila.

When you need a special machine or special tools—want unusual forgings—a line on stampings—expert advice on special machinery of any kind—consult MACHINERY'S Special Equipment Section.

GRINDERS

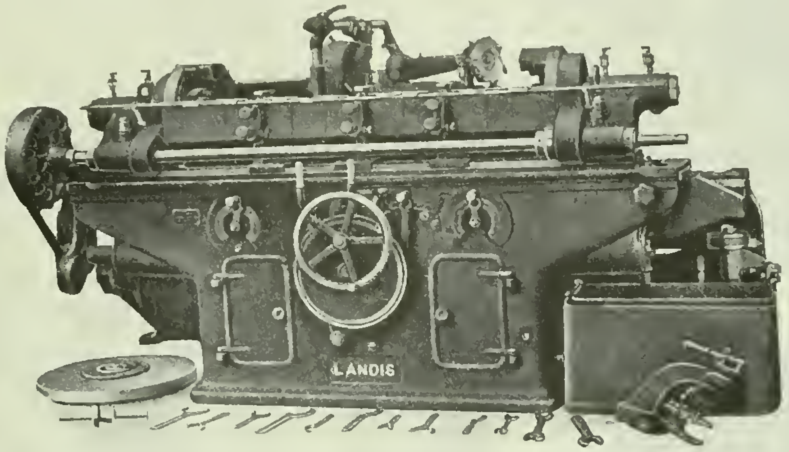
CURRENT MODELS—ATTRACTIVE PRICES

NORTON

6— 6″ x 32″ Norton, Plain.
12—10″ x 36″ Norton, Plain.
3—10″ x 72″ Norton, Plain.
1—14″ x 36″ Norton, Plain.
13—14″ x 50″ Norton, Plain.
5—14″ x 72″ Norton, Plain.
1—16″ x 72″ Norton, Plain.
1—15″ x 8′ Norton, Surface.

LANDIS

1—No. 1, 10″ x 20″ Landis, Univ.
5—12″ x 36″ Landis, Plain.
2—No. 3, 12″ x 36″ Landis, Univ.
1—12″ x 96″ Landis, Plain.
7—16″ x 48″ Landis, Crankshaft.
1—20″ x 96″ Landis, Plain.
1—20″ x 168″ Landis, Plain.



16″ x 48″ LANDIS SELF-CONTAINED CRANKSHAFT GRINDERS	**$1750**
also	
14″ x 50″ NORTON PLAIN	**$1650**
14″ x 50″ NORTON CRANKSHAFT	**$1750**

MISCELLANEOUS

1—No. 4 Gardner disc. B.B.
1—No. 6 Gardner disc. B.B.
1—No. 16 Besly Disc.
1—Modern Internal.
1—No. 10A, Bryant Internal.
2—No. 20 Bryant Internal.
1—No. 75 Heald Internal.
2—No. 22 Pratt & Whitney Vertical.
2—No. 1, 5″ x 20″ Morse, Plain.
2—No. 1, 5″ x 18″ Ott, Plain.
2—No. 2, 10″ x 30″ Fraser, Univ.
1—No. 2, 10″ x 30″ Webster & Perks
1—6″ x 20″ Fitchburg, Plain.
3—12″ x 36″ Modern, Plain.
5—12″ x 36″ Fitchburg, Plain.
1—14″ x 48″ Queen City, Plain.
1—84″ Diamond Face Guide Bar.

OUR GUARANTEE: your money back if you return machine in 30 days, freight prepaid. No excuses necessary.

HILL, CLARKE & CO. of CHICAGO

649 W. WASHINGTON BLVD.

WAR DEPARTMENT
U.S.A.
CATALOG
Q-M
SALES
WAR DEPART
Rehber 19G

As a business man—War Department sales compel your investigation

There are two sides to the Surplus Property situation:

1—The taxpayer's side of the billions of dollars in what financiers call "frozen assets."

2—The business man's (taxpayer too) side of tremendous stocks, which, if suddenly dumped on the market would cause violent price reactions.

At the beginning of 1919 the War Department faced the job of reconciling these two problems. Everyone appreciated the almost Herculean task.

Everybody was interested.

Not without mistakes but with a definiteness that accomplished the disposal of billions of dollars worth of materials at a remarkably low cost, the work of the Director of Sales Office was started.

Then a strange, but very human thing happened.

Because no load was laid on the shoulders of business, a great number of business men have never investigated the Surplus Property sales.

And this indifference has robbed many business men of the opportunity for profitably sharing in this great plan of distribution.

But it is not too late to come in—to investigate what the War Department still has to offer.

Final sales are being planned.

As taxpayers and for their own financial gain, American business men are urged to investigate the sales which are being announced—to appoint personal representatives to inspect the stocks—to carefully appraise the offerings.

You will find your Government a willing cooperator to clarify any details and assist with your investigation.

The Way to Investigate

Watch your Commercial Business Publication and the Metropolitan Dailies for announcements of specific auction or sealed bid sales.

Send for the Catalog mentioned in the announcement. Check off the items that interest you.

Send a representative to the sale to inspect the materials—in advance, *if possible.*

To ensure you more leeway, send your name and address at once to Major J. L. Frink, Chief, Sales Promotion Section, Room 2515, Munitions Building, Washington, D. C. Advise him the character of materials you are interested in, and catalogs containing such materials will be forwarded you as rapidly as sales are scheduled.

Final commodity sales will begin in September and continue until liquidation of stocks is completed at the Quartermaster Depots in Brooklyn, Chicago, San Antonio and San Francisco. Offerings include a wide range of Quartermaster Supplies, Ordnance Property and smaller quantities of Engineer Property, Chemical Warfare and Medical and Hospital Supplies.

Important sales of Real Estate, Buildings, Plants and Warehouses will be held at Camp Devens, Ayer, Mass.; Camp Dix, N. J.; Ordnance Reserve Depot, Amatol, N. J.; Camp Meade, Md.; Ordnance Reserve Depot, Toledo, O.; Camp Knox, Louisville, Ky., and Camp Lewis, American Lake, Wash. Definite dates will be announced later.

Look for the Eagle before you shop.

WAR DEPARTMENT

SECOND-HAND MACHINE TOOLS

Drills

1 spdl. Avey & Henry & Wright, ball bearing
2 apdl. Avey & Henry & Wright ball bearing
3 spdl. Avey & Allen, ball bearing
4 spdl. Avey & Allen, ball bearing
4 spdl. Avey, ball bearing, power feed
20", 25", 28", 30", 32", 36" uprights
3, 4, 5 ft. radials
D-2 Colburn mfg. drill
No. 315 Baker mfg. drill
No. 513 Baker beavy mfg. type
8 spdl. Fox multiple spindle

Lathes

9"x20" Porter Cable mfg. type
14"x6' Lodge & Sbipley, C.R., P.C.F., Q.C.
14"x6' Hendey, C.R., P.C.F., Q.C.
16"x8' Champion, C.R., P.C.F., Q.C.
16"x8' LeBlond, C.R., P.C.F., Q.C.
18"x8' Lodge & Shipley, C.R., P.C.F., Q.C., geared hd.
20"x8' American, C.R., P.C.F., Q.C.
24"x12' LeBlond, C.R., P.C.F., Q.C.
24"x22' Lodge & Shipley, C.R., P.C.F., Q.C.
38"x20' New Haven, C.R., P.C.F., Q.C.
14—28"x8' Fay & Scott, extension bed gap latha
24 46" x 10' Fay & Scott, extension bed gap latha

Boring Mills

No. 1 Lucas table typa horizontal, 3" bar
Bement-Niles R & L table type horizontal, 3⅞" bar
34" Colburn, vertical type, turret head
24" and 36" Bullard, New Era type turret head
38" and 51" Niles, 2 heads on rail
42" and 48" Colburn, 2 heads on rail
84" Betts

Screw Machines and Turret Lathes

No. 0 B. & S. Automatic
⅜", ½", ⅝", ⅞" Cleveland automatic plain, Model B
½", ⅝", ⅞", 1¼" Cleveland automatic turret, Model A
4—¼" Gridley automatic, arranged for M.D., with motor
1", 1¼", 1½" Cincinnati-Acme with wire feed
¾", 1", 1½" Pratt & Whitney, with wire feed
2¼", and 3¼" Jones & Lamson, flat turret type with both bar and chucking equipment
2¼" and 3¼" Cincinnati-Acme, flat turret type with both bar and chucking equipment
No. 1B Foster, turret type
16 W & S Fox turret type, with chasing bar
16 and 18" Cincinnati-Acme, turret type, with chasing bar

Grinders

12" x 36" Cincinnati universal
3", 6", 10" swing x 18", 32", 36", 72" long Norton, plain
10" and 12" and 30" and 120" Landis, plain
No. 2 Reed, surface type
12" x 36" Diamond, surface type
14" Pratt & Whitney vertical surface type
10" Garrigus, rotary surface typa
Nos. 1 and 1½ Cincinnati cutter and tool
No. 2 Walker cutter and Tool
Nos. 1 and 2 Norton cutter and tool
No. 2 Oakley cutter and tool
No. 60 Heald cylinder
No. 70 Heald internal
Taylor high speed water tool

Millers

Nos. 2, 3, 4 Cincinnati, plain
Nos. 2, 3, Brown & Sharpe, plain
No. 25 Becker-Brainerd, plain
Nos. 2, 3, Cincinnati, universal
No. 2 Hendey, universal
No. 2 Brown & Sharpe, universal
Nos. 2, 3, 4 Cincinnati, vertical
No. 4B, No. 5, No. 5B Becker-Brainerd, vertical
No. 2C Becker-Brainerd, vertical
No. ½ Van Norman, duplex type
No. 4 ½ x 12 Pratt & Whitoey, thread type
30" x 10' Ingersoll, slab type

Shapers and Planers

14", 16", 20", 24" Gould & Eberhardt, B.G. crank shapers
16", 20", 24" Hendey friction shapers
15" Potter & Johnston tool-room crank shapers
16" Smith & Mills, back geared crank shapers
15" Kelley crank shaper
24" x 24" x 6' Flather Planer, 1 hd.
30" x 30" x 8' Gray type Planer, 2 hds.
36" x 36" x 12' Pond Planer, 2 hds.
50" x 40" x 14' Pond Planer, 2 hds.
66" x 54" x 12' Pond Planer, 2 hds.
66" x 60" x 30' Bement Planer, 3 hds.
96" x 60" x 12' Detrick & Harvey open side, convertible type plain, 4 heads, reversible motor drive with motors.

Miscellaneous

Nos. 1, 3, 4 Lapointe broaching machines
36" Gould & Eberhardt automatic gear cutters
6" Gleason bevel gear cutter
V & O Bliss & Ferracute power presses

HENRY PRENTISS & COMPANY

149 Broadway, New York.

BOSTON BUFFALO HARTFORD SYRACUSE ROCHESTER

BORING MILLS

No. 1 Cleveland Horiz. (new)
No. 2 Rockford Horiz. (new)
60" Betts Horiz., 4" bar
52" Bertram Horiz., 2⅝" bar
52" Bausch Vert., 2 rail hds.
60" Bullard Vert., 2 heads

HAMMERS

500 lb. Billings & Spencer Board Drop
800 lb. Massillon Steam Drop
1100 lb. Erie Steam Forging
1200 lb. Bliss Board Drop

KEYSEATERS

No. 0, No. 3 and No. 3-A Mitts & Merrill Giant
No. 0 Baker, cap. 1" keyseats
John T. Burr Keyseat Miller, 60" feed

MILLERS

No. 4 Hendey Lincoln Type
No. 32 Kempsmith Lincoln
No. 25 Becker Plain
No. 2 Cleveland Plain
No. 4-B, No. 5-B and No. 6-B Becker Vertical
No. 8 Lees-Bradner Thread
42" x 40" x 8' Ingersoll Slab, incl. 14 cutters

TURRET LATHES

18" and 26" Libby
¾", 1¼" and 2" Wood Tilted Turret (new)
21" Gisholt
24" Steinle

MISCELLANEOUS

Used leather belting; chain hoists; gear cutters.

THE E. L. ESSLEY MACHINERY CO.

Main Store
551 W. Washington Blvd., Chicago

Branch Store
78 W. Water St., Milwaukee

Priced Right for Present Conditions

A FEW OF OUR BARGAINS IN USED MACHINERY

1—Bradford 18 x 18' Standard Engine Lathe. SBG. CR
1—16 x 8' Reed-Prentice Engine Lathe.
1—⅞" Cleveland Automatic Screw Machine.
1—2" Cleveland Automatic Screw Machine.
1—Hurlbut-Rogers 5" Double Cut-off Machine.
1—No. 2 Barber Coleman Gear Hobber, very fine.
1—Bridgeport 36" x 24' Extra Heavy Geared Head Engine Lathe, motor driven.
3—No. 4 Warner & Swasey Geared Friction Head Turret Lathes.
1—No. 0, B & S Plain Milling Machine.
1—No. 1 B & S Plain Milling Machine
1—Porter-Cable 9" x 20" Production Lathe.
1—American Tool & Machine Co.'s No 1 Square Arbor Brass Worker's Lathe.
1—No. 12 Leland Profileing Machine, with pump.
1—No. 35 Giddings & Lewis Horizontal Boring Machine.
1—Cincinnati Electric Grinder, 120 Volt D. C.
1—Brown & Sharpe No. 29 Plain Cylindrical Grinder, capacity 18" x 10' between centers.
1—Gardner No. 4 Ball-bearing Disc Grinding Machine, with right-hand plain table.
1—6" Oster Pipe Machine and equipment.
1—3/16" A D T Shuster Riveting Machine.
1—Brunner Automatic Air Compressor with ½ H.P. 110 V., single phase A.C. motor.

The E. A. Kinsey Co., Cincinnati, Ohio. Indianapolis, Ind.
Hamilton, Ohio

Why Waste Time at Auction Sales?

Our prices are lower, and we sell Machinery under a Real Guarantee

MILLING MACHINES—New and Used

3—No. 1½ Rockford Univ., cone type, cap. 25x77½x18.
2—No. 2½ Rockford Univ., cone type, cap. 34x9x18.
1—No. 2½ Rockford Univ., high pwr., grd., sgle. pulley drive, cap. 24x8x18.
2—No. 1½ American Pl. and Univ., cone type, cap. 25x19x19.
1—No. 2 Becker Plain, M.D.
6—No. 32 Kempsmith Lincoln
1—Nos. 1 and 2 Newton Keyseat Mills, M.D.
1—Ingersoll Slab 20x20x8'.
3—No. 3½ Fox, Table 7x27½".
1—No. 0 Bickett Vert. Mill and Profiler.

MISCELLANEOUS

1—27"x12' Greaves-Klusman Lathe—D.B.G., Q.C.
3—16"x8' Sidney Lathes, Q.C.
1—50" Sellers Car Wheel Borer.
1—52" Bertsch Multiple Punch.
1—20" Hendey Shaper.
2—10x36" Thompson Univ. Grs.
12—Gisholt 24" Turret Lathes.
4—Multi. Drills 3 to 24 spds.
14—Screw Mchs. 2 to 3¼" cap.
5—Oakley Univ. Grinders 10x20.
1—10x24" Landis Pl. Grinder.
1—No. 20 Lea Simplex Cold Metal Saw arranged M.D.
1—Amer. Radial Drill 3', T.A.
1—Amer. Radial Drill, 3½', T.A.
1—26" Barnes All Geared Head Drill Press, high power.
1—22" Barnes Heavy Duty Drill.
1—Hanna Riveter, 66" reach, 15" gap, 20 Ton cap.; approx. 5/16" cold, 9/16" hot rivets.
1—Ohio Shaper, 16/20".
1—Whipp Shaper, 20" B.G.
1—42x36x8 Am. Planer; 2 hds.
1—Pond Planer, 80" bet. housings, 49" under rail, 12' bed, 4 heads, motor drive.
1—42x36x18' Rockford Planer; 2 heads; arranged M.D.
1—96" Niagara Squaring Shear; 18 gauge cap.
1—No. 9-A Badger Double End Punch and Shear, 12" Throat, cap. punch ½ through ½" plate.

Money back if not satisfied.
Over 1,000 Machines in stock.

WAYNE MACHINERY CO.

Ft. Wayne, Ind.

14-Inch Lathes Plenty to Pick From

FLATHER	PRATT & WHITNEY	ROCKFORD
HENDEY	SENECA FALLS	SEBASTIAN
AMERICAN	CARROLL-JAMIESON	LEBLOND
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Prices range from $125.00 to $600.00

Our Blue List No. 7 gives complete details.

HILL, CLARKE & COMPANY, Inc.

156 Oliver Street *The Machinery Merchants* Boston 9, Mass.

THE OSBORNE & SEXTON MACHINERY COMPANY

COLUMBUS OHIO

Band Saw. metal Klamem, 12"
Bending Rolls, 7 for ⅜" plate
Boring Mill, vertical, 12", 2 heads
Boring Mill, Colburn, 48", 54" and 60", 2 heads
Brake, 8' 22 Gauge, hand operated
Chucking Machine, No. 23, New Britain.
Compressors, 6 x 6, 9 x 8 and 12 x 10
Drills, Barnes 26" all geared (2)
Drills, Sliding Head, 24, 26, 28 and 32"
Gear Millers, Automatic, Bilton No. 1 (5)
Grinders, Surface, 1, 3 and 78 Wilmarth & Morman
Grinders, 10 x 24 and 6 x 32 Norton Plain
Grinder, B. & S. No. 24 Dbl. Spdl., Internal
Grinder, Universal, 10 x 30 W. & P.
Grinder, Universal, 12 x 36 Cincinnati
Grinder, No. 4 Gardner double disc.
Hammer, 40 lb. Bradley Cushioned Helve
Lathes, 14" x 6' and 18" x 8' Monarch
Lathe, 24" x 24' Prentice with raising block
Lathe, 25" x 14'. Schummacher-Boye
Milling Machine No. 2 heavy Brown & Sharpe Pl.
Milling Machine, No. 26 Becker, Plain
Milling Mch. No. 32, Kampsmith, Lincoln Type (3)
Milling and Drilling Machine, No. 1 Knight
Planer, 24 x 24 x 6' Pease, Single Head
Planer, 36" x 36" x 12' Niles, Parallel drive
Planer, 48" x 48" x 16' Bament-Niles, 2 head
Planer, 60" x 60" x 17' Betts
Presses, 1, 1600 lbs.; 2½, 3000 lbs. Robinson.
Punch and Shear, ½ x ½—10" throat
Pipe Machines, 2", 4", 6" and 12".
Pyrometer, Brown 2000 degrees for furnaces
Radials, 3' Morris plain, gear box
Screw Machines, National Acme, Nos. 52 and 56
Scleroscope, Shore, Style B, complete (3)
Shapers, 14" Niles, travelling head
Shapers, 14". 16" and 21" Smith & Mills
Shear, No. 20 Quickwork, 14 gauge—30" throat
Shear, 5' Robinson, 10 gauge
Turret Lathe, 1" and 1⅝" Millholland
Turret Lathe, 1½" Friction Back Geared, Wood
Turrets, 2x24 and 3x36 J & L Single Pulley
Turret Lathe. No. 6, Warner & Swasey, prac. new.

NEW 3 PHASE MOTORS 5 H.P., $67.50, 3 H.P., $57.50

FOR SALE

Property of the Jamestown Die & Tool Corporation located in Jamestown, N. Y.

Consisting of land, building, stock and equipment. 1 acre of land; thoroughly modern concrete steel building, 185 feet by 83 feet, equipped with heating and lighting; the following machines all in excellent condition, as good as new and have been used on nothing but the highest grade of tool and die work:

LATHES

1 Hendey Norton, 20" x 8'
1 Blaisdell Engine
1 Hamilton, 16" x 6'
1 LeBlonde Engine, 12" x 6'
2 Hendey Norton, 14" x 6'
1 Lehman, 18" x 6'
1 Hamilton, 18" x 6'
2 Monarch, 16" x 6'
1 Lodge & Shipley, 18" x 8'
1 Stark Bench, No. 3½

SHAPERS

1 Hendey Crank, 16"
2 Hendey Crank, 20"
1 Gould & Eberhardt, 20"
1 Gould & Eberhardt

MILLING MACHINES

2 Cincinnati, No. 3
1 Knight

DRILLING MACHINES

1 Knight No. 2
1 Barnes No. 2, 26"
1 Barnes 34" Upright
1 American No 3 Sensitive Radial

PLANERS

1 Cincinnati, 36" x 36" x 10'
1 Lodge & Shipley, 24" x 24" x 6'

GRINDERS

1 Plane Dry Grinder
1 Whitney Wet Tool Grinder, 2½ x 18
1 Wilmarth & Norman Drill
1 Talf-Peirce Universal
1 Thompson Universal, 10" x 36"
1 Grindstone, 4" x 36"
1 Portable Electric Dumont
1 Reed No. 2 Surface
1 No. 1½ Cincinnati Univ. Tool and Cutter

FURNACES

1 W. S. Rockwell Brazing
1 Bethlehem Cyanide Pot
1 W. S. Rockwell Carbonizing
1 W. S. Rockwell Hardening
1 W. S Rockwell Tempering Pot

MISCELLANEOUS

1 Connersville Blower
1 Stewart Blower
1 ¾" Oil Pump
1 2½" Oil Pump
Hardening-Room Instruments
1 Bowser Oil Storage System
1 Racine Hack Saw
1 Power Hack Saw—Royal No. 5
1 No. 5 Niagara Punch Press
1 6" Belt Lacing Machine
1 Spring-Bench Straightening Press
1 Grenard Arbor Press No. 4

A large stock of tool, machine and high speed steel together with all other small tools and accessories required in high grade tool and die work.
Inspection of this material may be made and quotations on whole or part received from

W. K. COOPER, Assignee, Jamestown Die & Tool Corp., JAMESTOWN, N. Y.

FOR SALE

Vreeland 10-H.P. Gas Engine

Good condition. Occupies space about 4 feet by 8 feet. Suitable for small machine shop.

Edwin C. Bruen, Inc., 63 Barclay St. New York

Rebuilt and new electric motors, generators and transformers.

All standard makes, sold, bought and exchanged. Our rebuilt motors stand every test of new motors; 8000 always in stock; send for stock list. Write what you want or have to sell.

FUERST-FRIEDMAN CO., Cleveland, Ohio

PLANER BARGAINS

36" x 12' Powell, single head, belt or with motor drive, like new.
36" x 12' Wheeler, two heads. Priced low.

MILES MACHINERY CO., Saginaw, Mich.

Surplus Machinery For Sale

We have the following for sale—

- Acme Auto. Screw Machines
- Cleveland Auto. Screw Machines
- Lapointe Broaches
- Natco and Gardam Multiple Spindle Drills
- Upright Drills
- Norton Cylindrical Grinders
- Heald Internal Grinders
- Potter & Johnston 5a and 6a
- Acme Turret Lathes
- Greenlee Turret Lathes
- Engine Lathes
- Milling Machines
- Bardons & Oliver Hand Screw Machines
- Foster Screw Machines
- Pratt & Whitney Thread Millers

THE WILLYS-MORROW CO., Elmira, N. Y.

Practically New

30″ x 24″ x 12′
INGERSOLL Four Head
ADJUSTABLE RAIL
MILLING MACHINE

32″ between housings
32″ max. between horizontal spindle noses
20″ min. between horizontal spindle noses
Approximate weight 27,400 lbs.
PRICE. $5780.00

Condition Excellent
Exceptional Bargain

THE NEW BRITAIN MACHINE CO.
NEW BRITAIN, CONN.

FOR SALE

Billings & Spencer Board Drop Hammer, 800 lbs., Model D, New. United Engineering High Speed Steam-Hydraulic Forging Press, 150-183 Tons Capacity, New.

NATIONAL TOOL CO., Cleveland, Ohio

FOR SALE

150 K.W. General Electric Dynamo, American Ball Engine, 225 R.P.M., 60 cycle, 2 phase, A.C. 220 volts, 420 amp. Now running. About seven years old—good as new. Duplicate shells for bearings. Separator, Throttle, etc. 100 K.W. Ames Engine, Westinghouse Generator, 270 R.P.M., 60 cycle, 2 phase, A.C., 220 volts, 280 amp. Ready to run. No repairs necessary. Bargain.

Address: **Jacob Miller's Sons Co.**
16th and Reed Sts. PHILADELPHIA, PA.

FOR SALE

1—New 32 ft. Consolidated Vertical Boring and Turning Mill, "Betts type"

with all modern features. Machine has 24′ table with steel table drive gear and pinion. Takes 12′ 6″ under tools, has 10′ tool bar travel. Cross rail is heavy box section, 48″ face and special clamping device.

Machine is now under construction and will be ready for shipment September, 1923.

For further information and price, address:

WESTINGHOUSE ELECTRIC & MFG. CO.
South Philadelphia Sub-station,
Philadelphia, Penna.

Vertical Millers—Save 50%

1—No. 2 Cincinnati Vertical High Power Type Vertical Milling Machine, Table 47½″ x 12″, Feeds 28″ x 12″ x 14″. Condition like new..............$1150

2—No. 5-C Becker Vertical Plain Milling Machine, Table 12″ x 66″, equipped with Power Rotary Tables. Condition equal to new..............$1200 each

1—No. 5-B Becker Vertical Plain Milling Machine, Single Pulley Drive, Table 12″ x 58″, Feeda 42″ x 10″ x 14″. Condition equal to new...$1200

Write for our Big List

Reliance Machinery Sales Co.
Brighton Road at Penna. Ave.
PITTSBURGH, PA.

Your Attention

Used Machine Tools

3A Warner & Swasey Universal Turret
24″x24′ Lodge & Shipley (Late type) Q.C. Lathe With Oil Pan—same as new.
26″x24′ Lodge Davis Lathe (Raised to 32″)
30″x14′ Lodge & Shipley (Late Type) Q.C. Lathe, 3 Step Cone, D.B. Gear
24″x12′ Springfield S.Q. Change Lathe
5′ American Plain Radial, S.P. Drive
6′ American Plain Radial, S.P. Drive.
6′ Fosdiok Plain Radial, Cone Drive
3′ American Sensitive Radial
24″ x 6′ Gray Planer
No. 3 Wilmarth & Morman Surface Grinder
Shapers, 16″, 18″, 20″ and 24″.
No. 4 Baker Keyseater 4½″ capacity.
22″ Lioby Turret Lathe, S.P. Drive
200 other high grade tools to select from.

JONES MACHINE TOOL CO.
435 E. Pearl Street CINCINNATI, OHIO

Clear away your discarded machines and get back some of the money invested. Sell them through the GREEN SECTION. Write for advertising rates.

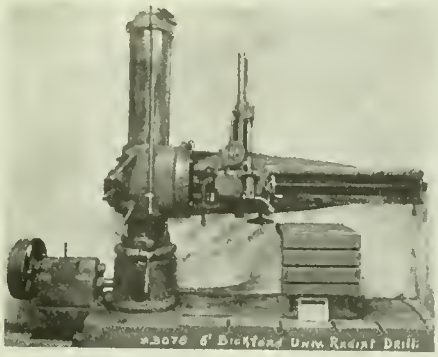
Samples from the Grinder Section of our *"Good as New"* DEPARTMENT

12x30 Fitchburg Plain cylindrical
18x50 Sterling plain cylindrical
Reed-Prentice vertical surface, 18"x78"
8x40 Morse plain cylindrical
No. 1 Brown & Sharpe Universal
Brown & Sharpe Cylinder Grinder
5x18 Ott, plain
No. 1½ Cincinnati Tool & Cutter Grinder
12x42 Landis, plain
10x72 Landis plain
No. 6 Bryant chucking
No. 20 Bryant chucking
No. 3 Wilmarth & Morman surface
No. 3 Wilmarth & Morman Surface Grinder
10x36 Thompson Universal
Diamond wet tool
6x6 Ott internal

May we send you our complete list of bargains?

Vonnegut Machinery Co.
25 W. South St., Indianapolis, Ind.

RADIAL DRILLS MULTIPLE SPINDLE



6' Bickford Radial Drill—Full Universal

Capacity, vertical range of arm, 42"; capacity, horizontal range of hd., 50"; greatest distance under spindle, 66"; diameter of column, 13".

This machine has been thoroughly rebuilt. It is a tool you would be proud to have in your shop.

PRICE f.o.b. Bpt. - $850.00

2½' Bickford Plain Radial Drill. Quick change	$600.00
4' Hammond Sensitive Radial Drill, brand new	450.00

MULTIPLE SPINDLE DRILLS

No. 25 Natco High Speed Multi Drill. Rectangular Head. Arranged for 20 spindles. Equipped with 8	475.00
No. 12 Pratt & Whitney Multi Spindle Drill. Arranged for 12 spindles, equipped with 10. Price	475.00
2 No. 13 Natco Multiple Spindle Drills. Rectangular Head. Arranged for 20 spindles, equipped with 8. Price	850.00
2—Gardam Multiple Spindle Drills—8 spindles. Price	475.00
No. 16 Natco Multiple Spindle Drill. Arranged 16 spindles, equipped with 11. Brand new. Price	900.00

J. L. LUCAS & SON Inc
LUCAS MACHINERY SERVICE
BRIDGEPORT, CONN.

HARRY F. ALLEN, 30 Church St., NEW YORK

NEW TOOLS

Special Prices

4—11" x 6' Star Lathes, Q.C.G.
4—12" x 6' Star Lathes, Q.C.G. (Micrometer Stops—Apron Control)
1—2½" Grand Rapids Twist Drill Grinder.
1—24" x 24" x 6' Powell High Speed Planer, 2 heads.
1—36" x 36" x 12' Powell High Speed Planer, 4 heads.
1—6" x 6" Acme High Speed Hack Saw.

USED TOOLS

A-1 Condition

1—12" x 6' Reed Lathe.
1—14" x 6' Reed Lathe, Q.C.G. Taper.
1—18" x 8' Reed Lathe.
1—18" x 8' Greaves Klusman Lathe.
1—24" Fay & Scott Pattern Makers' Lathe.
1—1 Spindle Allen B.B. Drill.
1—4 Spindle Allen B.B. Drill.
1—25-in. Snyder Sliding Head Drill, Tap. Attach.
1—24" Reed Prentice Sliding Head Drill.
1—No. 3 Foster Universal Turret Brass Lathe, Friction Head, A.C. W.F.
1—No. 1 Kempsmith Plain Miller.
1—No. 3 Brown & Sharpe Plain Miller.
1—No. 13 Brown & Sharpe Universal Cutter and Tool Grinder.

For Sale at Our West Haven Plant After August 1st

1—Corliss Steam Engine—11" bore, 30" stroke. Rated at 50 H.P. at 90 lbs. initial pressure. Built by the W. A. Harris Steam Engine Co.

1—30 KW. 125 Volt, 240 Amperes Direct Current Generator. Built by the Crocker-Wheeler Co. Several Direct Current Motors in sizes from 2 to 10 H.P.

2—Steam driven Air Compressors.

This machinery is now in operation at our West Haven plant, namely, the West Haven Mfg. Co., West Haven, Conn., and can be inspected at any time desired.

MILLERS FALLS CO.
Millers Falls, Mass.

No. 27-K Bliss Knuckle Joint Press
30-ton Lucas Straightening Press
No. 2-W Bliss Reducing Press
No. 23 New Britain Automatic
Betts Horizontal Mill, 3" Bar
1⅝" Gridleys, serial 5772 and 2631
No. 61 and 62 Bliss Presses
1¼" and 4¼" Model "A" Cleveland Auto.
No. 3A and No. 4 Warner & Swasey
1⅝" and 3¼" Gridley Automatics
⅝" and ½" Model "B" Clevelands
Nos. 52, 72 and 515 National Acmes
16" x 6' Hendey Lathe, taper att.
No. 3 Oesterlein Tool Grinder
24" Gisholt Turret Lathe, late type
No. 2 Colburn Heavy Duty 20" Drill
No. D-4 Colburn H D Drill Presses (2) mounted on base, adjustable centers.
No. 9126 Niagara Power Shear, ¼" cap. 10' 6" length of blade, 18" gap.
8' 6" Geo. A. Ohls Brake, 10 gauge.

D. C. OVIATT & CO.
1104 St. Clair Ave. CLEVELAND, OHIO

Ingersoll-Rand Imperial Type Air Compresser

Two Stage No. T-10, 100 lb. Capacity 300 cu. ft. per min.

Address

Tioga Steel & Iron Co.
EASTON, PA.

FOR SALE
at real bargains.

4-Spindle National Acme Automatic Screw Machines

5—No. 55—Capacity 1⅝"
3—No. 54—Capacity 1⅜"
2—No. 52—Capacity ¾"

In good running condition.
Also large number of Acme and Watson Box tools, tool-holders, collets, etc.

BENFORD AUTO PRODUCTS, Inc.
Mt. Vernon, N. Y.

3¼" single spindle Gridley Automatics.
Reed-Prentice Co. Lathes—14" x 5'4" bed, 23½" between centers, special cross slide, equipped with Hannifin Air Chucks.
Gisholt Turret Lathes.
Horizontal Boring Mills.

EAST DAYTON MACHINERY CO.
Cor. Keowee & Valley Sts., Dayton, Ohio

FOR SALE

1 Worthington Compound Pot Valve Pressure Pump 1500 lbs.

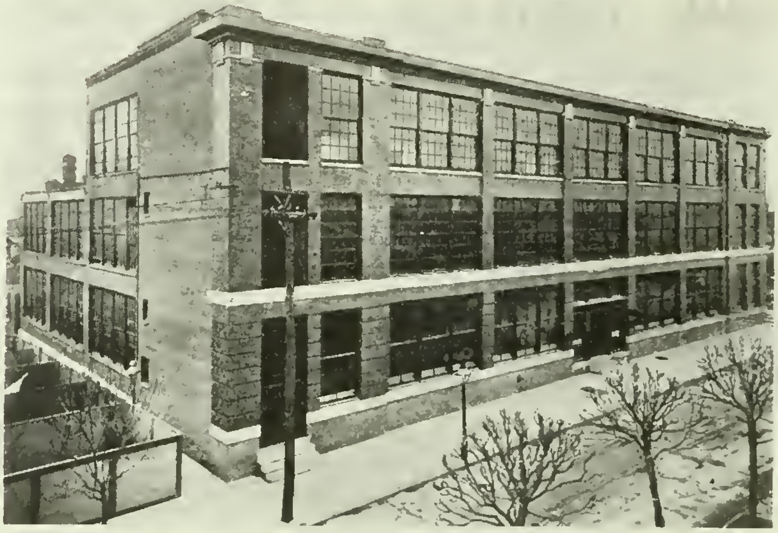
No. 597110, size of steam cylinders 14" and 20", water plungers 3½", length of stroke 12".

Address: P. O. Box 214, EASTON, PA.

PLANERS
1—32" x 8' Lathe and Morse
1—10' Open Plate Planer, practically new.

LATHE
1—21"x10' Lathe and Morse engine.

CARY SAFE CO. BUFFALO, N. Y.



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Located in an industrial center; ten minutes ride from City Hall; Penn. R. R. siding available; also one square distant from Phila. & Reading R. R. Freight Yard; buildings and building equipment about ten years old; ground area more than one acre; manufacturing floor area 40,000 square feet; sprinklered throughout; minimum New England Mutual Insurance Rates; light four sides; labor conditions ideal; high ceilings; 2 boilers—150 H.P. each; engine 125 H.P.; immediate possession; adapted for any business but constructed for metal working, containing a strictly modern brass foundry on third floor.

Get particulars from

BARBER, HARTMAN & COMPANY
1201 Chestnut Street PHILADELPHIA, PA.

FACTORY BUILDING FOR SALE

45,000 square feet, new and modern, part monitor and part saw tooth, construction of brick, steel and concrete. Building wired throughout in conduits for electricity. Equipped with one three-ton and one ten-ton crane. Located on main line of Michigan Central Railroad with sidetrack. Up-to-date heating plant and storage capacity for 8 to 10 cars of coal. Possession any time.

Box 622, care of Machinery
148 Lafayette St. New York City

24" BULLARD VERTICAL TURRET LATHES

Rapid Production Type
Rebuilt and Guaranteed

PRICE each f.o.b. Bridgeport $1800.

J. L. LUCAS & SON Inc
LUCAS MACHINERY SERVICE
BRIDGEPORT, CONN.

THE GREEN SECTION

Contains the latest lists of Used and Rebuilt Metal Working Machines and Tools

The GREEN SECTION offers the readers of MACHINERY an excellent quick-action market for the purchase of good used machine tools. Here are lists of machines and equipment at bargain prices advertised by reliable dealers. Consult it.

MACHINERY'S Green Section Inquiry Department

will help you find any machine shop equipment not listed—write us or send the coupon below. There is no charge for the service—we *want* to help you.

8-23

MACHINERY'S Green Section, Date..........................
140-148 Lafayette Street, New York City,

I should like particulars in regard to the following used equipment:

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Name ....

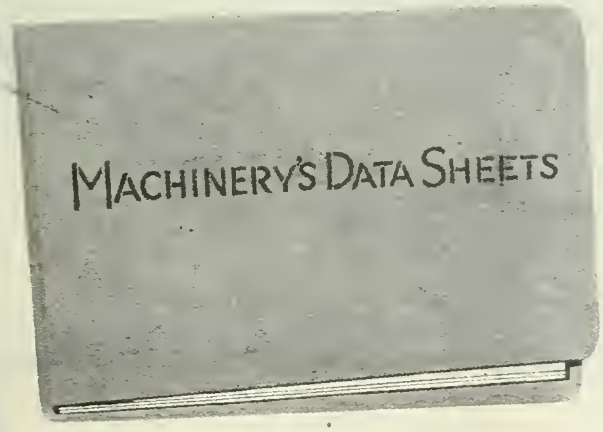
Address ....

"Correct Spiral" Expansion Reamer

Free cutting action insures smooth, accurate work, free from chatter marks. Can't be bettered for reaming bushings with keyways or oil grooves. Made with standard or special length pilots; the latter being especially adapted to Wrist Pin or any other work involving aligning features. Send for circular, price list and more details.

"Just the Reamer for Bushing Work."

REIFF & NESTOR
COMPANY
LYKENS PA., U. S. A.



A Binder for Your Data Sheets

You'll want to keep them in order and handy for reference. This binder, made up especially to fit the Sheets, is particularly convenient.

Ring type, canvas over board covers—a durable binder—$1.40 post paid.

MACHINERY
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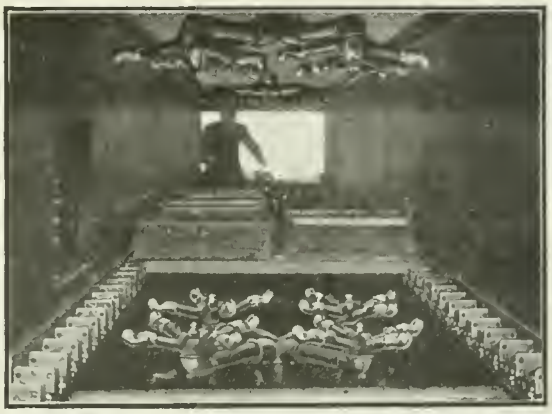


Interior of large Crescent Metal Cleaning Machine with section of conveyor removed, showing work to be cleaned passing between the upper and lower revolving wash arms. Each arm turns around and around—washing and rewashing every surface with heavy streams of cleaning solution under pressure.

This principle makes metal-cleaning easy

THE remarkable cleaning efficiency of the Double Revolving Wash is shown by the work Crescent Metal Cleaning Machines are doing for *Yale & Towne Mfg. Co., Stamford, Conn.* Here Crescents have been used for years to clean tripoli from brass lock parts.

At the *Chevrolet* plants in Cincinnati and Buffalo one Crescent cleans the entire output of automobile fenders preparatory to enameling.

Westinghouse, General Electric, Ford Motor Co. and hundreds of plants of *every* size, in every branch of the metal working industry, are getting better results with Crescents, at an average saving of 50% to 80% in labor costs.

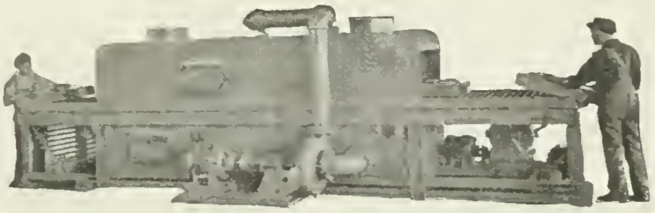
Write for our booklet
"Washing Metals by Machinery"

CRESCENT WASHING MACHINE CO.
83 Second Ave. NEW ROCHELLE, N. Y.

Crescent
WASHING MACHINES
for Cleaning Metals

Crescent Metal Cleaning Machine for cleaning broke drums and flanges.

Built specially for Hayes Motor Truck Wheel Co., St. Johns, Mich.



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Spindle Staybolt Taps

Fill the Bill in the Railroad Shop

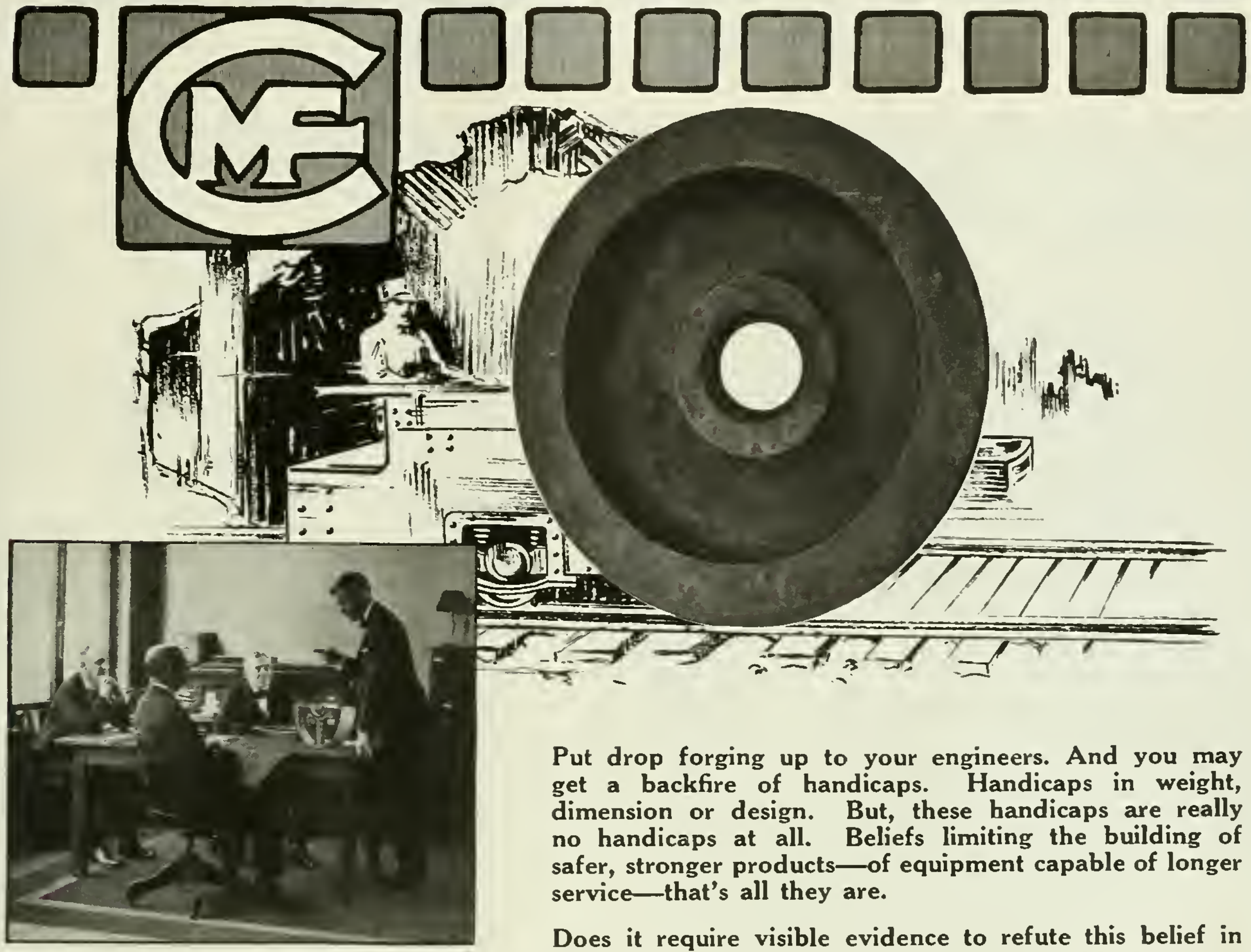
Railroad work is strenuous and tools that come up to the mark must be of a quality distinctly above the average. Retapping staybolt holes from inside the firebox of the locomotive is a tough job that can be most efficiently performed with the Brubaker Tool designed for this work.

Brubaker Tools work well and wear well. Special tools for particular purposes, standard types for usual use. Send for the catalog and price list.

W. L. Brubaker & Bros. Co.
Factory: MILLERSBURG, PA.

Sales Office:
50 Church St., New York, N. Y.

CHAMPION



Put drop forging up to your engineers. And you may get a backfire of handicaps. Handicaps in weight, dimension or design. But, these handicaps are really no handicaps at all. Beliefs limiting the building of safer, stronger products—of equipment capable of longer service—that's all they are.

Does it require visible evidence to refute this belief in handicaps? Then you have it in this gear blank.

Drop forged! Weight 208 pounds. Outside diameter 26¾ inches. Depth over all 4½ inches. Depth of dish 2½ inches. Dished just like it would be cast. No radical changes in design here. No limit on size or weight. Handicaps proven to be merely belief by the skill of Champion Engineers co-operating with the manufacturers' engineers.

Now, there's no handicap to you giving the vital parts of your product the tough, sturdy give and take strength of drop forged steel unless it's your own attitude. Put this last handicap down and write for details of cooperative service of Champion Engineers. There's no obligation.

Two years co-operating with manufacturers in developing the qualities of their products by drop forged parts have given Champion Engineers a well rounded fund of experience on which to draw in working out your problems. They have come through in fifty odd cases. And their cooperation is yours at any time at your factory. Make your need known to us.

The Champion Machine & Forging Company
3695 East 78th Street, Cleveland, Ohio

New York Office—30 Church Street
Philadelphia Office—Bourse Building
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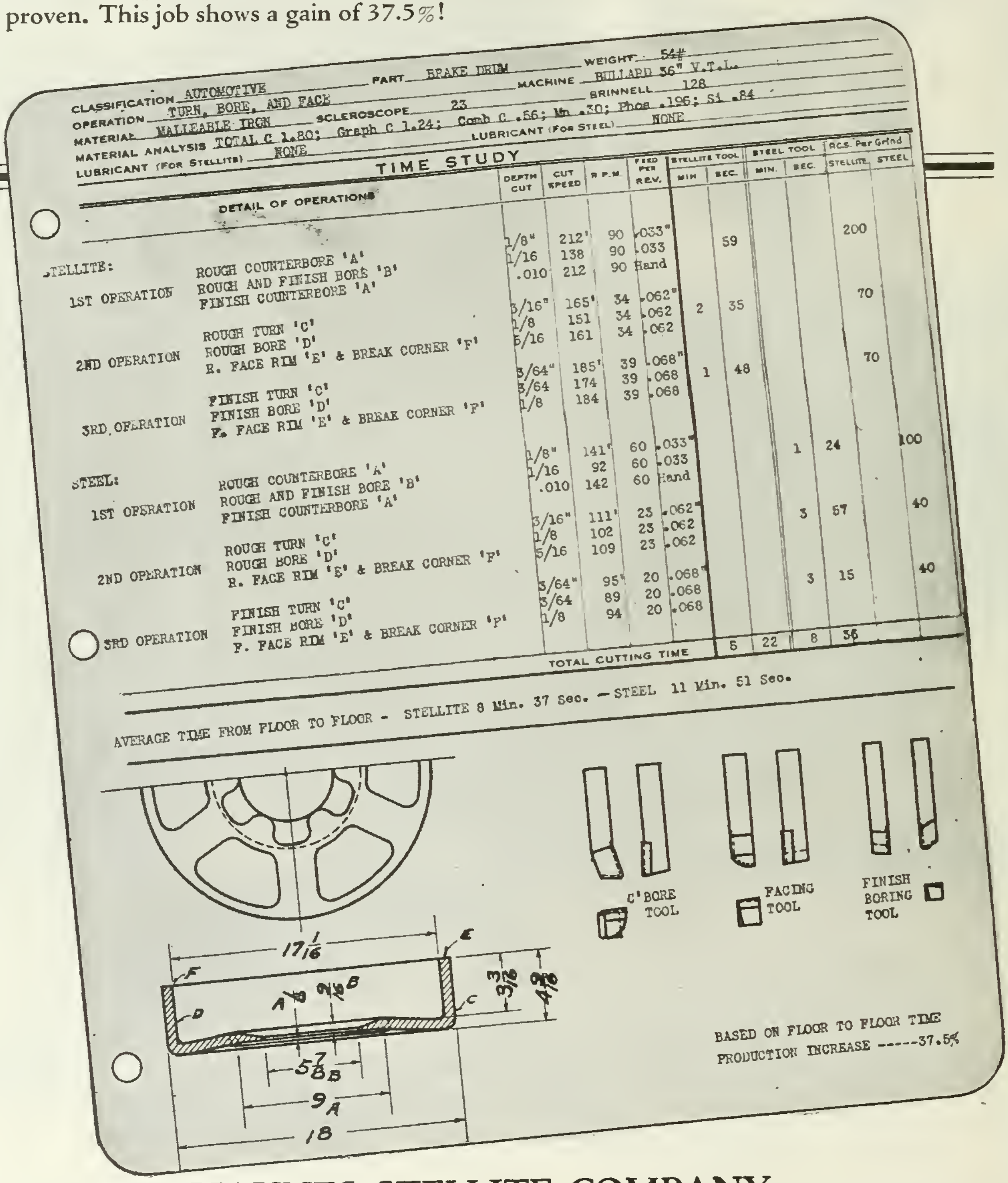
DROP FORGINGS

HAYNES STELLITE
CUTTING TOOLS

Our claim that the proper use of Haynes Stellite Cutting Tools will result in at least 30% increase in production is being continually proven. This job shows a gain of 37.5%!

Every man responsible for production will be interested in this shop time study. Others will follow—watch for them.



CLASSIFICATION AUTOMOTIVE PART BRAKE DRUM WEIGHT 54#
OPERATION TURN, BORE, AND FACE MACHINE BULLARD 36" V.T.L.
MATERIAL MALLEABLE IRON SCLEROSCOPE 23 BRINNELL 128
MATERIAL ANALYSIS TOTAL C 1.80; Graph C 1.24; Comb C .56; Mn .30; Phos .196; Si .84
LUBRICANT (FOR STELLITE) NONE LUBRICANT (FOR STEEL) NONE

TIME STUDY

DETAIL OF OPERATIONS		DEPTH CUT	CUT SPEED	R.P.M.	FEED PER REV.	STELLITE TOOL		STEEL TOOL		PCS. Per Grind	
						MIN	SEC.	MIN.	SEC.	STELLITE	STEEL
STELLITE: 1ST OPERATION	ROUGH COUNTERBORE 'A'	1/8"	212'	90	.033"		59			200	
	ROUGH AND FINISH BORE 'B'	1/16	138	90	.033						
	FINISH COUNTERBORE 'A'	.010	212	90	Hand						
2ND OPERATION	ROUGH TURN 'C'	3/16"	165'	34	.062"	2	35			70	
	ROUGH BORE 'D'	1/8	151	34	.062						
	R. FACE RIM 'E' & BREAK CORNER 'F'	5/16	161	34	.062						
3RD. OPERATION	FINISH TURN 'C'	3/64"	185'	39	.068"	1	48			70	
	FINISH BORE 'D'	3/64	174	39	.068						
	F. FACE RIM 'E' & BREAK CORNER 'F'	1/8	184	39	.068						
STEEL: 1ST OPERATION	ROUGH COUNTERBORE 'A'	1/8"	141'	60	.033"			1	24		100
	ROUGH AND FINISH BORE 'B'	1/16	92	60	.033						
	FINISH COUNTERBORE 'A'	.010	142	60	Hand						
2ND OPERATION	ROUGH TURN 'C'	3/16"	111'	23	.062"			3	57		40
	ROUGH BORE 'D'	1/8	102	23	.062						
	R. FACE RIM 'E' & BREAK CORNER 'F'	5/16	109	23	.062						
3RD OPERATION	FINISH TURN 'C'	3/64"	95'	20	.068"			3	15		40
	FINISH BORE 'D'	3/64	89	20	.068						
	F. FACE RIM 'E' & BREAK CORNER 'F'	1/8	94	20	.068						
					TOTAL CUTTING TIME	6	22	8	36		

AVERAGE TIME FROM FLOOR TO FLOOR - STELLITE 8 Min. 37 Sec. — STEEL 11 Min. 51 Sec.

BASED ON FLOOR TO FLOOR TIME
PRODUCTION INCREASE -----37.5%

HAYNES STELLITE COMPANY

Carbide and Carbon Bldg., 30 E. 42nd St., New York City
Peoples Gas Bldg., Chicago General Motors Bldg., Detroit 4503 Euclid Ave., Cleveland

McCrosky
COST-CUTTING TOOLS

You Can Cut Costs and Increase Drill Press Production If You Use

McCrosky WIZARD Chucks and Collets

For Example:—This illustration shows a McCrosky WIZARD Quick-change Chuck Outfit in operation in one of the most prominent automobile plants of the country. The job calls for 27 distinct operations on the cylinder block. With the aid of the WIZARD Chuck and that complete assortment of WIZARD Collets—one for each tool—the operator averages four blocks an hour—27 tool changes every 15 minutes. This is a typical example of the time-saving, cost-cutting, output-increasing efficiency of McCrosky WIZARD Chucks and Collets. And they are just as effective on variety work as they are on production jobs.

Every one of the exclusive features of McCrosky WIZARD Chucks and Collets contributes to rapid and accurate drill press production. Here are a few of them:—

The Improved WIZARD Locking Device makes it possible for the operator to change tools with one hand without stopping or slowing the machine. This lock is simple in design and instantaneous and positive in action.

The WIZARD Chuck is a sturdy tool that stands up under hard usage and heavy duty. It consists of only two main parts. The chuck collar is hardened all over. WIZARD Chucks drive backward and forward with equal power and positiveness.

WIZARD Collets hold tools rigidly and perfectly centered. The available assortment of WIZARD Collets is large and complete. Adjustable collets for small straight shank tools and compact, sensitive Friction Drive Collets for tapping and stud-setting are found only in the WIZARD.

We shall be glad to tell you how McCrosky WIZARD Chucks and Collets can increase the efficiency of your Drill Press Department. Write now.

McCrosky Tool Corporation, Meadville, Pa., U. S. A.

Branches in Boston, New York, Cleveland, Detroit, Chicago, San Francisco
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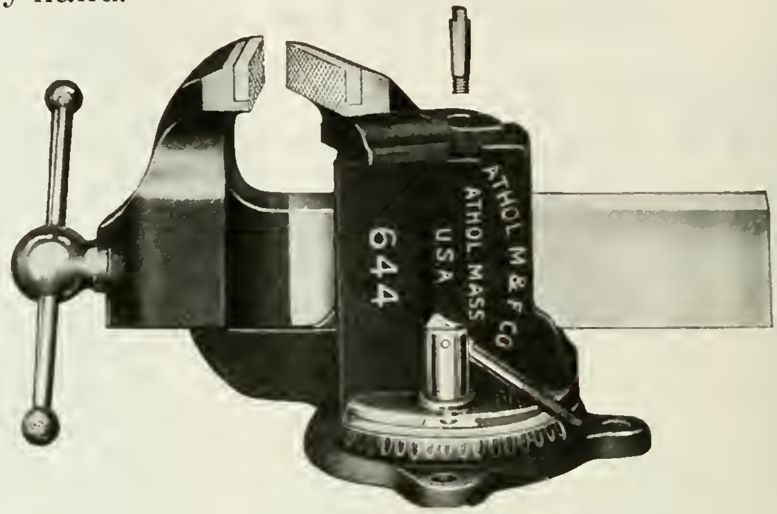
A Vise for Tapered, Round or Odd Shaped Work

This *Athol-Starrett* is the vise to hold odd shaped work securely, in any position; with no possibility of a slip.

The *swivel base* is equipped with a *positive* lock which cannot be slipped after clamp nut is tightened by hand.

Jaw faces are of special tool steel welded, in casting, to jaws, one of which is on a swivel with carefully fitted shank having a square keyway and a key long enough to give a good bearing.

No detail in material, workmanship or engineering skill necessary to produce a high grade, serviceable article has been overlooked.



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An Indispensable Book

The standard mechanical handbook covering thoroughly the field of machine shop practice, machine and tool design from the practical point of view. Its 1400 pages contain every essential fact, figure and table needed in machine shop and drafting-room. It is the working reference book of a great trade.

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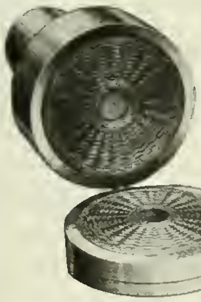

Clean cut, well made, economical dies for embossing sheet metal products. Correct heat-treatment insures durability of all "Salco" stamps.

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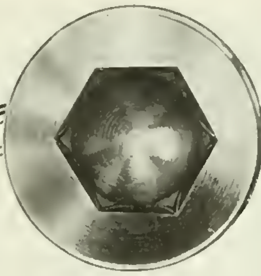

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for
STRENGTH
wherever set screws
MUST HOLD!

The cold-drawn sockets *stand the strain* of the tightest set-ups.

The perfect hexagon holes *hug the wrench* without possibility of slipping.

The evenly-burred ends of the Allen wrenches always *"bottom"* in the screw; engaging the full leverage of the deep, clean socket-holes.

Hence the screw that is *30% stronger* can be set up immeasurably tighter. Equal to more torsional strain than projecting-head screws of the same diameter; immune to right-angle strain that snaps off your headed screws.

These are not only technical superiorities; they're points of *saving* in your set screw buying. The Allen booklet covers them fully, and carries prices. It's a good book to ask for—and be guided by.

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Pacific Coast Branch Office:
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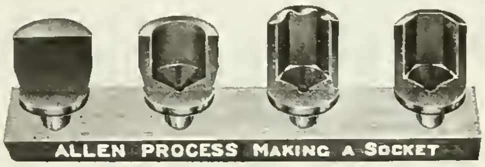
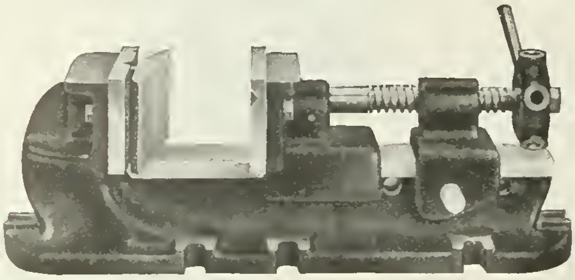
San Francisco, Calif.



ALLEN PROCESS MAKING A SOCKET

THE GEM DRILL PRESS VISE



Powerful Grip—Quick Action

The swivel jaw instantly adapts itself to irregular shapes and holds all work rigid. Strong, adaptable, durable—wide capacity makes it one of the most useful pieces of equipment in the shop. Three sizes—jaws opening to 10½″.

Send for a Circular and List of Users

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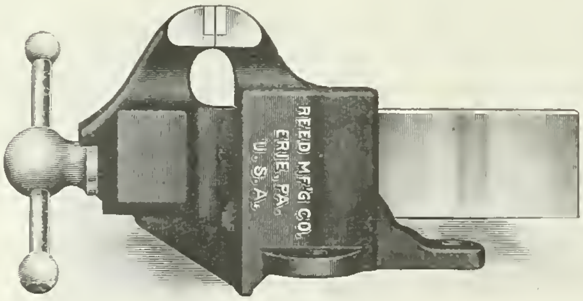
It behooves the plant executive to see that each worker who needs to use a vise (only occasionally) has one right at hand and doesn't have to cross the shop or wait while another finishes using the one he wants to use.

REED VISES

are cheap enough to put one at the work station of every man having need for a vise. They are RIGID and last longer—cheapest and most satisfactory in the end. Send for booklet.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0.1002	0.102	0.120	0.200
0.1003	0.103	0.130	0.300
0.1004	0.104	0.140	0.500
0.1005	0.105	0.150	1.000
0.1006	0.106	0.160	2.000
0.1007	0.107	0.170	3.000
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Use Set MTT and preserve your reference blocks.

You will like these cylindrical shaped gage blocks. They outwear rectangular gages, and are guaranteed for accuracy and permanency.

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They have improved expanding features. The body of expanding screw fits closely into pilot and always maintains alignment. They are true after expanding. Micrometer dial on end of pilot gives readings in ¼ thousandths. Large range of expansion. They will ream true holes in keyseated or oil-grooved holes. Made in spiral or straight flutes and special lengths. All sizes can be shipped from stock.

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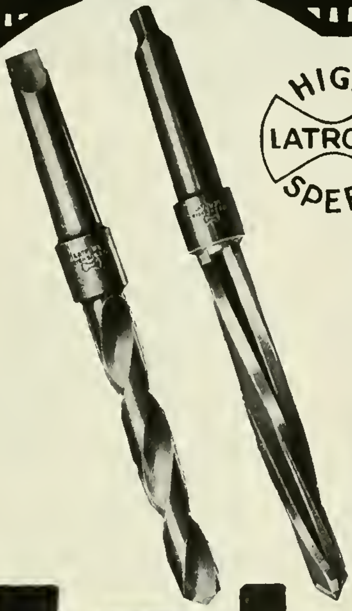

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Latrobe High Speed Drills

were the first practical combination forged and milled drills on the market.

Introduced over five years ago, their success was almost instantaneous with the result that this type of drill is being imitated and gradually adopted as standard by other leading drill manufacturers throughout the country.

Latrobe Drills have proven their worth and ultimate economy under all working conditions—they have passed the experimental stage—they are the kind your men should be using to obtain the best results.

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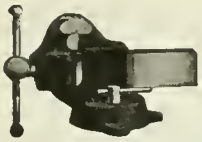
To—Purchasing agents everywhere

Subject—Yost Vises

Before choosing a vise, find out about Yost Vises. Ask any owner, user, or purchaser. He'll tell you there's no need to take advantage of the Yost replacement guarantee *but it always goes with a Yost product.*

Yost products include Stationary, Adjustable Jaw, Swivel Base and Universal Double Swivel Vises, Dial Press Vise, Pipe Vises, Anvils, etc.



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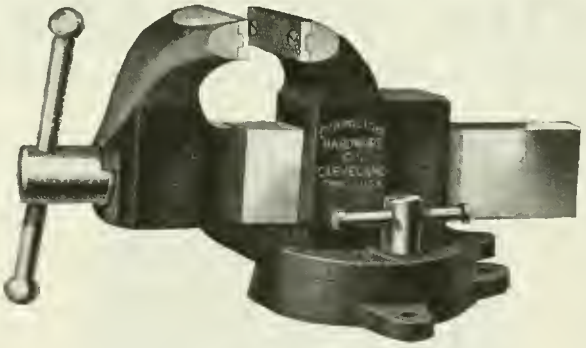

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Personality—Bright, alert, good mixer, able to absorb new ideas quickly.

APPLICATIONS — Are invited from men whom this description fits. Write giving age, and details concerning education, experience and salary received in last position; also state whether married or single.

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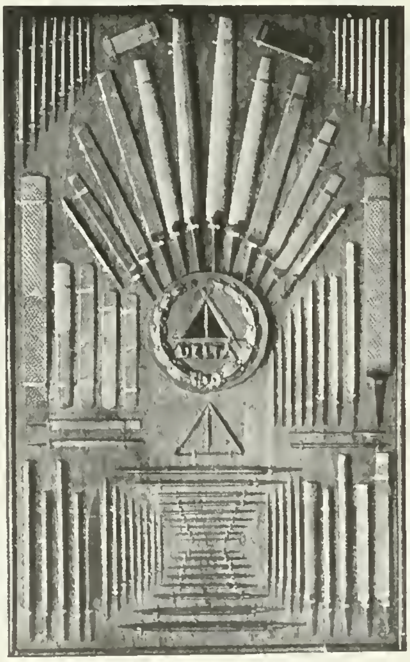

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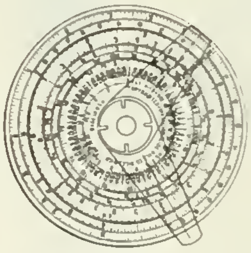

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SITUATIONS WANTED

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PATENTS SECURED—C. L. PARKER, Ex-member Examining Corps, U. S. Patent Office. Instructions upon request. McGill Bldg., Washington, D. C.

PATENTS

INDUSTRIAL MACHINERY—Special and automatic. Design, patents, construction and tests in our own mechanical, electrical and chemical laboratories. Manufacturing processes developed. GENERAL ENGINEERING AND SUPPLY CO., 160 Fifth Ave., New York.

PATENTS—H. W. T. JENNER, patent attorney and mechanical expert, 622 F St., Washington, D. C. Established 1883. I make an examination and report if a patent can be had, and the exact cost. Send for full information. Inventors assisted in developing ideas and inventions.

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C. L. PARKER
Ex-Member Examining Corps,
U. S. Patent Office

Attorney-at-Law and Solicitor of Patents

American and Foreign Patents secured. Searches made to determine patentability, validity and infringement.
Handbook for Inventors sent upon request.

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FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX SEE ALPHABETICAL INDEX, PAGES 295-296

ABRASIVE CLOTH AND PAPER
Carborundum Co., Niagara Falls, N. Y.

ACCUMULATORS, HYDRAULIC
Bethlehem Steel Co., Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Eng. Works, Charles F., 222 North Morgan St., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
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Southwark Foundry & Machine Co., Philadelphia.
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Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.

ACETYLENE, DISSOLVED
Air Reduction Sales Co., 342 Madison Ave., New York.
Prest-O-Lite Co., Inc., 30 E. 42d St., New York.

AIR HOISTS
See Hoists, Air.

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Baush Machine Tool Co., Springfield, Mass.
Chesterfield Metal Co., Detroit, Mich.
Haynes Stellite Co., 30 E. 42d St., New York.
Ludlum Steel Co., Watervliet, N. Y.
Vanadium Alloys Steel Co., Latrobe, Pa.

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Coats Mch. Tool Co., Inc., 112 W. 40th St., New York

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Columbian Hardware Co., Cleveland.
Yost Mfg. Co., Meadville, Pa.

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See Presses, Arbor

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Whitman & Barnes Mfg. Co., Akron, O.

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Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

BABBITT
Ajax Metal Co., Philadelphia, Pa.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Doehler Die Casting Co., Brooklyn, N. Y.
Hoyt Metal Co., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

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Divine Bros. Co., Utica, N. Y.
Norton Co., Worcester, Mass.
Rockford Tool Co., Rockford, Ill.

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Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Gwilliam Co., 253 West 58th St., New York.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.

BARS, BORING
See Boring Bars.

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Bunting Brass & Bronze Co., Toledo, Ohio.
Franklin Die-Casting Corp., Syracuse, N. Y.
Hoyt Metal Co., St. Louis, Mo.
Johnson Bronze Co., New Castle, Pa.
Link-Belt Company, Chicago.
Royersford Fdry. & Machine Co., 54 North 5th St., Philadelphia.
Stewart Mfg. Corp., 4503 Fullerton Ave., Chicago.
Wood's Sons Co., T. B., Chambersburg, Pa.

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Aetna Ball Bearing Mfg. Co., 2737 High St., Chicago.
Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Ball Bearing Co., Bantam, Ct.
Bearings Co. of America, Lancaster, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Cresson-Morris Co., Philadelphia.
Fafnir Bearing Co., New Britain, Ct.
Federal Bearings Co., Inc., Poughkeepsie, N. Y.
Gurney Ball Bearing Co., Jamestown, N. Y.
Gwilliam Co., 253 West 58th St., New York.
New Departure Mfg. Co., Bristol, Ct.
Norma Co. of America, Long Island City, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York
U. S. Ball Bearing Mfg. Co., 4563 Palmer St., Chicago.

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Hoyt Metal Co., St. Louis, Mo.
Johnson Bronze Co., New Castle, Pa.

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Adamson Mch. Co., Akron, O.
Royersford Foundry & Mch. Co., 54 North 5th St., Philadelphia.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, OILLESS
Arguto Oilless Bearing Co., 145 Berkley St., Wayne Junct'n, Philadelphia.

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Bantam Ball Bearing Co., Bantam, Ct.
Gwilliam Co., 253 West 58th St., New York.
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Rollway Bearing Co., Inc., Syracuse, N. Y.
Royersford Foundry & Mch. Co., 54 North 5th St., Philadelphia.
Timken Roller Bearing Co., Canton, Ohio.

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Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York
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Bearings Co. of America, Lancaster, Pa.
General Electric Co., Schenectady, N. Y.
Gwilliam Co., 253 West 58th St., New York.
Norma Co. of America, Long Island City, N. Y.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.

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Schieren Co., Charles A., 73 Ferry St., New York.

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Hoggson & Pettis Mfg. Co., New Haven, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

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Greene, Tweed & Co., 109 Duane St., New York.
Schieren Co., Charles A., 73 Ferry St., New York

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Haskins Co., R. G., 516 W. Monroe St., Chicago.
Ready Tool Co., Bridgeport, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

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Lupton's Sons Co., David, Philadelphia.

BENDING MACHINES, ANGLE IRON
Buffalo Forge Co., Buffalo, N. Y.
Wickes Bros., Saginaw, Mich.

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Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.
Williams, White & Co., Moline, Ill.

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Sellers & Co., Inc., Wm., Philadelphia.
Southwark Foundry & Machine Co., Philadelphia
Underwood Corp., H. B., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

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See Hoists, etc.

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Ingersoll-Rand Co., 11 Broadway, New York.
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Leiman Bros., 60-62 Lispenard St., New York.

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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.

BLUEPRINT FILING CABINETS
See Cabinets, Filing.

BLUEPRINT MACHINES
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Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.
Wickes Bros., Saginaw, Mich.

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Paragon Machine Co., Rochester, N. Y.

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Ryerson & Sons, Joseph T., 2558 W. 16th St., Chicago.

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Ajax Mfg. Co., Cleveland
Landis Machine Co., Inc., Waynesboro, Pa.
National Acme Co., Cleveland.
National Machinery Co., Tiffin, O.

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Wiley & Sons, Inc., John, 432 Fourth Ave., New York

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Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
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Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
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Gisholt Machine Co., 9 So. Baldwin St., Madison, Wis.
Ingersoll Milling Mch. Co., Rockford, Ill.
Moline Tool Co., Moline, Ill.
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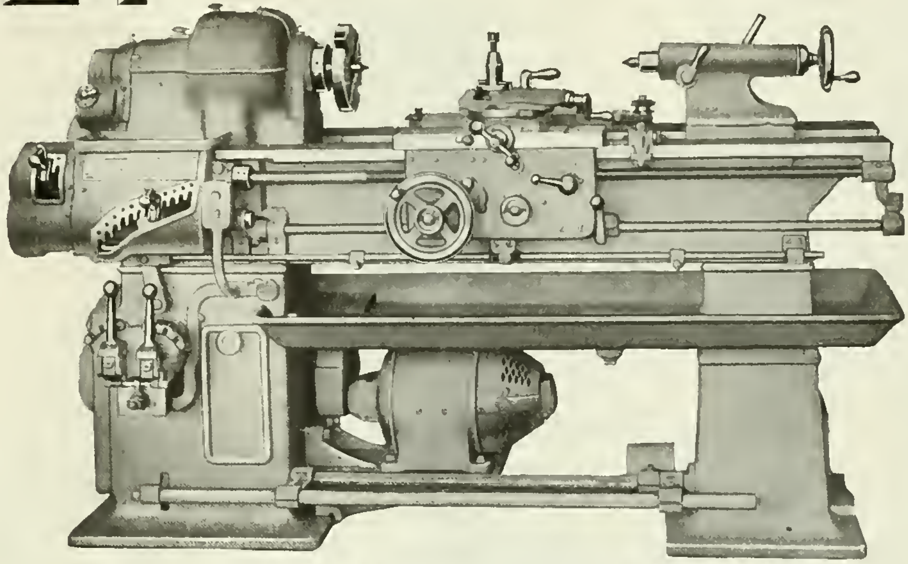

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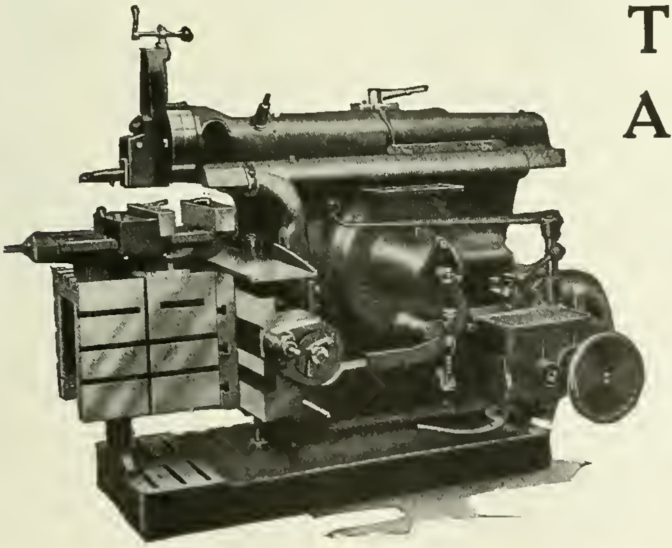

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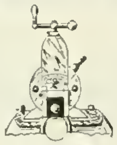

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Johnson Bronze Co., New Castle, Pa.

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Chase Metal Works, Waterbury, Conn.

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Builders Iron Foundry, Providence, R I.
Cleveland Armature Works, Cleveland,
Dillon Electric Co., Canton, O
Divine Bros. Co., Utica, N. Y
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Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis
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Stow Mfg. Co., Binghamton, N Y.

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Wilmington Fibre Specialty Co., Wilmington, Del.

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See furnaces, Case-hardening.

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Tiffin Brass & Bronze Co., Tiffin, O.

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Hoyt Metal Co., St. Louis, Mo.
Mt Vernon Die-Casting Corp., Mt. Vernon, N. Y.
Phoenix Die Casting Co., Buffalo, N Y.
Republic Die Casting Co., 138 Mott St., New York.
Stewart Mfg. Corp., 4503 Fullerton Ave., Chicago.
Superior Die-Casting Co, Cleveland.
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn

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Franklin Die-Casting Corp., Syracuse, N. Y.
Mt Vernon Die-Casting Corp., Mt. Vernon, N. Y
Republic Die Casting Co., 138 Mott St., New York.
Stewart Mfg. Corp., 4503 Fullerton Ave., Chicago.
Superior Die-Casting Co., Cleveland.

CASTINGS, GRAY IRON

Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engineering Co., Chambersburg, Pa
Cresson-Morris Co. Philadelphia.
Machinery Co. of America, Big Rapids, Mich.
Reed-Prentice Co., Worcester, Mass.
Toledo Mch. & Tool Co., Toledo, O.

CASTINGS, MALLEABLE

Link-Belt Company, Chicago.

CASTINGS, STEEL

Cresson-Morris Co., Philadelphia
Farrell-Cheek Steel Foundry Co, Sandusky, O

CAST-IRON HARDENING COMPOUND

Macalene Co., St. Cloud, Minn.

CEMENT, DISC GRINDING WHEEL

Badger Tool Co., Beloit, Wis.
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.

CENTERING MACHINES

Consolidated Mch. Tool Corp. of America, 17 E 42nd St., New York
Hanson-Whitney Machine Co., Hartford, Conn.
Hendey Mch. Co., Torrington, Conn.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis
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Standard Engineering Works, Pawtucket, R. I
Whiton Mch. Co., D. E., New London, Conn.

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Morse Twist Drill & Mch. Co., New Bedford, Mass.

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See Hoists, Chain, etc.

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Smith & Egge Mfg. Co, Bridgeport, Conn.

CHAINS, POWER TRANSMISSION

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Boston Gear Works, Norfolk Downs, Mass
Diamond Chain & Mfg Co Indianapolis, Ind
Duckworth Chain & Mfg Co, Springfield, Mass.
Link-Belt Company, Chicago
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Morton, Thomas, 245 Centre St., New York.
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Noble & Westbrook Mfg Co., Hartford, Conn.
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Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Machine Co, Pawtucket, R I

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Jones & Lamson Machine Co., Springfield, Vt
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Frontier Chuck & Tool Co., Buffalo, N. Y.
Garvin Machine Co., Spring and Varick Sts., New York.
Hannifin Mfg. Co., Kolmar Ave. and Lexington St, Chicago.
Logansport Machine Co, 529 Market St., Logansport, Ind.
Nelson-Blanck Mfg. Co., Detroit, Mich.

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Standard Engineering Works, Pawtucket, R. I.
Stark Tool Co., Waltham, Mass.
Wade-American Tool Co., Waltham, Mass.
Whitney Mfg Co., Hartford, Conn.

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Almond Mfg. Co., T. R, Ashburnham, Mass.
Beaman & Smith Co., Providence R I.
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Consolidated Machine Tool Corp. of America, 17 E. 42nd St., N Y.
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Goodell-Pratt Co., Greenfield, Mass.
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Jacobs Mfg Co., Hartford, Conn.
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Modern Tool Co., Erie, Pa
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National Twist Drill & Tool Co., Detroit Mich
Production Engineering Corp., Canastota, N Y.

Scully-Jones Co., 13th and Robey Sts., Chicago.
Skinner Chuck Co., New Britain, Ct.
Standard Tool Co., Cleveland
Titan Tool Co., Erie, Pa
Trump Bros. Machine Co., Wilmington, Del.
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Wahlstrom Tool Co., 2nd Ave. and 56th St., Brooklyn, N Y.
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Westcott Chuck Co., Oneida, N. Y.
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Whiton Machine Co., D. E, New London, Conn

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Watts Bros. Tool Works, Turtle Creek, Pa.

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Horton & Son Co., E., Windsor Locks, Conn.
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Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
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Thomas Elevator Co., 24 So. Hoyne Ave., Chicago.
Union Mfg. Co., New Britain, Conn.
Westcott Chuck Co, Oneida, N Y.
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Skinner Chuck Co., New Britain, Ct.
Union Mfg. Co., New Britain, Conn.

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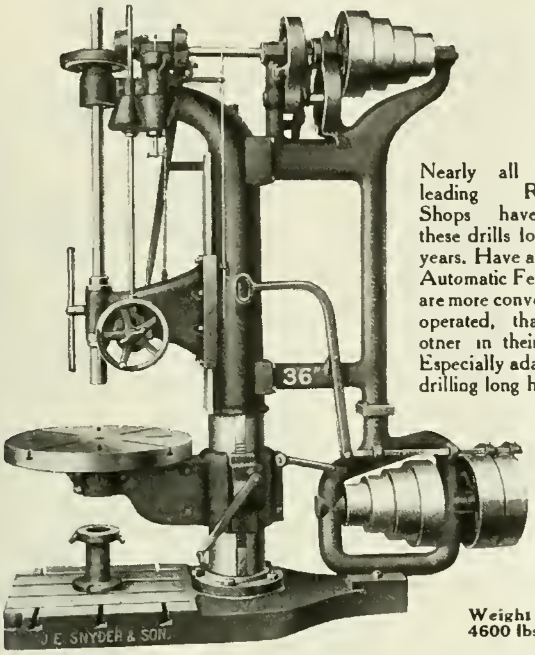

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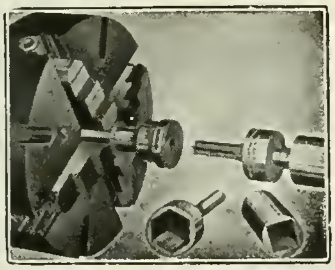

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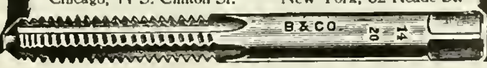

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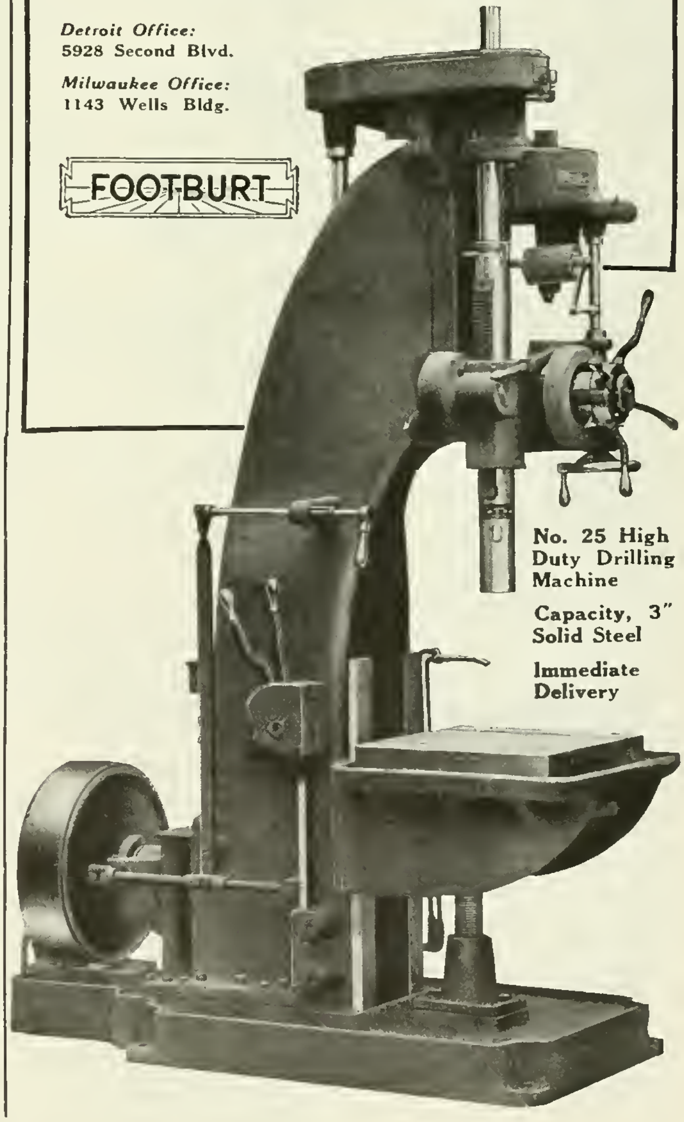

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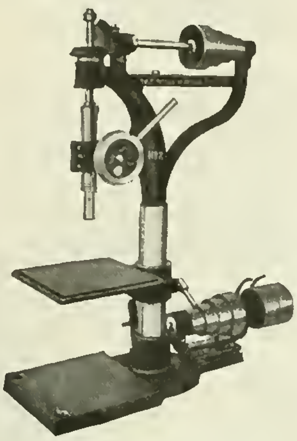

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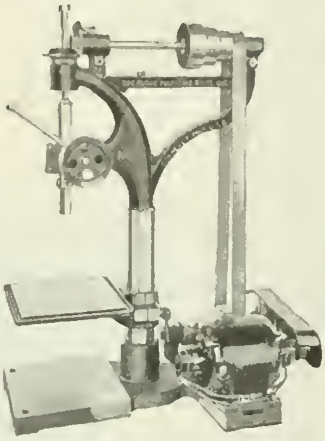

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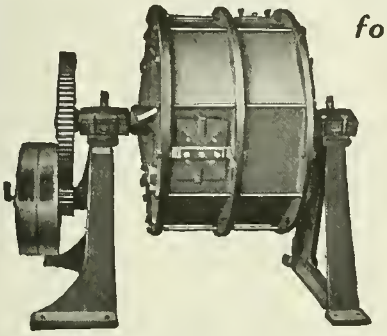

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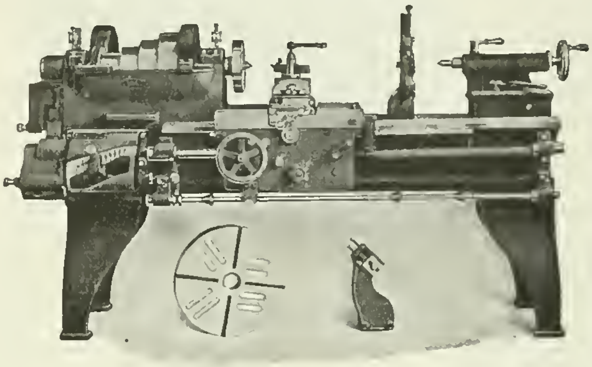

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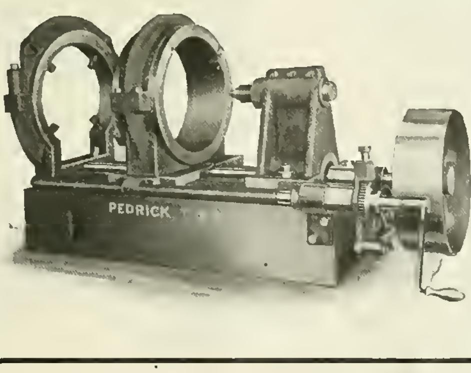

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Simonds Saw & Steel Co., Fitchburg, Mass.

FILING MACHINES, DIE, ETC.
Ames Co., B. C., Waltham, Mass.
Haskins Co., R. G., 516 W. Monroe St., Chicago.
Illinois Tool Works, 160 E. Erie St., Chicago.
La Porte Mch. & Tool Co., La Porte, Ind.
Oliver Instrument Co, Adrian, Mich.

FILTERS, OIL
Oil & Waste Saving Mch. Co, Philadelphia.
Tolhurst Machine Works, Troy, N. Y

FITTINGS, HYDRAULIC
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Southwark Foundry & Machine Co., Philadelphia
Watson-Stillman Co., 192 Fulton St., New York.

FITTINGS, STEAM
Dart Mfg. Co., E. M Providence, R. I.

FLUX, WELDING
Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.

FORGES
American Gas Furnace Co., Elizabeth, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Machinery Co. of America, Big Rapids, Mich.

FORGING MACHINES
Acme Machinery Co., Cleveland.
Ajax Mfg. Co., Cleveland.
Beaudry & Co., Inc., Boston.
Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Williams, White & Co., Moline, Ill.

FORGINGS, DROP
Bearings Co. of America, Lancaster, Pa.
Champion Machine & Forging Co., Cleveland, O.
Johnston & Jennings Co., Addison Rd. and Lake Shore R. R. Tracks, Cleveland, O.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

FORGINGS, IRON AND STEEL
American Hollow Boring Co., Erie, Pa.
Champion Machine & Forging Co., Cleveland, O.
Dyson & Sons, Joseph, Cleveland.
Johnston & Jennings Co., Addison Rd. and Lake Shore R. R. Tracks, Cleveland, O.
Machinery Forging Co., Cleveland.

FORMING AND BENDING MACHINES
Air Reduction Sales Co., 342 Madison Ave., New York.
Bethlehem Steel Co., Bethlehem, Pa.
Davis-Bournonville Co (Air Reduction Sales Co.), 342 Madison Ave., New York
Niagara Machine & Tool Works, Buffalo, N. Y.
Shuster Co., F. B., New Haven, Conn.

FOUNDRY EQUIPMENT
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Company, 11 Broadway, New York.

FURNACES, ANNEALING
American Gas Furnace Co., Elizabeth, N. J
Brown & Sharpe Mfg. Co., Providence, R. I.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 362 Gerard Ave., New York.

FURNACES, CASE-HARDENING
American Gas Furnace Co., Elizabeth, N. J.
Brown & Sharpe Mfg. Co., Providence, R. I
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 362 Gerard Ave., New York.

FURNACES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Hoskins Mfg Co., Detroit, Mich.
Strong, Carlisle & Hammond Co., Cleveland

FURNACES, HARDENING
American Gas Furnace Co., Elizabeth, N. J
Brown & Sharpe Mfg. Co., Providence, R. I
General Electric Co., Schenectady, N. Y.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 362 Gerard Ave., New York.

FURNACES, MELTING
American Gas Furnace Co., Elizabeth, N. J.
Chicago Flexible Shaft Co., 1154 So. Central Ave., Chicago.
General Electric Co., Schenectady, N. Y.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 362 Gerard Ave., New York.

FURNACES, TEMPERING
American Gas Furnace Co., Elizabeth, N. J
Brown & Sharpe Mfg. Co., Providence, R. I
General Electric Co., Schenectady, N. Y.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 362 Gerard Ave., New York.

FURNITURE, DRAFTING-ROOM
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Economy Drawing Table & Mfg. Co., Adrian, Mich.

FURNITURE, SHOP
Lupton's Sons Co., David, Philadelphia.
Western Tool & Mfg Co., Springfield, O

FUSES, ELECTRIC
General Electric Co., Schenectady, N. Y.

GAGES STANDARDS
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Van Keuren Co., Boston.

GAGES, COMPARATOR
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Jones & Lamson Machine Co., Springfield, Vt.

GAGES, DEPTH
Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.

GAGES, DIAL
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y
Wallace Bros., 160 N. Wells St., Chicago.

GAGES, HEIGHTH
Brown & Sharpe Mfg. Co., Providence, R. I
Starrett Co., L. S., Athol, Mass.

GAGES, PLUG AND RING
Brown & Sharpe Mfg. Co., Providence, R. I.
Budd-Ranney Engineering Co., Columbus, O.
Coats Mch. Tool Co., Inc., 112 W 40th St., New York.
Ferner Co., Roy Y, Washington, D. C.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Precision & Thread Grinder Mfg. Co., Philadelphia
Van Keuren Co., Boston.

GAGES, RECORDING, STEAM VACUUM
Bristol Co., Waterbury, Conn.
Taylor Instrument Companies, Rochester, N. Y.

GAGES, SNAP
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass
Ferner Co., Roy Y., Washington, D. C.
Pratt & Whitney Co., Hartford, Conn.
Precision & Thread Grinder Mfg Co., Philadelphia.
Reliance Die & Stamping Co., 515 N. La Salle St., Chicago.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N Y
Van Keuren Co., Boston.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y

GAGES, SURFACE
Brown & Sharpe Mfg Co., Providence, R. I.
Columbus Die, Tool & Mch. Co., Columbus, O.
Goodell-Pratt Co., Greenfield, Mass.
Pratt & Whitney Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y

GAGES, TAPER
Pratt & Whitney Co., Hartford, Conn
Starrett Co., L. S., Athol, Mass.

GAGES, THREAD
Brown & Sharpe Mfg. Co., Providence, R. I.
Ferner Co., Roy Y., Washington, D. C.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Tap & Die Corp.; Greenfield, Mass.
Hanson Tap & Gauge Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn
Precision & Thread Grinder Mfg. Co., Philadelphia.
Reliance Die & Stamping Co., 515 No. La Salle St., Chicago.
Starrett Co., L. S., Athol, Mass.

GASKETS
Greene, Tweed & Co., 109 Duane St., New York
Wilmington Fibre Specialty Co., Wilmington, Del

GEAR BLANKS, BRONZE
Bunting Brass & Bronze Co., Toledo, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

GEAR BLANKS, RAWHIDE
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Ganschow Co., Wm., Washington Blvd. and Morgan St., Chicago.
Meachem Gear Corp., Syracuse, N. Y.

GEAR BLANKS, STEEL
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y

GEAR CUTTING MACHINES, BEVEL (GENERATOR AND TEMPLET PLANER)
Bilgram Machine Works, 1231 Spring Garden St., Philadelphia.
Gleason Works, Rochester, N. Y

GEAR CUTTING MACHINES, BEVEL (ROTARY CUTTER)
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J
Newark Gear Cutting Machine Co., Newark, N. J.
Whiton Mch. Co., D. E., New London, Conn.

GEAR CUTTING MACHINES, HELICAL AND SPUR (HOB)
Adams Co., Dubuque, Iowa
Barber-Colman Co., Rockford, Ill.
Cincinnati Gear Cutting Mch. Co., Cincinnati.
Gould & Eberhardt, Newark, N. J
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.

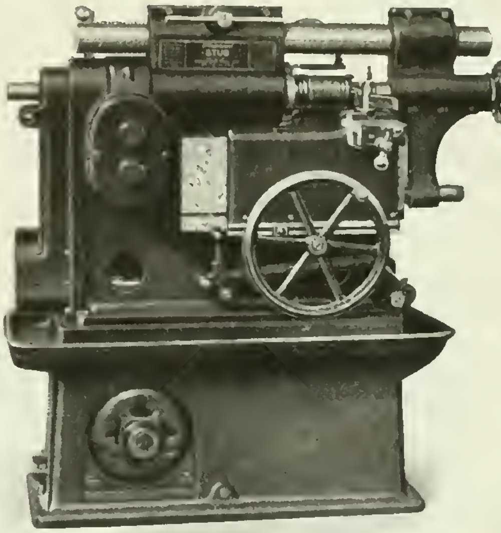
GEAR CUTTING MACHINES, HELICAL AND SPUR (SHAPER OR PLANER TYPE)
Fellows Gear Shaper Co., Springfield, Vt.

GEAR CUTTING MACHINES, SPIRAL PINION ROUGHER
Gleason Works, Rochester, N. Y

GEAR CUTTING MACHINES SPIRAL BEVEL
Gleason Works, Rochester, N. Y

GEAR CUTTING MACHINES, SPUR (ROTARY CUTTER)
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Gear Cutting Mch. Co., Cincinnati.
Gould & Eberhardt, Newark, N. J
Newark Gear Cutting Machine Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

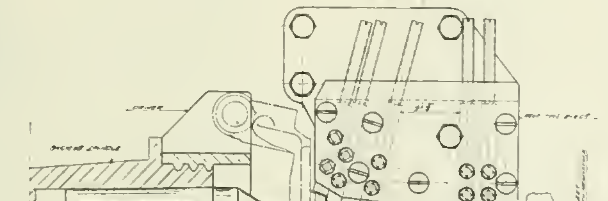
The Multiple Tooling Possibilities of the "Stub" are Practically Unlimited



Provision is made for mounting an air cylinder and draw bar for chuck—in such work as can be held in an air chuck—these attachments are supplied to meet individual requirements. The front tool slide has stop screws underneath for tool adjustment and the slide is of sufficient width so that several tools can be clamped on at one setting. The rear tool is supplied as standard equipment; it has 4″ in and out travel and ample adjustment sideways.

The overhanging arm, 3½″ in diameter, is so arranged that tools can be clamped on for doing several operations; such as facing and boring, center drilling, etc. Adjustment can easily be made by means of a rack and pinion. A rack is cut on the overhanging arm.

These features add greatly to the productivity and range of the Stub Lathe—a remarkable tool for the manufacture of such work as pistons, wheel hubs, gear blanks, ball joints, steering knuckles, etc. Send for the circular.



The Sundstrand Stub Lathe is ideally suited for turning automobile steering knuckles. The lay-out shown above represents the tooling designed for this part.

ROCKFORD TOOL CO.

ROCKFORD, ILL., U. S. A.

DOMESTIC AGENTS: Manning, Maxwell & Moore, Inc., Boston, Mass.; Homer, Strong & Co., Inc., Buffalo, N. Y.; Manning, Maxwell & Moore, Inc., Chicago, Ill.; Manning, Maxwell & Moore, Inc., Cincinnati, Ohio; Co-Operative Machinery Co., Cleveland, Ohio; Mid-West Machine Tool & Supply Co., Davenport, Iowa; M. D. Larkin Supply Co., Dayton, Ohio; Cadillac Machinery Co., Detroit, Mich.; McMullen Machinery Co., Grand Rapids, Mich.. Mid-West Machinery Co., Kansas City, Mo.; Herberts Machinery & Supply Co., Los Angeles, Cal.; Western Iron Stores Co., Milwaukee, Wis.; F. E. Satterlee Co., Minneapolis, Minn.; Fairbanks Co., New Orleans, La.; Manning, Maxwell & Moore, Inc., New York City; Manning, Maxwell & Moore, Inc., Philadelphia, Pa.; Manning, Maxwell & Moore, Inc., Pittsburgh, Pa. Homer, Strong & Co., Inc., Rochester, N. Y.; Herberts Machinery & Supply Co., San Francisco, Cal.; American Hardware & Steel Products Co., Seattle, Wash.; Manning, Maxwell & Moore, Inc., Seattle, Wash.; West Coast Mchy. Co., 1006 First Ave., S., Seattle, Wash. Manning, Maxwell & Moore, Inc., Syracuse, N. Y.

CANADIAN AGENTS: Rudel-Belnap Machinery Co., Ltd., Montreal, Que.; Albert Herbert, Ltd., Toronto, Ont.; Jones & Shipman, Ltd., Toronto, Ont.; Sales Limited, Vancouver, B. C.; Charles A. Strelinger Co., Ltd., Windsor, Ont.; General Supply Co. of Canada, Ltd., Winnipeg, Man.

FOREIGN AGENTS: Casamitjana Hermanos, Barcelona, Spain; Roku-Roku-Shoten, Tokyo, Japan; A. A. Jones & Shipman, Ltd., Leicester, England; R. S. Stokvis & Fils, Paris, France; M. Mett Engineering Co. (Petrograd, Russia), 1 Madison Ave., New York City; R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland; Anness & Sessums, Sena, Mexico, D. F. Aktiebolaget Rylander & Asplund, Stockholm, Sweden. (For China, Siberia and P. I.); Marx & Traube, Mainzedlandstrasse Nr. 51, Frankfurt, Germany; Swiss Machinery Import Co., Zurich.

GEAR CUTTING MACHINES. WORMS AND WORM WHEELS (HOB)

Adama Co, Dubuque, Iowa.
Barber-Colman Co., Rockford, Ill.
Cincinnati Gear Cutting Mch. Co., Cincinnati.
Gould & Eberhardt, Newark, N. J.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.

GEAR HARDENING MACHINES

Gleason Works, Rochester, N. Y.

GEARS, CUT

Adams Co., Dubuque, Iowa.
Albaugh-Dover Co., 2100 Marshall Blvd., Chicago.
Alling-Lander Co., Inc., Sodus, N. Y.
Atlantic Elevator Co., Inc., Philadelphia.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Machine Works, 1231 Spring Garden St., Philadelphia.
Boston Gear Works, Norfolk Downs, Mass.
Brown Co., A. & F., 79 Barclay St., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Christiana Mch. Co., Christiana, Pa.
Cincinnati Gear Co., Cincinnati.
Connecticut Gears, Inc., Waterbury, Conn.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Davis, Rodney, Philadelphia.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Fawcus Mch. Co., Pittsburgh.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., 232 North Curtis St., Chicago.
Ganschow Co., Wm., Washington Blvd. and Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Inc., Boston.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Hindley Gear Co., Philadelphia.
Horsburgh & Scott Co., Cleveland.
James Mfg. Co., D. O., 1120 West Monroe St., Chicago.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Link-Belt Company, Chicago.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.
Niles-Bement-Pond Co., 111 Broadway, New York.
Nuttall Co., R. D., Pittsburgh, Pa.
Perkins Appliance Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia.
Pittsburgh Gear & Mch. Co., 2700 Smallman St., Pittsburgh.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Mch. Co., Cleveland.
Toledo Mch. & Tool Co., Toledo, O.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

GEARS, DOUBLE HELICAL, CUT

Bethlehem Steel Co., Bethlehem, Pa.
Connecticut Gears, Inc., Waterbury, Conn.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Fawcus Machine Co., Pittsburgh.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Horsburgh & Scott Co., Cleveland.
Meachem Gear Corp., Syracuse, N. Y.
Newark Gear Cutting Machine Co., Newark, N. J.
Pittsburgh Gear & Mch. Co., 2700 Smallman St., Pittsburgh.

GEARS, FABRIC AND FIBRE

Boston Gear Works, Norfolk Downs, Mass.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Continental Fibre Co., Newark, Del.
Diefendorf Gear Corp., Syracuse, N. Y.
Formica Insulation Co., Cincinnati.
Ganschow Co., Wm., Washington Blvd. and Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Grant Gear Works, Inc., Boston.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
James Mfg. Co., D. O., 1120 West Monroe St., Chicago.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.

GEARS, FORGED

Nuttall Co., R. D., Pittsburgh.

GEARS, MOLDED

Brown Co., A. & F., 79 Barclay St., New York.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Christiana Mch. Co., Christiana, Pa.
Franklin Die-Casting Corp., Syracuse, N. Y.
Jones Fdry. & Mch. Co., W. A., 4406 West Roosevelt Road, Chicago.
Link-Belt Company, Chicago.
Philadelphia Gear Works, Philadelphia.
Pittsburgh Gear & Mch. Co., 2700 Smallman St., Pittsburgh.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.

GEARS, NON-METALLIC

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago.
Boston Gear Works, Norfolk Downs, Mass.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Foote Bros. Gear & Machine Co., 232 North Curtis St., Chicago.
Formica Insulation Co., Cincinnati.
Ganschow Co., Wm., Washington Blvd. and Morgan St., Chicago.
Grant Gear Works, Inc., Boston.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Horsburgh & Scott Co., Cleveland.
James Mfg. Co., D. O., 1120 West Monroe St., Chicago.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Newark Gear Cutting Machine Co., Newark, N. J.
Nuttall Co., R. D., Pittsburgh.
Philadelphia Gear Works, Philadelphia
Pittsburgh Gear & Mch. Co., 2700 Smallman St., Pittsburgh.
Simonds Mfg. Co., Pittsburgh.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

GEARS, RAWHIDE

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago.
Brown Co., A. & F., 79 Barclay St., New York.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Fawcus Machine Co., Pittsburgh.
Foote Bros. Gear & Machine Co., 232 North Curtis St., Chicago.
Ganschow Co., Wm., Washington Blvd., and Morgan St., Chicago.
Grant Gear Works, Inc., Boston.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Horsburgh & Scott Co., Cleveland.
James Mfg. Co., D. O., 1120 West Monroe St., Chicago.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Nuttall Co., R. D., Pittsburgh.
Philadelphia Gear Works, Philadelphia.
Pittsburgh Gear & Mch. Co., 2700 Smallman St., Pittsburgh.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Mch. Co., Cleveland.

GEARS, WORM

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago.
Alling-Lander Co., Inc., Sodus, N. Y.
Alantic Elevator Co., Inc., Philadelphia.
Baush Machine Tool Co., Springfield, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Co., A. & F., 79 Barclay St., New York.
Cincinnati Gear Co., Cincinnati.
Cleveland Worm & Gear Co., Cleveland.
Connecticut Gears, Inc., Waterbury, Conn.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 232 North Curtis St., Chicago.
Ganschow Co., Wm., Washington Blvd. and Morgan St., Chicago.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Hindley Gear Co., Philadelphia.
Horsburgh & Scott Co., Cleveland.
James Mfg. Co., D. O., 1120 West Monroe St., Chicago.
Link-Belt Company, Chicago.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Newark Gear Cutting Machine Co., Newark, N. J.
Nuttall Co., R. D., Pittsburgh.
Perkins Appliance Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia.
Pittsburgh Gear & Mch. Co., 2700 Smallman St., Pittsburgh.
Simonds Mfg. Co., Pittsburgh
Stahl Gear & Mch. Co., Cleveland.

GEAR TESTING MACHINERY

Adams Co., Dubuque, Iowa
Ferner Co., Roy Y., Washington, D. C.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.
Gleason Works, Rochester, N. Y.
Manufacturers Consulting Engineers, Syracuse, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

GENERATORS, ACETYLENE

Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.

GENERATORS, ELECTRIC

General Electric Co., Schenectady, N. Y.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland.

GENERATORS, GAS

American Gas Furnace Co., Elizabeth, N. J.

GIBS AND KEYS FOR CONNECTING RODS

Moltrup Steel Products Co., Beaver Falls, Pa.

GLUE HEATERS

Divine Bros. Co., Utica, N. Y.
General Electric Co., Schenectady, N. Y.
Globe Mch. & Stamping Co., Cleveland, O.

GRADUATING MACHINES

Ferner Co., Roy Y., Washington, D. C.
Noble & Westbrook Mfg Co., Hartford, Conn.

GREASE

Sun Oil Company, Philadelphia.
Texas Company, 17 Battery Place, New York.

GREASE CUPS

Bowen Products Corp., Auburn, N. Y.
Link-Belt Company, Chicago.

GRINDING MACHINES. ABRASIVE BELT

Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Production Machine Co., Greenfield, Mass.

GRINDING MACHINES, BENCH

Athol Mch. & Foundry Co., Athol Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Fdry., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati
Cleveland Armature Works, Cleveland.
Diamond Machine Co., Providence, R. I.
Dillon Electric Co., Canton, O.
Forbes & Myers, 178 Union St., Worcester, Mass.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Goodell-Pratt Co., Greenfield, Mass.
Hardinge Bros., Inc., Bereau and Ravenswood Aves., Chicago.
Machinery Co. of America, Big Rapids, Mich.
Marathon Electric Mfg. Co., Wausau, Wis.
Marschke Mfg. Co., Indianapolis, Ind.
Neil & Smith Electric Tool Co., Cincinnati.
Ransom Mfg. Co., Oshkosh, Wis
Rivett Lathe & Grinder Corp., Brighton, Boston.
Wilmarth & Mornon Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.

GRINDING MACHINES, CENTER

Cincinnati Elec. Tool Co., Cincinnati.
Diamond Mch. Co., Providence, R. I.
Neil & Smith Electric Tool Co., Cincinnati.
Stroud, Arva, 233 Broadway, N. Y.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati.

GRINDING MACHINES, CENTERLESS

Ball & Roller Bearing Co., Danbury, Conn.
Detroit Mch. Tool Co., 6525 St. Antoine St., Detroit, Mich.
Reeves Pulley Co., Columbus, Indiana.

GRINDING MACHINES, CHASER OR DIE

Geometric Tool Co., New Haven, Conn
Precision & Thread Grinder Mfg. Co., Philadelphia.

GRINDING MACHINES. CHUCKING

Bryant Chucking Grinder Co., Springfield, Vt.

GRINDING MACHINES, CUTTER

Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Gear Cutting Mch. Co., Cincinnati.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Garvin Machine Co., Spring and Varick Sts., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Tap & Die Corp., Greenfield, Mass.
Ingersoll Milling Machine Co., Rockford, Ill.
LeBlond Machine Tool Co., R. K., Cincinnati.
Machinery Co. of America, Big Rapids, Mich.
Modern Tool Co., Erie, Pa.
Newark Gear Cutting Machine Co., Newark, N. J.
Norton Co., Worcester, Mass.
Osterlein Machine Co., Cincinnati.
Pratt & Whitney Co., Hartford, Conn.
Precision & Thread Grinder Mfg. Co., Philadelphia.
Taylor & Fenn Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
Universal Grinding Mch. Co., Fitchburg, Mass.
Waltham Machine Works, Waltham, Mass.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.
Woods Engineering Co., Alliance, O.

GRINDING MACHINES, CYLINDER

Heald Machine Co., 16 New Bond St., Worcester, Mass.

GRINDING MACHINES. CYLINDRICAL, PLAIN

Brown & Sharpe Mfg. Co., Providence, R. I.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Fitchburg Grinding Mch. Co., Fitchburg, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Precision & Thread Grinder Mfg. Co., Philadelphia.
Universal Grinding Mch. Co., Fitchburg, Mass.

GRINDING MACHINES. CYLINDRICAL, UNIVERSAL

Brown & Sharpe Mfg. Co., Providence, R. I.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Fitchburg Grinding Mch. Co., Fitchburg, Mass.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa
Pratt & Whitney Co., Hartford, Conn.
Thompson Grinder Co., Springfield, O.
Universal Grinding Mch. Co., Fitchburg, Mass.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.
Woods Engineering Co., Alliance, O.

GRINDING MACHINES, DIE SINKERS' PORTABLE

Keller Mechanical Engineering Corp., 74 Washington St., Brooklyn, N. Y.

GRINDING MACHINES, DISC

Badger Tool Co., Beloit, Wis.
Besly Co., Charles H., 120-B North Clinton St., Chicago.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Machine Co., Providence, R. I.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.
Rowbottom Machine Co., Waterbury, Conn.

GRINDING MACHINES, DRILL

Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Cleveland Stone Co., Cleveland.
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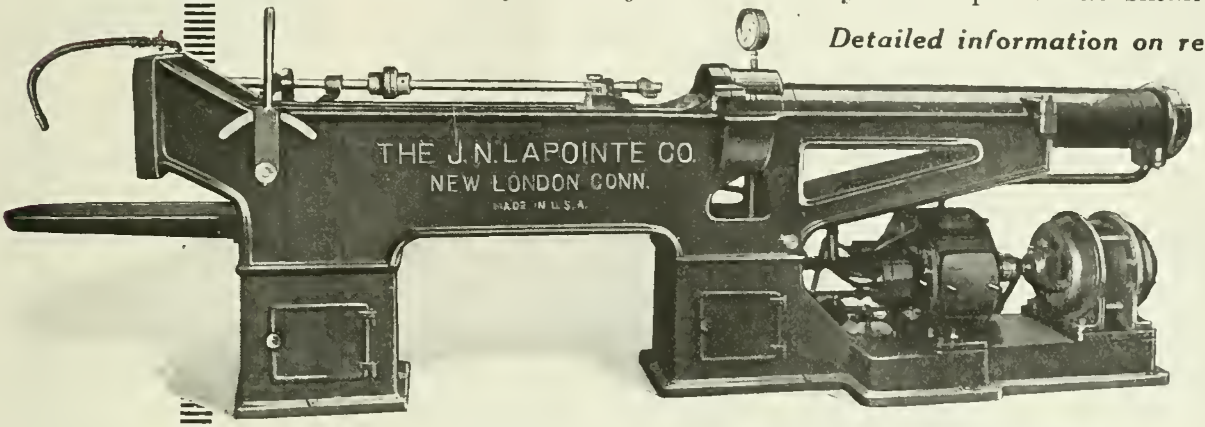

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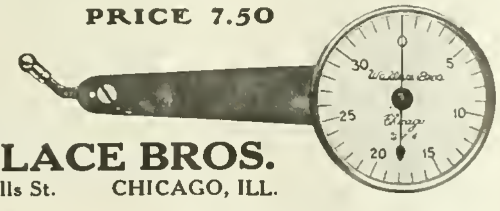

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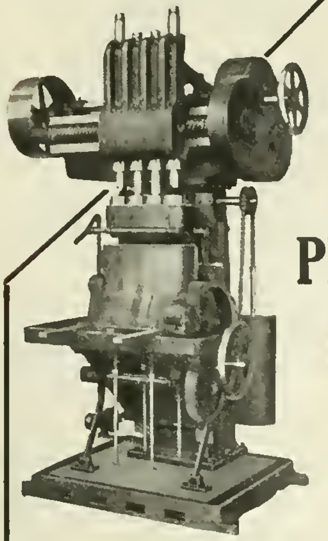

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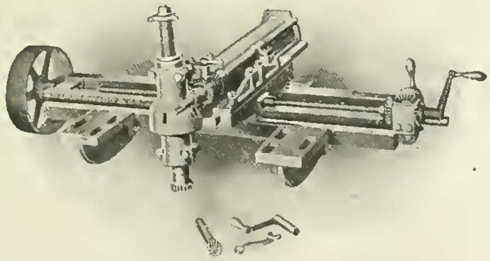

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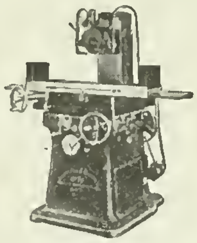

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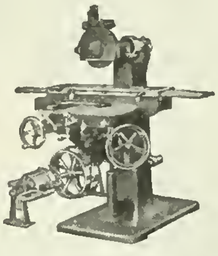

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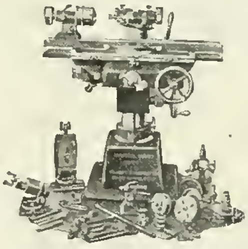

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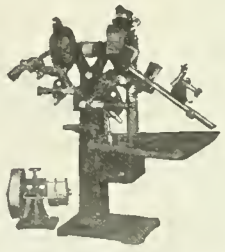

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Champion Tool Works, 4955 Spring Grove Ave., Cincinnati.
Cisco Machine Tool Co., Cincinnati.
Diamond Machine Co., Providence, R. I.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Inc., Nashua, N. H.
Garvin Machine Co., Spring and Varick Sts., New York.
Greaves-Klusman Tool Co., Cincinnati.
Hendey Mch. Co., Torrington, Conn.
LeBlond Mch. Tool Co., R. K., Cincinnati.
Lodge & Shipley Machine Tool Co., Cincinnati.
Monarch Machine Tool Co., 209 Oak St., Sidney, O.
Mueller Mch. Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Rockford Tool Co., Rockford, Ill.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Stark Tool Co., Waltham, Mass.
Vandyck-Churchill Co., 149 Broadway, New York.

LATHE DOGS

Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Ready Tool Co., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

LATHE DOGS, SAFETY

Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

LATHE, PLANER AND SHAPER TOOLS

Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Gisholt Machine Co., 9 So. Baldwin St., Madison, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
McCrosky Tool Corp., Meadville, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Ready Tool Co., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

LATHES, AUTOMATIC

Gisholt Machine Co., 9 So. Baldwin St., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Cincinnati, O.
National Acme Co., Cleveland.
Potter & Johnston Machine Co., Pawtucket, R. I.
Reed-Prentice Co., Worcester, Mass.
Rockford Machine Tool Co., Rockford, Ill.

LATHES, AUTOMATIC SCREW THREADING

Automatic Machine Co., Bridgeport, Conn.

LATHES, AXLE

Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

LATHES, BENCH

Ames Co., B. C., Waltham, Mass.
Diamond Mch. Co., Providence, R. I.
Elgin Tool Works, Inc., Elgin, Ill.
Goodell-Pratt Co., Greenfield, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hjorth Lathe & Tool Co., Boston.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
South Bend Lathe Works, Inc., South Bend, Ind.
Stark Tool Co., Waltham, Mass.
Van Norman Machine Tool Co., Springfield, Mass.
Wade-American Tool Co., Waltham, Mass.

LATHES, BORING

Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Gisholt Machine Co., 9 So. Baldwin St., Madison, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

LATHES, BRASS WORKERS'

Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Cleveland.
Dreses Machine Tool Co., Cincinnati.
Garvin Machine Co., Spring and Varick Sts., New York.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Warner & Swasey Co., Cincinnati.

LATHES, CAR WHEEL

Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

LATHES, CRANKSHAFT

American Tool Works Co., Cincinnati
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
LeBlond Machine Tool Co., R. K., Cincinnati.
Lodge & Shipley Machine Tool Co., Cincinnati.
Niles-Bement-Pond Co, 111 Broadway, New York.
Wickes Bros., Saginaw, Mich.

LATHES, DOUBLE END

Rockford Milling Mch. Co., Rockford, Ill.

LATHES, ENGINE

American Tool Works Co., Cincinnati.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill
Betts Machine Co., Rochester, N. Y.
Bradford Mch. Tool Co., Cincinnati.
Carroll, A. Y., Machine Tool Co., Cincinnati.
Carroll & Jamieson Machine Tool Co., Batavia, O.
Champion Tool Works, 4955 Spring Grove Ave., Cincinnati.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Cisco Machine Tool Co., Cincinnati.•
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Flather & Co., Inc., Nashua, N. H.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.
Greaves-Klusman Tool Co., Cincinnati.
Hamilton Mch. Tool Co., Hamilton, O.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hendey Mch. Co., Torrington, Conn.
LeBlond Machine Tool Co., R K, Cincinnati.
Lodge & Shipley Machine Tool Co., Cincinnati.
Monarch Machine Tool Co., 200 Oak St., Sidney, O.
Morris Machine Co., Cincinnati.
Mueller Mch. Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Rockford Lathe & Drill Co., Rockford, Ill.
Rockford Tool Co., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Sidney Machine Tool Co., Sidney, O.
South Bend Lathe Works, Inc., South Bend, Ind.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Steptoe Co., John, Cincinnati.
Wickes Bros., Saginaw, Mich.
Willard Mch. Tool Co., Cincinnati.

LATHES, EXTENSION BED AND GAP

Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
South Bend Lathe Works, Inc., South Bend, Ind

LATHES, FOOT POWER

Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.

LATHES, GUN BORING

Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
LeBlond Machine Tool Co., R. K., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.

LATHES, PATTERNMAKERS'

Blount Co., J. G., Everett, Mass.

LATHES, PULLEY

Avey Drilling Mch. Co., Cincinnati.

LATHES, SHAFT

Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, 17 E 42nd St., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc, Wm., Philadelphia.

LATHES, SPEED

Blount Co., J. G., Everett, Mass.
Diamond Machine Co., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.

LATHES, SPINNING

Bliss Co., E. W., Brooklyn, N. Y.
Stoll Co., Inc., D. H., Buffalo, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
See also Chucking Machines.

LATHES, TURRET

Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Cleveland.
Betts Machine Co., Rochester, N. Y.
Consolidated Machine Tool Corp. of America, 17 E. 42nd St., New York.
Dreses Machine Tool Co., Cincinnati.
Foster Machine Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.
Greaves-Kinsman Tool Co., Cincinnati.
International Mch. Tool Co., Indianapolis, Ind.
Jones & Lamson Machine Co., Springfield, Vt.
Lodge & Shipley Machine Tool Co., Cincinnati.
Millholland Mch. Co., Indianapolis, Ind.
Morris Mch. Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Stark Tool Co., Waltham, Mass.
Steinle Turrett Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland.

LATHES, WOODWORKERS'

Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.

LEAD VARIATORS, THREAD

Precision & Thread Grinder Mfg. Co., Philadelphia.

LEATHER BELTING, ROUND

See Belting Round Leather.

LEVELS

Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J
Starrett Co., L. S., Athol, Mass.

LOCKS, FOR INDUSTRIAL PURPOSES

Yale & Towne Mfg. Co., Stamford, Conn.

LUBRICANTS

Bassick Mfg. Co., 2644 N. Crawford Ave., Chicago.
Dixon Crucible Co., Jos., Jersey City, N. J.
International Chemical Co., Philadelphia.
Oakley Chemical Co., 26 Thames St., New York.
Royersford Foundry & Mch. Co., 54 North 5th St., Philadelphia.
Sun Oil Company, Philadelphia.
Texas Co., 17 Barclay Pl., New York.

LUBRICATORS

Bassick Mfg. Co., 2644 N Crawford Ave., Chicago.
Besly & Co., Chas. H., 120-B North Clinton St., Chicago.
Bowen Products Corp., Auburn, N. Y.
Greene, Tweed & Co., 109 Duane St., New York.

MACHINISTS' SMALL TOOLS

See Calipers, Hammers, Wrenches, Drills, Taps, etc.

MALLETS, RAWHIDE

Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.

MANDRELS, EXPANDING AND SOLID

See Arbors and Mandrels, Expanding and Solid.

MARKING MACHINES

Grant Mfg. & Mch. Co., N. W., Station, Bridgeport, Conn.
Matthews & Co., J. H., Pittsburgh.
Noble & Westbrook Mfg. Co., Hartford Conn.
V & O Press Co., Hudson, N. Y.

MEASURING MACHINES, PRECISION

Ferner Co., Roy Y., Washington, D. C.
Norma Co. of America, Long Island City, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Van Keuren Co., Boston.

METALS, BEARING

Stewart Mfg. Corp., 4503 Fullerton Ave., Chicago.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
See also Bearings, Bronze, Babbitt, etc. and Bushings, Brass, Bronze, etc.

METALS, PERFORATED

Chicago Perforating Co., 2445 West 24th Place, Chicago.

MICROMETERS

Almond Mfg. Co., T. R, Ashburnham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Ferner Co., Roy Y., Washington, D. C.
Goodell-Pratt Co., Greenfield, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

MILLING AND DRILLING MACHINES, UPRIGHT

See Drilling and Milling Machines, Vertical.

MILLING ATTACHMENTS

Adams Co., Dubuque, Iowa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Elgin Tool Works, Inc., Elgin, Ill.
Garvin Machine Co., Spring and Varick Sts., New York.
Hendey Mch. Co., Torrington, Conn
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K, Cincinnati.
Oesterlein Mch. Co., Cincinnati.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Rockford Milling Machine Co., Rockford, Ill.
Standard Engineering Works, Pawtucket, R. I.
Taylor & Fenn Co., Hartford, Conn.
Van Norman Mch. Tool Co., Springfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

MILLING MACHINES, AUTOMATIC

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Ingersoll Milling Machine Co., Rockford, Ill.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.
Weed Engineering Works, Inc., Bridgeport, Conn.

MILLING MACHINES, BENCH

Ames Co., B. C., Waltham, Mass.
Burke Mch. Tool Co., 516 Sandusky St., Conneaut, O.
Carter & Hakes Co., Sterling Place, Winsted, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Rockford Milling Machine Co., Rockford, Ill.
Stark Tool Co., Waltham, Mass.
Van Norman Mch. Tool Co., Springfield, Mass.
Weed Engineering Works, Inc., Bridgeport, Conn.

MILLING MACHINES, CIRCULAR CONTINUOUS

Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York
Gould & Eberhardt, Newark, N. J.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis
Newton Machine Tool Works, Inc., Philadelphia.

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MILLING MACHINES, HAND
Brown & Sharpe Mfg. Co., Providence, R. I.
Burke Mch. Tool Co., 516 Sandusky St., Conneaut, O.
Carter & Hakes Co., Sterling Place, Winstead, Conn.
Garvin Machine Co., Spring and Varick Sts., New York.
Kent-Owens Mch. Co., Toledo, O.
Pratt & Whitney Co., Hartford, Conn.
Rockford Milling Machine Co., Rockford, Ill.
Standard Engineering Works, Pawtucket, R. I.
Steptoe Co., John, Cincinnati.
Van Norman Mch. Tool Co., Springfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

MILLING MACHINES, HORIZONTAL, PLAIN
Beaman & Smith Co., Providence, R. I.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Garvin Machine Co., Spring and Varick Sts., New York.
Gooley & Edlund, Inc., Cortland, N. Y.
Hendey Mch. Co., Torrington, Conn.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati.
McCrosky Tool Corp., Meadville, Pa.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Machine Co., Cincinnati.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Rockford Milling Machine Co., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Standard Engineering Works, Pawtucket, R. I.
Steptoe Co., John, Cincinnati.

MILLING MACHINES, HORIZONTAL, UNIVERSAL
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Hendey Mch. Co., Torrington, Conn.
Kearney & Trecker Corp., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati.
McCrosky Tool Corp., Meadville, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Machine Co., Cincinnati.
Rockford Milling Machine Co., Rockford, Ill.
Rowbottom Mch. Co., Waterbury, Ct.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING MACHINES, LINCOLN TYPE
Beaman & Smith Co., Providence, R. I.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Machine Co., Spring and Varick Sts., New York.
Hendey Mch. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Pratt & Whitney Co., Hartford, Conn.
Reynolds Mch. Co., Massillon, O.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING MACHINES, MULTIPLE SPINDLE
Automatic Mch. Co., Bridgeport, Ct.
Beaman & Smith Co., Providence, R. I.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York
Ingersoll Milling Machine Co., Rockford, Ill.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.

MILLING MACHINES, PORTABLE
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Newton Machine Tool Works, Inc., Philadelphia.
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

MILLING MACHINES, SPLINE
Pratt & Whitney Co., Hartford, Conn.
Standard Engineering Works, Pawtucket, R. I.

MILLING MACHINES, VERTICAL
Beaman & Smith Co., Providence, R. I.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Garvin Machine Co., Spring and Varick St., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Knight Mchy. Co., W. B., St. Louis.
LeBlond Mch. Tool Co., R. K., Cincinnati.
Newton Machine Tool Works, Inc., Philadelphia
Niles-Bement Pond Co., 111 Broadway, New York.
Reed-Prentice Co., Worcester, Mass.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Taylor & Fenn Co., Hartford, Conn.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING TOOLS, HOLLOW ADJUSTABLE
Geometric Tool Co., New Haven, Ct.

MODEL AND EXPERIMENTAL WORK
See Special Machinery and Tools.

MOLDING MACHINES
Adams Co., Dubuque, Iowa
Hanna Engineering Works, 1763 Elston Ave., Chicago.

MOTORS, ELECTRIC
Cleveland Armature Works, Cleveland.
Dillon Electric Co., Canton, O.
General Electric Co., Schenectady, N. Y.
Marathon Electric Mfg. Co., Wassau, Wis.
Master Electric Co., Dayton, O.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

NAME PLATES, CAST BRONZE
Matthews & Co., Jas. H., Pittsburgh.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Pittsburgh.
Schwerdtle Stamp Co., Bridgeport, Conn.

NAME PLATES, ETCHED
Matthews & Co., Jas. H., Pittsburgh.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Pittsburgh, Pa.
Schwerdtle Stamp Co., Bridgeport, Conn.

NAME PLATES, STAMPED
Matthews & Co., Jas. H., Pittsburgh.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Pittsburgh
Schwerdtle Stamp Co., Bridgeport, Conn.

NIPPLE THREADING MACHINERY
Bethlehem Steel Co., Bethlehem, Pa.
Bignall & Keeler Machine Works, Edwardsville, Ill.
Landis Machine Co., Inc., Waynesboro, Pa.
Merrell Mfg. Co., 15 Curtis St., Toledo, O.
Murchey Mch. & Tool Co., 34 Porter St., Detroit.
Saunders' Sons, Inc., D., Yonkers, N. Y.

NUTS, CASTELLATED
National Acme Co., Cleveland

NUT TAPPERS
See Bolt and Nut Machinery.

ODOMETERS
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

OIL CUPS
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Bowen Products Corp., Auburn, N. Y.
Gits Bros. Mfg. Co., 1901 South Kilbourne Ave., Chicago.
Tucker, W. M. & C. F., Hartford, Conn.

OILERS
Gem Mfg. Co., Pittsburgh, Pa.
Hanna Engineering Works, 1763 Elston Ave., Chicago.

OILERS, LOOSE PULLEY
Brown Engineering Co., 133 No. 3rd St., Reading, Pa.

OIL EXTRACTORS
Tolhurst Mch. Works, Troy, N. Y.

OIL GROOVING TOOLS
Hanson-Whitney Machine Co., Hartford, Conn.

OIL HOLE COVERS
Bowen Products Corp., Auburn, N. Y.
Gits Bros. Mfg. Co., 1901 South Kilbourne Ave., Chicago.
Tucker, W. M. & C. F., Hartford, Conn.

OILS, LUBRICATING
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Sun Oil Company, Philadelphia.
Texas Co., 17 Battery Pl., New York.

OILS, QUENCHING AND TEMPERING
Sun Oil Company, Philadelphia
Texas Co., 17 Battery Pl., New York.

OILS, SOLUBLE
See Compound, Cutting, Grinding, etc.

OVENS, BAKING
American Gas Furnace Co., Elizabeth, N. J.
General Electric Co., Schenectady, N. Y.

OVENS, TEMPERING
General Electric Co., Schenectady, N. Y.

OXY-ACETYLENE APPARATUS
See Welding and Cutting Oxy-Acetylene Equipment.

OXYGEN
Air Reduction Sales Co., 342 Madison Ave., New York.
Linde Air Products Co., 30 E. 42nd St., New York.

PACKING, LEATHER
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.

PARALLELS
Walker Co., Inc., O. S., Worcester, Mass.

PATENTS
O'Brien, Clarence A., 1033 Southern Bldg., Washington, D. C.
Parker, C. L., Washington, D. C.

PATTERN SHOP MACHINERY
Crescent Machine Co., 56 Main St., Leetonia, O.

PATTERNS, METAL
Grant Mfg. & Machine Co., N. W., Station, Bridgeport, Conn.
Mummert-Dixon Co., Hanover, Pa.

PATTERNS, WOOD
Y & O Press Co., Hudson, N. Y.

PENCILS, DRAWING
American Lead Pencil Co., 230 Fifth Ave., New York.
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Dixon Crucible Co., Jos., Jersey City, N. J.

PHOSPHOR BRONZE
See Bronze.

PINIONS, FORGED
See Gears, Forged.

PIPE, STEEL
National Tube Co., Pittsburgh.

PIPE BENDING TOOLS
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

PIPE CUTTING AND THREADING MACHINES
Armstrong Mfg. Co., Bridgeport, Conn.
Bignall & Keeler Machine Works, Edwardsville, Ill.
Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Foote-Burt Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Harrington Son & Co., Inc., Edwin, Philadelphia.
Hart Mfg. Co., East 20th and Marion Ave., Philadelphia.
Landis Machine Co., Inc., Waynesboro, Pa.
Merrell Mfg. Co., 15 Curtis St., Toledo, O.
Murchey Mch. & Tool Co., 34 Porter St., Detroit.
Saunders' Sons, Inc., D., Yonkers, N. Y.
Williams Tool Corp., Erie, Pa.

PLANER ATTACHMENTS
Cincinnati Planer Co., Cincinnati.
Gray Co., G. A., Cincinnati.
Hanson-Whitney Machine Co., Hartford, Conn.

PLANERS
American Tool Works Co., Cincinnati.
Bethlehem Steel Co., Bethlehem, Pa.
Betts Machine Co., Rochester, N. Y.
Cincinnati Planer Co., Cincinnati.
Consolidated Machine Tool Corp. of America, 17 E. 42d St., New York.
Gorton Mch. Co., Geo., 1107 13th St., Racine, Wis.
Gray Co., G. A., Cincinnati.
Hamilton Mch. Tool Co., Hamilton, O.
Liberty Mch. Tool Co., Hamilton, O.
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed-Prentice Co., Worcester, Mass.
Rockford Mch. Tool Co., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Sellers & Co., Inc., Wm., Philadelphia.
Woodward & Powell Planer Co., Worcester, Mass.

PLANERS, CRANK
Consolidated Machine Tool Corp. of America, 17 E. 42nd St., New York
Newton Machine Tool Works, Inc., Philadelphia.

PLANERS, OPEN-SIDE
Automatic Mch. Co., Bridgeport, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Liberty Mch. Tool Co., Hamilton, O.

PLANERS, PORTABLE
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood Corp., H. B., Philadelphia.

PLANERS, ROTARY
Consolidated Machine Tool Corp. of America, 17 E. 42d St., New York.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Machine Co., 3639 North Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

PLATE ROLLS
Bethlehem Steel Co., Bethlehem, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
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Wicks Bros., Saginaw, Mich.

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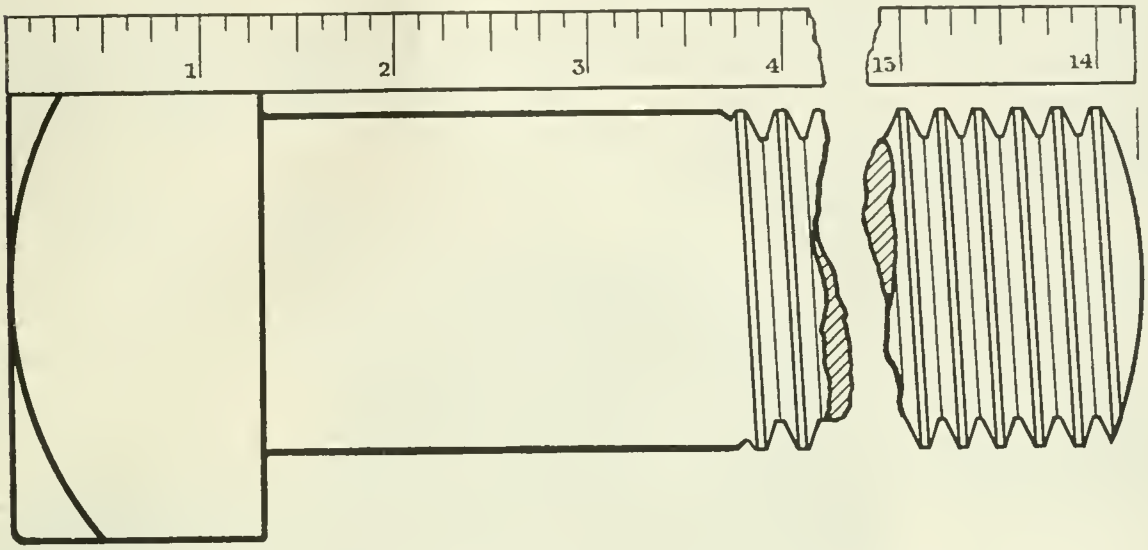

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Diamond Saw & Stamping Works, Buffalo, N. Y.
Edlund Mchy. Co., Inc., Cortland, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Napier Saw Works, Inc., Middletown, N. Y.
Peerless Mch. Co., Racine, Wis.
Racine Tool & Machine Co., 250 15th St., Racine, Wis.
Victor Saw Works, Middletown, N. Y.
Western Tool & Mfg. Co., Springfield, Ohio.

SAWING MACHINES, WOOD

Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Crescent Machine Co., 56 Main St., Leetonia, O.
Woods Engineering Co., Alliance, O.

SAWS, METAL CUTTING HAND

Atkins & Co., Inc., E. C., Indianapolis, Ind.

SAWS, SCREW SLOTTING

Atkins & Co., Inc., E. C., Indianapolis, Ind.
Barber-Colman Co., Rockford, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.

SCALES, COUNTING AND TESTING

Toledo Scale Co., Toledo, O.

SCALES, WEIGHING

Toledo Scale Co., Toledo, O.

SCRAPING TOOLS, BEARING

Goodell-Pratt Co., Greenfield, Mass.

SCRAPING TOOLS, METAL POWER DRIVEN

Anderson Bros. Mfg. Co., Rockford, Ill.

SCREENS, PERFORATED

Chicago Perforating Co., 2445 West 24th Place, Chicago.

SCREW CUTTING TOOLS

See Taps and Dies.

SCREW DRIVING MACHINES

Errington Mechanical Laboratory, Broadway and John St., New York.
Reynolds Machine Co., Massillon, O.

SCREW MACHINES, AUTOMATIC

Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland.
Cone Automatic Mch. Co., Inc., Windsor, Vt.
National Acme Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.

SCREW MACHINES, HAND

See also Lathes, Turret.
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Cleveland.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dreses Machine Tool Co., Cincinnati.
Foster Machine Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Machine Co., Springfield, Vt.
Kent-Owens Mch. Co., Toledo, O.
Millholland Machine Co., Indianapolis, Ind.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Stark Tool Co., Waltham, Mass.
Warner & Swasey Co., Cleveland.

SCREW MACHINES, MULTIPLE SPINDLE

Cleveland Automatic Machine Co., Cleveland.
Cone Automatic Machine Co., Inc., Windsor, Vt.
National Acme Co., Cleveland.

SCREW MACHINE TOOLS AND EQUIPMENT

Bardons & Oliver, Cleveland.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland.
Foster Machine Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Jones & Lamson Machine Co., Springfield, Vt.
National Acme Co., Cleveland.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Steinle Turret Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland.

SCREW MACHINE WORK

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago.
Bridgeport Brass Co., Bridgeport, Ct.
Eastern Machine Screw Corp., New Haven, Conn.
H. & G. Works, Eastern Mch Screw Corp., New Haven, Conn.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
National Acme Co., Cleveland.
Reliance Die & Stamping Co., 515 No. LaSalle St., Chicago.
Wicaco Screw & Mch. Wks., Inc., Philadelphia

SCREW PLATES

American Tap & Die Co., Greenfield, Mass.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Brubaker & Bros., Co., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W. Div. of Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland.
Hjorth Lathe & Tool Co., Boston.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Wells Corporation, Greenfield, Mass.

SCREWS, CAP AND SET

Allen Mfg. Co., Hartford, Conn.
National Acme Co., Cleveland.

SCREWS, MACHINE

Allen Mfg. Co., Hartford, Conn.
National Acme Co., Cleveland.

SCREWS, SPECIAL LEAD, FEED, ETC.

Alling-Lander Co., Inc., Sodus, N. Y.
Automatic Mch. Co., Bridgeport, Conn.
Ferner Co., Roy Y., Washington, D. C.
Hindley Gear Co., Philadelphia.

SEAMLESS STEEL TUBING

See Tubing, Seamless Steel.

SECOND-HAND MACHINERY, ETC.

Allen, H. F., 30 Church St., New York.
Cincinnati Planer Co., Cincinnati.
Essley Mchy. Co., E. L., 555 Washington Blvd., Chicago.
Fuerst-Friedman Co., Cleveland.
Hill, Clarke & Co., Inc., Boston.
Hill, Clarke & Co. of Chicago, 649 Washington Blvd., Chicago.
Jones Mch. Tool Co., Cincinnati.
Kinsey Co., E. A., Cincinnati.
Lucas & Son, Inc., J. L., Bridgeport, Conn.
Miles Mchy. Co., Saginaw, Mich.
New Britain Mch. Co., New Britain, Conn.
Niles-Bement-Pond Co., 111 Broadway, New York.
Osborne & Sexton Mchy. Co., Columbus, O.
Oviatt & Co., D. C., Cleveland.
Prentiss & Co., Inc., Henry, 149 Broadway, New York.
Reliance Machinery Sales Co., Pittsburgh, Pa.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Southwark Foundry & Machine Co., Philadelphia.
Timken Roller Bearing Co., Canton, O.
Vandyck Churchill Co., 149 Broadway, New York.
Vonnegut Mchy Co., Indianapolis, Ind.
Walcott Lathe Co., Jackson, Mich.
Wayne Mchy. Co., Fort Wayne, Ind.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

SEPARATORS, CENTRIFUGAL

Oil & Waste Saving Mch. Co., Philadelphia, Pa.
Tolhurst Mch. Works, Troy, N. Y.

SET SCREWS, SAFETY

Allen Mfg. Co., Hartford, Conn.
Bristol Co., Waterbury, Conn.

SHAFTING, STEEL

Adamson Mch. Co., Akron, O.
Brown Co., A. & F., 79 Barclay St., New York.
Moltrup Steel Products Co., Beaver Falls, Pa.
Royersford Foundry & Mch. Co., 54 North 5th St., Philadelphia.
Union Drawn Steel Co., Beaver Falls, Pa.
United Alloy Steel Corp., Canton, O.

SHAFTING, STEEL TUBING FOR

National Tube Co., Pittsburgh.

SHAFTS, FLEXIBLE

Errington Mechanical Laboratory, Broadway and John St., New York.
Gem Mfg. Co., Pittsburgh, Pa.
Haskins Co., R. G., 516 W. Monroe St., Chicago.
Oliver Instrument Co., Adrian, Mich.
Stow Mfg. Co., Binghamton, N. Y.
Strand & Co., N. A., 5001 N. Lincoln St., Chicago.

SHAFTS, HOLLOW BORED

American Hollow Boring Co., Erie, Pa.

SHAPERS

American Tool Works Co., Cincinnati.
Columbia Machine Tool Co., Hamilton, Ohio.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Conn.
Kelly Co., R. A., Xenia, O.
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., 111 Broadway, New York.
Osborne & Sexton Mchy. Co., Columbus, O.
Potter & Johnston Machine Co., Pawtucket, R. I.
Rhodes Mfg. Co., Hartford, Conn.
Rockford Machine Tool Co., Rockford, Ill.
Smith & Mills Co., Cincinnati.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Steel Products Engineering Co., Springfield, O.
Steptoe Co., John, Cincinnati.

SHAPERS, PORTABLE

Reed-Prentice Co., Worcester, Mass.

SHAPERS, VERTICAL

Hanson-Whitney Machine Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rhodes Mfg. Co., Hartford, Conn.

SHAPER SLOTTING ATTACHMENT

Moore Co., H. A., Rochester, N. Y.

SHEARING MACHINERY

Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., Buffalo, N. Y.
Canton Foundry & Machine Co., Canton, O.
Chambersburg Engineering Co., Chambersburg, Pa
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Ferracute Mch. Co., Bridgeton, N. J.
Hilles & Jones Works, Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Loy & Nawrath, Div. Birmingham Iron Foundry, Derby, Conn.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Royersford Foundry & Machine Co., 54 No. 5th St., Philadelphia.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Southwark Foundry & Machine Co., Philadelphia.
Stoll Co., Inc., D. H., Buffalo, N. Y.
Union Mfg. Co., New Britain, Conn.
Watson-Stillman Co., 192 Fulton St., New York.
Wickes Bros., Saginaw, Mich.
Williams, White & Co., Moline, Ill.

SHEARING MACHINERY, HAND POWER

Machinery Co. of America, Big Rapids, Mich.
Niagara Machine & Tool Works, Buffalo, N. Y.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Tucker, W. M. & C. F., Hartford, Conn.

SHEARS, ROTARY

Bliss Co., E. W., Brooklyn, N. Y.
Niagara Machine & Tool Works, Buffalo, N. Y.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Southwark Foundry & Machine Co., Philadelphia.
Stoll Co., Inc., D. H., Buffalo, N. Y.
Toledo Mch. & Tool Co., Toledo, O.

SHEARS, SQUARING

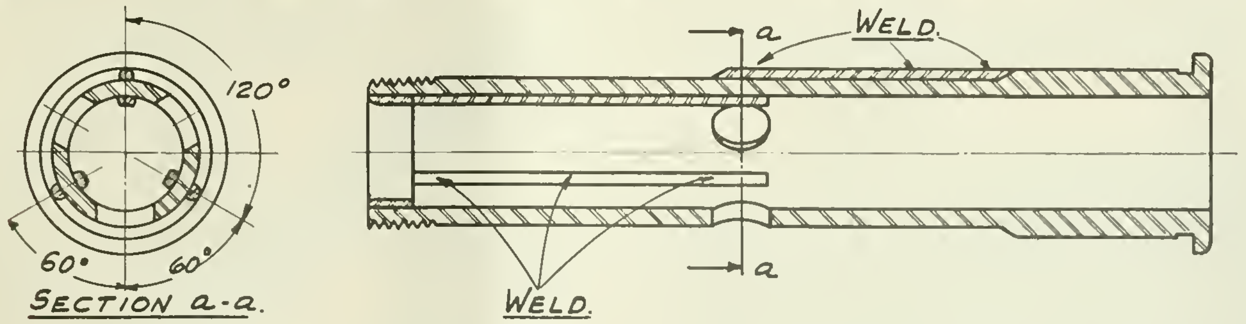
Loy & Nawrath, Div. Birmingham Iron Foundry, Derby, Conn.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Stoll Co., Inc., D. H., Buffalo, N. Y.
Toledo Mch. & Tool Co., Toledo, O.

SHEAVE WHEELS

Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Wood's Sons Co., T. B., Chambersburg, Pa.

SHEET METAL WORK

Dickgiesser & Co., Chas. J., Derby, Conn.
King, R. D., 1620 Monadnock Block, Chicago.
Reliance Die & Stamping Co., 515 N. La Salle St., Chicago.



A Welding Problem—

Solved by the U. S. Welder

This particular part is a feed tube for a cream separator. It is made of machine steel, finished all over. Ribs, which are clearly indicated on the drawing, are made of stainless steel about 3/64" x 1/16". These ribs are welded on as indicated and must be accurately spaced. The ribs cannot by any means change. They must be welded on without any flash or deformation of any kind. It is a rather large order, but it is being done on a U. S. Welder very satisfactorily.

Have you a welding problem similar to this? Or quite different? If it is a problem we'd like to know about it. If it is a problem you'll want to know what we've got to say about it.

The U. S. Electric Welder Company

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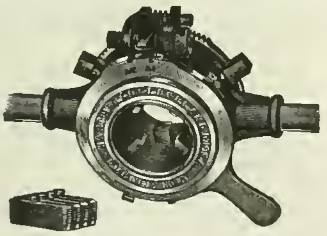

Quick Adjustability In Dies

With Positive Control

That is what is found in the "DUPLEX" Die Stock for threading pipe. It has a positive lock for the dies; means for wide and accurate adjustment; self-locking, entering jaws; a construction easily understood.

Further information gladly supplied.

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E. 20th St. & Marion Ave., CLEVELAND, OHIO, U. S. A.

Style G

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Is Your Conscience Clear?

You won't need to worry about the bearings on your mechanism when your product is equipped with

Tucker Oil Hole Covers

Catalogue No. 6 for your literature

Style A has Rotary Sleeve
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Style D

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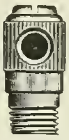
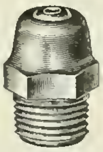
Style A



Style B

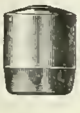
Style C



Style D

Style E

Style F

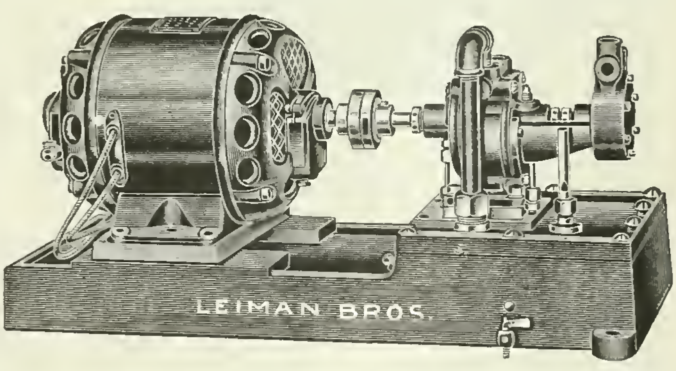


Style G

W. M. & C. F. TUCKER, Hartford, Conn.

FOREIGN AGENTS: Fenwick Freres & Co., Paris, France.
Alfred Herbert, Ltd., Yokohama, Japan.

Air Pumps for Oil Burners



Complete motor driven units including our highly efficient air pumps, our latest improved oil pump (not a gear pump) with our automatic force feed air pump lubricator with low oil level alarm. Just the thing for domestic as well as commercial oil burner heating plants. Made to suit any make of burner and any system of oil supply.

Leiman Bros. Patented ROTARY AIR PUMPS OIL PUMPS

used for soldering, annealing, hardening, tempering. Also used for a great many other purposes in every industrial plant.

- SAND BLASTING
- BOTTLE FILLING
- PAPER FEEDING
- LABELING
- FOLDING PAPER
- AGITATING SOLUTIONS
- BANDING CIGARS
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A NOISELESS, POWERFUL AIR PUMP for blowing or vacuum—for either Gas or Air. NOT THE KIND OF AN AIR PUMP THAT ANNOYS YOU—IT SATISFIES YOU. Tell us how you want to use air.

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Makers of good machinery for 35 years.

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Loy & Nawrath, Div. Birmingham Iron Foundry, Derby, Conn.
Niagara Machine & Tool Works, Buffalo, N. Y.
Toledo Mch. & Tool Co., Toledo, O.

SHERARDIZING, ELECTRIC

General Electric Co., Schenectady, N. Y.

SLEEVES

Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

SLIDE RESTS

Blount Co., J. G., Everett, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.

SLIDE RULES

Gilson Slide Rule Co., Niles, Mich.
Keuffel & Esser Co., Hoboken, N. J.

SLOTTERS, MACHINE

Baker Bros., Toledo, O.
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Co. of America, 17 E. 42nd St., New York.
Dill Mch. Co., T. C., Philadelphia.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Rhodes Mfg. Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia.
Steptoe Co., John, Cincinnati.

SLOTTERS, PORTABLE

Consolidated Mch. Tool Co. of America, 17 E. 42nd St., New York.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.

SOCKETS

Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

SOLDER

Hoyt Metal Co., St. Louis, Mo.

SPECIAL MACHINERY AND TOOLS

Adamson Mch. Co., Akron, O.
Air Reduction Sales Co., 342 Madison Ave., New York.
Automatic Machine Co., Bridgeport, Conn.
Baird Machine Co., Bridgeport, Conn.
Banner Die, Tool & Stamping Co., Columbus, O.
Beaman & Smith Co., Providence, R. I.
Bethlehem Steel Co., Bethlehem, Pa.
Betta Machine Co., Rochester, N. Y.
Bilgram Machine Works, 1231 Spring Garden St., Philadelphia.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Brock Tool & Mfg. Works, Arthur, Jr., Philadelphia.
Brown Co., A. & F., 79 Barclay St., New York.
Bucher-Smith Co., East Liverpool, O.
Budd-Ranney Engineering Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Columbus Die, Tool & Mch. Co., Columbus, O.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Davenport Mfg. Co., Meadville, Pa.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.
Earle Gear & Machine Co., 4767 Stenton Ave., Philadelphia.
Fawcus Machine Co., Pittsburgh.
Ferner Co., Roy Y., Washington, D. C.
Garvin Machine Co., Spring and Varick Sts., New York.
Gisholt Mch. Co., 9 South Baldwin St., Madison, Wis.
Grant Mfg. & Mch. Co., N. W., Station, Bridgeport, Conn.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kent-Owens Machine Co., Toledo, O.
King, R. D., 1620 Monadnock Block, Chicago.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Littell Machine Co., F. J., 4125 Ravenswood Ave., Chicago.
Lucas Machine Tool Co., Cleveland.
Manufacturers' Consulting Engineers, Syracuse, N. Y.
Mehl Mch. Tool & Die Co., Rosella, N. J.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Meisel Press Mfg. Co., 948 Dorchester, Ave., Boston 25, Mass.
Millholland Machine Co., Indianapolis, Ind.
Modern Tool Co., Erie, Pa.
Mueller Mch. Tool Co., Cincinnati.
National Acme Co., Cleveland.
National Automatic Tool Co., Richmond, Ind.
National Machinery Co., Tiffin, O.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Newton Machine Tool Works, Inc., Philadelphia.
Niagara Machine & Tool Works, Buffalo, N. Y.
Niles-Bement-Pond Co., 111 Broadway, N. Y.
Paxson Co., J. W., Philadelphia.
Pratt & Whitney Co., Hartford, Conn.
Precision Engineering Co., Jamestown, N. Y.
Production Engineering Corp., Canastota, N. Y.
Reed-Prentice Co., Worcester, Mass.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Rockford Machine Tool Co., Rockford, Ill.
S & S Machine Works, 4522 West Lexington St., Chicago.
Shuster Co., F. B., New Haven, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Southwark Foundry & Machine Co., Philadelphia.
Steel Products Engineering Co., Springfield, O.
Taylor-Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.
Wade-American Tool Co., Waltham, Mass.
Waltham Machine Works, Waltham, Mass.
Weed Engineering Works, Inc., Bridgeport, Conn.
Wiggins Machine & Mfg. Co., Inc., Burke, Vt.
Woods Engineering Co., Alliance, O.

SPEED REDUCERS

Adamson Mch. Co., Akron, Ohio.
Cleveland Worm & Gear Co., Cleveland.
Foote Bros. Gear & Mch. Co., 232 North Curtis St., Chicago.
James Mfg. Co., D. O., 1120 West Monroe St., Chicago.
Jones Foundry & Machine Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Moore & White Co., 2707-2737 No 15th St., Philadelphia.

SPINDLES, HOLLOW BORED

American Hollow Boring Co., Erie, Pa.

SPINNING LATHES

See Lathes, Spinning.

SPRING COILING AND FORMING MACHINERY

Baird Machine Co., Bridgeport, Conn.
Hjorth Lathe & Tool Co., Boston.

SPRINGS

Chatillon & Sons, John, 85 Cliff St., New York.

SPROCKET CHAINS

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Duckworth Chain & Mfg. Co., Springfield, Mass.
Link-Belt Company, Chicago.
Morse Chain Co., Ithaca, N. Y.
Morton, Thomas, 245 Centre St., New York.
Philadelphia Gear Works, Philadelphia
Whitney Mfg Co., Hartford, Conn.

SPROCKETS

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Duckworth Chain & Mfg. Co., Springfield, Mass.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Link-Belt Company, Chicago.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.
Whitney Mfg. Co., Hartford, Conn.

SPRUE CUTTERS

Hanna Engineering Works, 1763 Elston Ave., Chicago.

STAMPINGS, SHEET METAL

American Tool & Mfg. Co., Urbana, Ohio.
Banner Die, Tool & Stamping Co., Columbus, O.
Bridgeport Brass Co., Bridgeport, Ct.
Chase Metal Works, Waterbury, Conn.
Eastern Tool & Mfg. Co., 135 Bloomfield Ave., Bloomfield, N. J.
Globe Mch. & Stamping Co., Cleveland, O.
King, R. D., 1620 Monadnock Block, Chicago.
Safety Wire Gas Globe Co., Columbus, Ohio.

STAMPS, LETTERS AND FIGURES, STEEL

Goodell-Pratt Co., Greenfield, Mass.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Matthews & Co., Jas. H., Pittsburgh.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Pittsburgh.
Schoder & Lombard Stamp Co., 202 Centre St., New York.
Schwerdtle Stamp Co., Bridgeport, Conn.

STEEL

Colonial Steel Co., Pittsburgh.
Firth-Sterling Steel Co., McKeesport, Pa.
Hawkridge Bros. Co., Boston, Mass.
Ludlum Steel Co., Watervliet, N. Y.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Simonds Saw & Steel Co., Fitchburg, Mass.
Vanadium Alloys Steel Co., Latrobe, Pa
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL, COLD DRAWN

Moltrup Steel Products Co., Beaver Falls, Pa.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Standard Gauge Steel Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
United Alloy Steel Corp., Canton, O.

STEEL, COLD ROLLED STRIP AND SHEET

Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.

STEEL, HIGH SPEED TOOL

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Chesterfield Metal Co., Detroit, Mich.
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Hawkridge Bros. Co., Boston, Mass.
Haynes Stellite Co., 30 E. 42nd St., New York.
Ludlum Steel Co., Watervliet, N. Y.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Simonds Saw & Steel Co., Fitchburgh, Mass.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL, MACHINE

Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Hawkridge Bros. Co., Boston, Mass.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Standard Gauge Steel Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL SHELVING, RACKS, BARRELS, TABLES, ETC.

Lupton's Sons Co., David, Philadelphia, Pa.

STELLITE

Haynes Stellite Co., 30 E. 42nd St., New York.

STENCILS, STEEL

Matthews & Co., J. H., Pittsburgh.
Schoder & Lombard Stamp Co., 202 Centre St., New York.

STOCKS, DIE

Armstrong Mfg. Co., Bridgeport, Conn.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W. Div. Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, Inc., D., Yonkers, N. Y.

STONES, OIL

Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

STOOLS, STEEL

See Furniture, Shop and Drafting room.

STRAIGHTENING MACHINERY

Morse Twist Drill & Mch. Co., New Bedford, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.
Shuster Co., F. B., New Haven, Conn.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Standard Engineering Works, Pawtucket, R. I.

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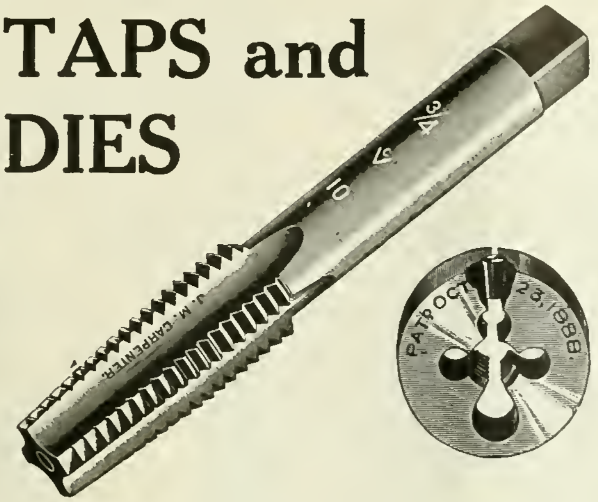

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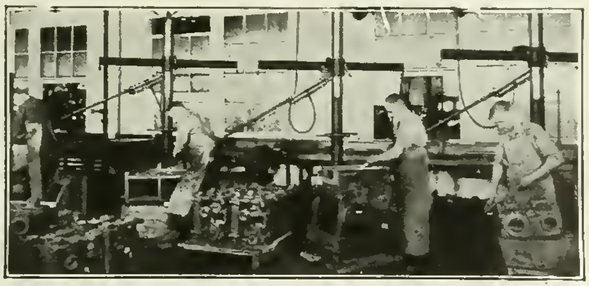

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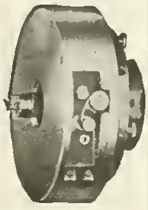

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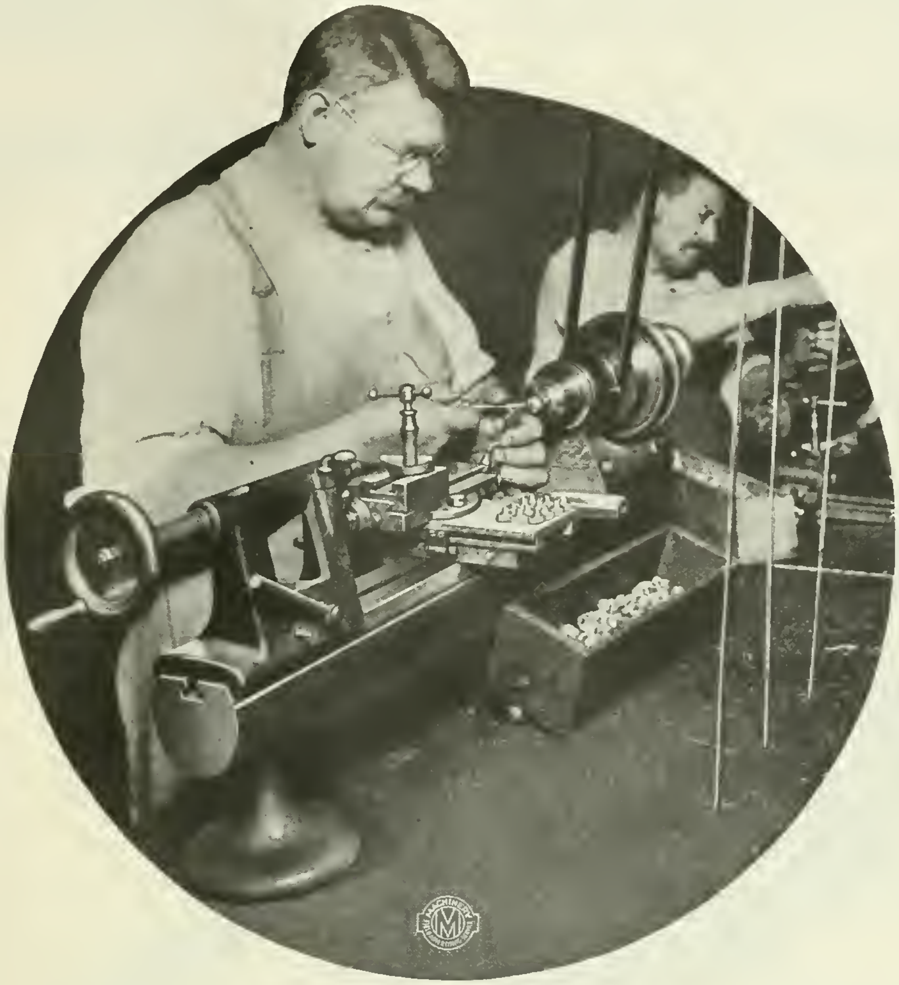

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